OKLAHOMA AGRICULTURAL EXPERIMENT STATION

BULLETIN NO. 59.

SEPTEMBER, 1903.

REPRINTS

FROM

BULLETINS NO. 47, 50, AND 52, AND ANNUAL REPORTS, 8 TO 11.

BULLETINS OF THIS STATION ARE SENT FREE TO RESIDENTS OF THE TERRITORY ON REQUEST.

STILLWATER, OKLAHOMA.

Oklahoma Agricultural Experiment Station.

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Oklahoma Agricultural and Mechanical College

AGRICULTURAL EXPERIMENT STATION.

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The publications of the Station are sent free to residents of the Territory on request. All communications should be addressed, not to individuals or departments, but to the

EXPERIMENT STATION, Stillwater, Oklahoma.

Reprints from Bulletins and Reports.

INTRODUCTION.

The many thousands of new settlers in western and southwestern Oklahoma naturally look to the Experiment Station for information which will be of service to them in developing farms in a climate with which they are unacquainted. Many of the publications of the Station were designed to answer questions which new settlers ask, but the demand for bulletins and reports has been such that but few are left. An effort was made to secure a small appropriation from the legislature for the purpose of reprinting the reports for which the demand was greatest but it failed of success.

The need has been such however, that a partial reprint is absolutely essential and this is presented in the following pages. This bulletin contains nothing which, in some form or other, has not been sent to all of the addresses on the mailing list, and it will be sent only in response to a direct request or in reply to inquiries which are answered by articles in it.

Those who receive this bulletin and other publications of the Station are urged to preserve them for future reference and to advise the Station of change of address or failure to receive bulletins as issued.

JOHN FIELDS.
Director.

Reprints From Bulletins.

REPORTS OF WHEAT RAISERS.*

Through the kindness of the millers of the territory the Station secured the names of several successful wheat growers in each county who have furnished a statement of the methods which they follow on a large scale and the results which they have secured.

The reports cover a wide range of soil and climatic conditions and their uniformity is but another proof that good methods of farming will bring success in every part of Oklahoma. The chief points of uniformity of practice are:

1. Plow early and deep and work the soil well before seeding.

2. Complete the seeding before October 15.

3. Hard wheats as a rule are preferred in the western counties and on the uplands. Soft wheats are grown in the eastern counties.

4. Rotation is generally preferred to continuous culture of wheat and the beneficial effect of manure is mentioned in many cases.

Losses from insect ravages have been slight, but rust has been troublesome, especially on late wheat. The grain louse which attracted attention early in the season is mentioned as probably having caused loss in only one case. Grading up of seed wheat by using the fanning mill is recommended as profitable.

The majority of wheat raisers reporting pasture wheat when the conditions are suitable and find it profitable. Early sown wheat that is growing vigorously is said to be benefitted by proper pasturing and the advantage of the succulent feed during the winter is large.

JOHN FIELDS.

*From Bulletin No. 47, September, 1900.

EXPERIMENTS WITH WHEAT 1900.*

SUMMARY.

I. The wheat season of 1899-1900 was quite a favorable one, and large yields were the rule on well tilled land. A dry fall and rust in the spring were the only drawbacks.

II. Wheat on July plowing yielded 7.84 bushels per acre more than wheat on August plowing; and 16 bushels more than on September plowing.

III. The grain on the early plowing was of a much better quality than on the late.

IV. The plowing and preparing of the early plowed plats was much less expensive than the August or the September plowing.

V. Results of trials at this station in former seasons agree in general with II, III and IV.

VI. July plowing that had been well worked down, retained over twice the amount of moisture that unplowed ground did during a very dry August and September, and twenty-four days of October.

VII. On the July plowing at no time during this drouth, of which there was a period of sixty days in which less than an inch of rain fell, was the moisture content of the soil too low to germinate the seed, nor did the crop suffer.

VIII. Moisture equal to an inch and a half of rain was lost in a few days from unplowed ground in August and September while there was a very small loss from the early plowed ground.

IX. Land, plowed in August, while the ground was hard and dry but worked down at several successive intervals with the aid of light showers, retained more moisture and carried the wheat through a severe drouth much better than the September plowed ground did.

X. Wheat seeded September 15, yielded two bushels more per acre than wheat seeded October 18, and thirteen and one-third bushels more than wheat seeded November 15.

XI. The wheat from the late seeding weighed seven pounds less per bushel than the early or medium seeding.

XII. In six former trials at this station, the November seedings ranged in yields from 1 to 13 bushels per acre; the October seeding, 4 to 30 bushels; the September seeding 15 to 49 bushels per acre.

*From Bulletin No. 47, September, 1900.

XIII. In 1898-'99 wheat on land that received an application of 15 1-2 tons of stable manure per acre yielded six bushels more than double the yield on unmanured land.

XIV. In 1899-'00, wheat on the same manured land that had received an additional 11 tons of stable manure per acre yielded twice as much as the same unmanured land.

XV. The majority of the following varieties have been grown on the station farm for six years and can be recommended:—

SOFT, SMOOTH WHEATS.

Early Red Clawson, Fultz, German Emperor.

SOFT, BEARDED WHEATS.

Fulcaster, Missouri Blue Stem, New Red Wonder.

HARD SMOOTH WHEATS.

Red Russian, Oregon Red.

HARD, BEARDED WHEATS.

Sibley's New Golden, Turkey, Eversaw.

XVI. In 1899-'00, the yield of seventeen varieties averaged forty bushels per acre. Sibley's New Golden gave the largest yield, 44.5 bushels. Big English the smallest, 37.7 bushels per acre.

XVII. In the averages for six years, '93, '96, '97, '98, '99 and 1900 Sibley's New Golden stood first with an average yield of 29.2 bushels, and Big English last with a yield of 26.3 bushels per acre. Several other varieties were only a half bushel below Sibley's New Golden.

F. C. BURTIS.

J. G. KERR.

MANURING THE SOIL.*

SUMMARY.

Without going into detail as to the various considerations that may affect the results of manuring, at the present stage of our agricultural practice, the chief points to be observed in manuring are:

1. To manure the soil. Use all of the manure produced, prevent losses by washing away, quit burning straw, haul manure onto the fields, somewhere, sometime, somehow.

2. Manure the highest and poorest spots, give a good application at one time—from fifteen to twenty two-horse loads—and manure another place next time.

3. Manure with reference to the time of rainfall, to the next crop which is to be grown, and to the other work which must be done. Late fall and winter, when other work is not pressing, is a good time. Light top-dressings may be applied to wheat in the fall.

4. Growing crops for green manuring alone is not the most profitable method. Pasture them and plow under the remainder when about to mature. This applies chiefly to cow-peas. If sorghum is to be plowed under, it should be while the stalks are green and juicy so that they will decay quickly.

INTRODUCTION.

The tendency everywhere in cultivating new soil has been to pay but little or no attention to the conservation and improvement of fertility. It is customary to refer to the fertility of new soils as "limitless unbounded and inexhaustible." Enthusiasts speak of the vast natural fertility of the soils and many who till the soil come to believe what they hear and give no heed to facts and the teachings of experience. This bulletin is issued in the hope that it may call to mind the really great opportunities for soil improvement possessed by Oklahoma farmers, and to partially clear away some of the difficulties that have appeared in the way of the use of farm manures.

SOIL FERTILITY.

By soil fertility is meant, in a general way, its productiveness—its ability to produce a paying crop. Variations in the degree of fertil-

*Bulletin No. 50. April, 1901.

ity produce variations in the crops produced. Soil fertility depends upon three things:

1. The supply of moisture. Soils may be either too wet or too dry to produce a crop. They may be too hard or too loose, too coarse or too fine, and thus unable to retain sufficient moisture for crop production.

2. The mechanical condition. Texture, ease of working, tilth, cold, warm, are general terms referring to mechanical condition. The available supply of moisture is greatly affected by the mechanical condition of the soil.

3. The supply of plant food. By this is meant the chemical elements which are removed from the soil by plants and which must be present in the soil for crops to be grown and matured. Nitrogen, potash and phosphoric acid are the principal substances constituting plant food.

It is not the purpose of this bulletin to argue for the practice of manuring and to present a case in its defense. It is a fact that the aplication of manure to the soil is essential to continued, successful crop production, and those who dispute this fundamental principle as a principle, will find nothing of interest in what follows.

The application of manure, on the other hand, is a matter that should be investigated by every farmer and results that seem peculiar are often produced and are difficult of explanation.

MANURING.

Under this general head are two sub-divisions:

1. The use of manure produced by animals and of refuse material such as straw, corn-stalks and the like.

2. Green manuring, or plowing under of all or part of a crop grown either solely for this purpose or in part for pasture.

The effect of the application of manure of any sort to the soil is to modify the supply of plant food, the mechanical condition, and the capacity for holding moisture. In practically all cases, the supply of plant-food is increased and a larger amount of it is placed at the disposal of succeeding crops. The mechanical condition, and consequently the capacity of the soil for water, is altered. For a time, until the soil settles and rains fill it with moisture after plowing, the effect may be harmful. After this condition is met, the results are usually beneficial.

It is upon this point that the profitable manuring of Oklahoma

soils hinges. The time of application in reference to the periods of ample rain-fall and to cultural methods determines whether or not beneficial results will be secured the first season. And since in farm operations, immediate results largely determine opinions of methods, it is thought by some that manuring is not profitable.

EXPERIENCE OF FARMERS.

Among the questions included in an inquiry concerning the experience of farmers in the raising of wheat was the following: "What has been the result of manuring wheat ground?" To this inquiry 52 out of 118 reported trials with manure, thus implying that the other 66 had not tried it on wheat land. Six of the 52 reported unfavorable results from using manure on wheat.

The following are the condensed statements of those reporting adversely:

"Manured ground grows too much straw; not as good." "Bad results." "I think the land better for wheat without manure while it is new." "Heavy manuring has not proven a success here (Cleveland County) causing too rank straw and, in nearly every instance, late maturing and rust." "Manure on fresh land causes wheat to fall and rust." "It makes too much straw and does not fill."

The following are the condensed statements of those who have good results from using manure on wheat:

"Results better in second year; too much straw the first." "Good results from manure." "Good results from manuring." "Manuring light after wheat is sowed has given best results." "Sometimes it does not do well to manure too heavy." "Light manuring is good, heavy makes the wheat fall." "Heavy manuring makes too much straw." "Have manured some hard spots with good results." "Good results." "Good results." "Will increase yield one-half if proper amount is used." "Have manured a few patches with good results." "Light top-dressing with stable manure increased yield." "It makes a large increase in the crop." "Manured three acres last year and think wheat was two bushels better on it." "Good results; would not manure too heavy." "Manured thin land with fifty per cent increase in yield." "Good results." "Better yield" "Manure is all right if not too heavy." "On hard land it is all right." "Manuring is all right but there is not enough of it done." "Good results." "Tried small area, great success." "Very good results." "Good results." "Good results." "I have only this to say of manure—that it is the best work that I do to my wheat." "Good results." "You can't get too much. Head the wheat high and let all the litter on the ground to turn under." "Good results." "Think manuring of some kind very essential to invigorate the wheat plant." "Fresh stable manure and ashes, either from wood or straw, have paid largely for their application." "Increases the yield one-fourth." "With good results by top-dressing and working in with harrow and disk." "Manuring will increase yield one-fourth." "Top-dressing increased yields one-third, results of plowing under depend on supply of moisture. Manured ground ripens wheat earlier." "Good results." "Where manured, I get one-third more." "It pays to manure." "Paid well." "Good on land manured and plowed early." "Good results." "Farmers will have to manure their land to make wheat profitable." "Fine results." "Use all I can get with gratifying results."

When variations in seasons and soils and the rainfall and temperature of the wheat seeding season are considered, it is remarkable that the results of practical experience so strongly favor the application of manure to wheat lands. The report, "Top-dressing increased yields one-third, results of plowing under depend on supply of moisture," states the case exactly. In seasons where there is an abundant summer rainfall, manure plowed under will decay and settle down. On the other hand, in dry seasons, and especially if the soil is not well cultivated soon after plowing, manure which is plowed under will keep the soil open and make it dry out easily. The seed then goes into a dry soil, germinates poorly giving a thin stand, and starts off the wheat in a weakened condition.

This makes the manuring of land sown continuously to wheat difficult, and in such cases, it would appear that a top-dressing, well worked into the surface of the soil, would be the best and safest practice.

RESULTS AT THE STATION.

The following table taken from bulletin No. 47, of this Station, is inserted, being of interest in this connection. An acre has been sown continuously to wheat since 1892. During the first six years no manure was applied. In the summer of 1898, 15,720 pounds of stable manure were applied to the south half of the acre and in 1899, another application of 11,350 pounds of well-rotted stable manure was put on. Both halves of the acre were treated exactly alike in all other respects. The yields for the last four years were as follows:

WHEAT, HALF ACRE PLATS.

YEAR	Plat No.	YIELD PAR ACRE		Treatment
		Grain Bu.	Straw Tons	
1896-97	1	17.8	1.13	Unmanured
	2	17.9	1·14	Unmanured
1897-98	1	7.0	.57	Unmanured
	2	7.5	.66	Unmanured
1898-99	1	30.6	1.65	Manured
	2	12 0	.68	Unmanured
1899-00	1	36.8	2.50	Manured
	2	18.1	1.17	Unmanured

In each case where manure was applied, the land was plowed in July and kept well worked until seeding time. Figured on a cash basis

with wheat at fifty cents per bushel, thirteen and one-half tons of manure produced an increased yield of wheat amounting to a little more than eighteen and one-half bushels worth $9.25. The residual effect on the soil was such that no manure was applied last fall and it is safe to assume that less than one-half of the benefit from the use of the manure has yet been realized.

The results of manuring wheat land have been discussed rather fully for the reason that the use of manure on wheat presents peculiar difficulties and possibilities of loss during the first season.

MANURING AND CROP ROTATION.

When a succession of crops is grown, the problem of manuring the soil is much simpler than when wheat is the sole crop. Greater opportunities are afforded for choice in the matter of time of application of manure, and there is less possibility of loss because of the drying of the soil. There is practically no danger of loss by leaching when manure is applied in the winter in this climate, and the soil is usually sufficiently dry so that loads may be readily drawn through the fields. It is thus possible to put manure on land that is to be used for corn, cotton, Kafir corn, castor beans, and other spring crops. If the land is plowed early, the spring and early summer rains will settle the soil and lessen the danger which exists when manure is applied in a dry time of the year. Another factor favoring winter manuring is the more comfortable working temperature at that time of the year and the lack of urgent work that must be done.

As the use of manure becomes more general, discussions as to the best time to apply manure will arise and experiments to test this point will be made. At present, however, the great need is that farmers generally should save and use the manure produced on the farms and put it on the soil. It now matters little when or how—the one great thing is to form the habit of using the manure that is produced in the towns and on the farms.

SOURCES OF MANURE.

As previously indicated, anything that grows on the farm and is in such condition as to decay and become a part of the soil is classed as manure. The passing of feed through animals does not add anything in the way of fertility. When grain and forage are fed, about three-fourths of the plant-food which was in the feed is excreted either in the dung

or urine, the amounts varying with the kind of animals. The location of the feed lot should be such that this plant-food can be saved and returned to the soil. Expensive arrangements for the prevention of leaching and loss of plant-food are not necessary. But the manure pile should not be located in a draw, or on the bank of a creek where each rain will wash away valuable plant-food. A level spot or a small alkali spot make ideal places for the storing of manure until such time as it can be hauled into the fields.

Corn and cotton stalks and other rubbish in the fields are easily cut down and plowed under. This method requires but little more labor than raking together and burning and adds much to the fertility of the soil. When such material is dragged together and burned, both the nitrogen and the organic matter are lost, and both are greatly needed for the perpetuation of soil fertility.

Wheat straw instead of being burned should be used as much as possible and converted into manure to be returned to the soil for the benefit of future crops. It should never be burned.

Farmers near cities and large towns can procure large quantities of manure for only the labor of hauling it. Manure from livery stables is usually very rich, only a small amount of straw being used, and heavy grain feeding being the usual custom. The only difficulty with which the experiment station has met in procuring manure from stables in Stillwater has been inability to haul it away fast enough. It has been a grand opportunity to get something for nothing and the Station has taken advantage of it and manured portions of the farm so that they are now in a high state of fertility. Other portions have been left unmanured for comparison, but if the farm were conducted for profit, all of it would have been manured.

GREEN MANURING.

The chief object of green manuring, or plowing under of crops, is to increase the supply of organic matter in the soil and to improve its mechanical condition. Some plants when plowed under actually increase the store of plant-food in the soil. These are known as leguminous crops and those that are successfully grown in Oklahoma are cowpeas, soy beans, peanuts, and alfalfa. The first of these is best suited for green manuring, but it is preferable to pasture the cowpeas off before turning them under. This can be done successfully by sowing cowpeas after wheat.

Some very sandy soils have been benefited by growing a crop of sorghum and plowing it under after it has attained nearly full growth.

The land should, of course, not be planted to crops immediately after plowing under a heavy crop of sorghum.

SOIL EXHAUSTION.

As frequently considered, soil exhaustion is taken to mean lack of plant-food caused by continuous cropping without manure. It means much more than that, and includes a change in mechanical condition which hinders the growth of crops. This is brought about in many cases by the loss of organic matter. The failure of a soil to produce a satisfactory crop does not argue that there is a deficiency in the supply of plant-food in the soil.

The application of manure to the soil of the Station farm produced such marked results that an experiment was begun last season to determine whether or not the benefit was entirely due to the plant-food in the manure, or was in part produced by the change in the mechanical condition brought about by the organic matter in the manure. No definite results have yet been secured but the indications of the work up to this time are that the application of plant-food in the form of chemicals does not produce as satisfactory results as when applied in barnyard manure.

But few Oklahoma farmers have a thorough appreciation of the extent to which commercial fertilizers are used in the eastern and central western states. The use of artificial manures is crowding westward and many farmers in Iowa, Missouri, and eastern Kansas find their use necessary. It is not the intention to even suggest the desirability of using commercial fertilizers in Oklahoma, except possibly by gardeners and growers of small fruits. On the other hand, the evil day should be put off by caring for and using farm manures while the soil is yet comparatively new. Carelessness in such matters is nothing short of vicious.

WHEN TO MANURE.

As has been indicated, the time of manuring should bear some relation to periods of greatest rainfall. The following tables give the average monthly, seasonal, and annual rainfall of nineteen stations in Oklahoma and Indian Territories, calculated from data furnished by C. M. Strong, Section Director, Oklahoma City, Okla.

FALL AND WINTER RAINFALL.

AVERAGE OF NINETEEN STATIONS.

October	November	December	January	February	March	Total
2.64	2.02	2.09	1.79	1.12	2.11	11.79

SPRING AND SUMMER RAINFALL.

AVERAGE OF NINETEEN STATIONS.

April	May	June	July	August	September	Total
2.92	4.93	3.84	4.50	2.53	2.27	20.99

Of a total average rainfall of 32.76 inches, 20.99 inches or nearly 65 per cent falls during the months from April to September inclusive. This fortunate distribution of rainfall is the controlling factor in crop production in Oklahoma, and requires study so as to manure without loss the first season.

Generally speaking, manuring of the wheat crop is difficult because of the need of saving all of the soil moisture for the germination of the wheat. And as a general rule, if it is possible to do otherwise, wheat should not immediately follow the plowing under of manure. Green manuring may precede almost any spring crop, for the reason that this process usually diminishes the number of weeds. But applications of stable manure should, in most cases, be followed by some clean culture crop.

If cowpeas are grown for pasture and green manuring, they may follow wheat, being planted as soon as the wheat is cut. They will furnish considerable pasture during the late summer and fall, and may be plowed under during the late fall or winter. The land will then be in condition for a crop of oats, to be followed again by wheat and cowpeas. Stable manure may be hauled into the fields during the fall and winter, and applied to land that is to be used for corn, cotton, castor beans, Kafir corn, sorghum, broom corn and similar crops.

SOIL MOISTURE.

Attempts to follow Kafir corn or sorghum with wheat have very often resulted in failure. "Kafir corn ruins the land" is an expression frequently heard in conversation with farmers. When the matter is studied, it is found that, after all, it is largely a question of the supply of moisture in the soil. Kafir corn grows a large mass of forage and uses the soil moisture up until the time of wheat seeding, and the wheat goes into a soil without sufficient moisture for the germination of the seeds and the growth of the plants.

Early plowing of land for wheat does little but prepare the soil so that it will take in water and keep it. Working the soil, keeping the surface loose, helps out a dry season by holding the water in the soil. Cultivation at the proper times is much to be preferred to manuring when there is no opportunity for the soil to fill with moisture before a crop is to be planted. The effect of a given crop on the moisture content of

the soil has more to do with the yield of the next crop than does the amount of plant-food removed from the soil.

Cultivation and manuring—as much as possible of each—and study and knowledge of the true effect of different crops on available soil moisture are essential to a profitable and improved system of farming. The day of crop failures, worn out farms, and purchase of fertilizers should be put off by the use of things at hand that cost only energy, time, and labor to utilize and possess. JOHN FIELDS.

THE POTATO CROP*

COMMERCIAL POTATO GROWING.

The largest district of commercial potato growing in Oklahoma is confined to the valley of the North Canadian river in Pottawatomie county. The soil in this district is well adapted to producing an early crop of potatoes and the work has been taken up by active, up-to-date farmers and pushed to its present high standing. It is now one of the best paying crops of that district. There are two crops grown each year, an early or spring crop, and a late or fall crop.

The soil of this district is a sandy loam and is an ideal potato soil. The subsoil is porous, containing a large proportion of sand. This insures good drainage and makes the land work easily and warm up early in the spring, which is a very essential feature for the spring crop. The clay loam lands will produce almost as large crops of potatoes but they will be later in season than those on sandy soil.

There is not much difference in the methods of planting and cultivation followed by the different growers. All the growers have almost the same kind of soil, grow the same variety of potatoes and for the same market. They are all striving to attain the same results, a large crop at an early date; and for this reason they follow practically the same process in growing a crop. This fact also accounts for the success of most of the growers.

The land is plowed in the fall or early winter when preparing for the early crop. This gives the soil time to settle and catch the winter rains and prepare for the drouth that usually comes in March and April. This drouth catches most of the early crop just as it is coming up and the young plants are beginning to depend on their own roots for food. If the

*Bulletin No. 52, December, 1901.

plants are not supplied with moisture at this time many will die and those living will be greatly weakened, even though plenty of rain should fall later on. This fall plowing keeps the soil in better condition and avoids turning under two or three inches of dry surface to help injure the crop. Deep plowing has uniformly given the best results.

PLANTING.

The planting is done as soon as danger of hard frosts and freezes is past. This is about from the middle of February to the first of March. There are frosts later than this but they are seldom heavy enough to harm potatoes. There has been some planting done in January but it has not proven to be any better and is but little if any earlier in maturing the crop than later planting. In some of the earlier plantings last spring the potatoes started into growth and the vines were killed back to the surface of the ground by frost, but came up again and made a good crop.

Most of the planting is done with planters. The potatoes are cut about two eyes to the piece and the pieces are dropped from twelve to eighteen inches apart in rows about three feet apart. The potatoes are planted about two inches below the surface of the soil. The soil is then ridged up over the row until the seed is covered four to six inches deep. The earlier the planting is done the more the rows are ridged. This is done to protect the seed from the cold and hasten sprouting.

The seed used for this planting is that produced by the second crop of the previous year, or else it is shipped in from the north. The seed from the previous spring crop is sometimes used but has not given as good results as either the fall crop or the imported potatoes. The first crop of potatoes is difficult to keep over the summer on account of rot, and those that escape the rot dry and wither until they make very poor seed potatoes. The Bliss Triumph is the only variety grown to any extent for shipping. This is a very early medium-sized, red potato. Its special merit lies in its earliness and productiveness.

CULTIVATION.

The cultivation begins with smoothing down the ridges over the potato row as son as the potatoes begin sprouting and before they are up. This work is done with a light harrow or drag that will work down the ridges and not disturb the seed. The subsequent cultivation is level and shallow, forming a dust mulch on the surface of the ground without breaking and destroying the roots of the plants. The cultivation is just

frequent enough to keep the land free from weeds and the soil in good condition. The soil is gradually worked to the rows again and the last cultivation forms a distinct ridge about three or four inches high along the row. The cultivation is discontinued when the young potatoes are about a half inch in diameter. Cultivation later than this does no good and in some instances has done actual damage. The rows are sometimes cleaned with the hoe and this is about all of the hoe work that is done.

HARVESTING.

The crop is harvested while the potatoes are still green and growing. The chief object is to put the crop on the market at the earliest possible date. The digging is done with potato diggers and plows. The potatoes are simply thrown to the surface of the soil and gathered up by hand. The sorting is done in the field as the potatoes are gathered up. The marketable ones are placed in sacks and immediately taken to market. The culls are thrown to one side and covered with soil to protect them from the sun until they can be planted for the second crop.

THE SECOND CROP.

The culls from first crop form the seed for the second crop. The largest ones are usually cut about two eyes to the piece for planting and the smaller ones are planted whole. This seed sprouts very slowly on account of its being so green when dug and planted. The growth from this seed is very uneven, but this fault is overcome to a large extent by planting a large quantity of seed. Sometimes the seed rots badly, and gives a poor stand; when this happens the largest and ripest potatoes decay first and the smaller ones last.

The planting for the second crop is done during the last of June and the first of July. The method of planting and cultivating the second crop does not differ from that of the first crop. The crop is usually allowed to mature before harvesting.

YIELDS.

The first crop yields from eighty to one hundred or more bushels of marketable potatoes per acre. Last summer most of this crop sold for from fifty to seventy-five cents per bushel delivered on the cars of the Choctaw, Oklahoma & Gulf railroad. The growers estimate the entire cost of the crop placed on the cars at ten to seventeen dollars per acre.

This leaves a good profit for the grower. The second crop does not usually make as large yields but a higher price is usually received for the crop. This crop, however, is well worth the growing if it only makes seed for the following spring crop.

Diseases and insects have done no noticeable harm as yet, and have not forced any thought or demand for spraying apparatus. The nature of the crop makes it convenient to crop the same land with potatoes year after year. This will rapidly reduce the value of the land for potato growing and hasten the spread of such diseases as scab and blight after they are once started in the field. Some other crop should be grown on the land every other year. Such crops as corn, or wheat and cowpeas make good rotations with potatoes.

VARIETY TESTS.

A test of varieties of potatoes has been carried on at the Station for the last two years. The land used in this test is a light upland loam. The seed was cut two eyes to the piece and planted two pieces to the hill, hills eighteen inches apart in rows three feet apart. The patch was given clean, shallow cultivation until the young potatoes were about one-half inch in diameter and then all cultivation ceased. The seed was all northern grown. The potatoes were all dug as soon as mature. The crop of 1901 was taken to the cave as soon as dug and placed in small boxes. The temperature of the cave ranged between 72 and 80 degrees Fahrenheit during July and August.

The following table gives the names and yields of the varieties grown. The potatoes of the crop of 1901 that were put in the cave were counted when placed in the cave and again on August 21 and September 24. The rotten potatoes were thrown out each time and from these counts the per cent of rotten potatoes was estimated:

NAME	1900		1901		
	No. of Bushels per Acre	Per Cent of Crop Marketable	No. of Bushels per Acre	Per Cent of Crop Marketable	Per Cent of Crop Rotten Sept. 24
Acme	.....	.....	78	63.6	7
eauty of Hebron	82	50	52	64.2	16
Bliss Triumph	66	80.9	.....	.....	.....
Bovee	56	40	44	47.9	1
Burbank	54	42.9	81	36.9	2
Burpee's Extra Early	58	57.6	94	61.3	.....
Burpee's Superior	59	57	.....	.....	.....
California Russet	45	62.3	.....	.....	.....
Carmen No. 1	121	.....	30	60.3	6
Carmen No. 3	94	.....	52	79.8	10
Country Gentleman	.....	.....	26	66	13.7
Early Six Weeks	213	82.4	69	56.4	3
Early Rose	123	62.8	61	63.3	10
Early Kansas	96	52.8	71	58.7	27
Early Ohio	90	49.3	83	63 4	5
Early Fortune	.....	.....	111	62.7	1
Early Norther	39	32.3	.....	.....	.....
Early Pingree	.....	.....	47	46.4	11
Early Puritan	49	27.7	.....	.....	.....
Empire State	92	95.5	.....	.....	.....
Extra Early Vermont	108	57.1	.....	.....	.....
Great Divide	95	42.1	.....	.....	.....
Good News	.....	.....	105	60.7	9
Ideal	16	57.1	.....	.....	.....
Irish Cobbler	161	80.7	.....	.....	.....
Joseph	.....	.....	18	30.3	29
Maggie Murphy	72	69	.....	.....	.....
Rural New Yorker	93	52.9	39	60.8	13
Secretary Wilson	.....	.....	97	44 2	11
Sir Walter Raleigh	23	40	43	49.7	.....
State of Maine	77	67.8	60	56.7	.....
State of Wisconsin	.....	.....	28	32.9	.....
Thoroughbred	139	.....	101	35.1	.....
Vigorosa	.....	.....	66	66.6	.....
World's Fair	.....	.....	35	14	.....
White Star	116	.....	79	68.9	.....
White Beauty	.....	.....	48	39.3	.....

NOTES ON VARIETIES.

Acme; small; short, oblong, thick; eyes medium to large; skin pink, a little rough; very early.

Beauty of Hebron; large; oval; eyes few, shallow; skin white; early.

Bliss Triumph; medium to large; round, or a little flat; eyes deep; skin red; very early.

Bovee; medium to large; oblong, thick; eyes shalow, numerous; skin yellowish white with pink markings; early.

Burbank; medium size; long; eyes small; skin white; midseason.

Burpee's Extra Early; medium size; oval; eyes few, small; skin rose color; very early.

Burpee's Superior; large; long oval; eyes few, small; skin white; midseason.

California Russet; large; long; eyes few, medium size; skin white, covered with russet; late.

Carman No. 1; a little above medium size; broad oval, flattened; eyes few, medium size; skin white; midseason.

Carman No. 3; medium to large; broad oval, flattened; eyes few, medium size; skin white; late.

Country Gentleman; medium to large; oblong to long, flattened; eyes large, shallow; skin pink; late.

Early Six Weeks; medium size; round; eyes deep; skin rose color; very early.

Early Rose; medium size; oval to long; eyes medium size; skin rose color; early.

Early Kansas; medium size; long oval; eyes medium size; skin white, a little russet; early.

Early Ohio; medium size; oval; eyes medium size; skin light rose color; very early.
Early Fortune; large; oblong; eyes few, medium size; skin white; early.
Early Norther; medium to large; oblong; eyes large, deep; skin white; early.
Early Pingree; medium size; oval to long; eyes few, small; skin white; early.
Early Puritan; medium to large; oval; eyes large, shallow; skin white; early.
Empire State; very large; long; eyes large, deep; skin white; late.
Extra Early Vermont; large; round to oval; eyes large, shallow; skin light rose; early.
Great Divide; large; oblong, slightly flattened; eyes small; skin white; midseason to late.
Good News; large; long, cylindrical; eyes shallow; skin smooth, white; late.
Ideal; small; long, slightly irregular; eyes few, small; skin light red; early.
Irish Cobbler; medium size; short, oblong; eyes medium deep; skin white; midseason.
Joseph; medium size; oval; eyes small; skin red; late.
Maggie Murphy; medium size; broadly oval; eyes few, medium size; skin light rose netted; late.
Rural New Yorker No. 2; medium size; oblong, usually pointed; eyes few, shallow; skin white, netted; late.
Secretary Wilson; medium size; oval, flat; eyes large, shallow; skin white; midseason.
Sir Walter Raleigh; medium size; round to oval; eyes few, medium size; skin white; midseason.
State of Maine; large; round; eyes large, shallow; skin white; late.
State of Wisconsin; large; long; eyes medium size, deep; skin white; late.
Thoroughbred; medium size; oblong; eyes small, shallow; skin light rose; early.
Vigorosa; large; flat, oblong and sometimes irregular; eyes shallow, large; skin red; late.
World's Fair, medium size; oval; eyes shallow; skin white, very finely netted; late.
White Star; medium size; round to oblong; eyes medium size, shallow; skin white; late.
White Beauty; large; long to oval; eyes few, small, shallow; skin white; late.

FALL AND SPRING PLOWING.

The potato growers in Pottawatomie county generally agree that their experience and observation proves that the land should be plowed in the fall before the potato crop is planted in the spring. The soil in that district is a sandy loam. The soil on the Experiment Station farm is a light upland soil mixed with some hard pan or clay. The results of experiments in fall and spring plowing on this soil coincide with the results on the sandy loam.

The results of several experiments along this line differ so little that the result of only one test is given. The field was divided into forty-eight plats of equal size. Twelve plats were on land that was plowed in October before the crop was planted in March. These plats made an average yield of 95.5 bushels of marketable potatoes per acre. Twelve were on land that was plowed seven inches deep and subsoiled five inches deep just before the crop was planted. These plats made an average yield of 72.5 bushels of marketable potatoes per acre. The other twenty-four plats were on land that was plowed about seven inches deep just before the crop was planted. These plats made an average yield of 73 bushels of marketable potatoes per acre.

DEPTH OF PLANTING.

The depth at which the seed should be planted varies with the season and condition of the soil at the time of planting. In very cold or very warm weather the seed should be covered a little deeper than at other times, or if the soil is very dry the seed may be planted a little deeper than would otherwise be advisable. The yield of the plants that were planted to test this point varied from those in which the seed was planted in furrows three to four inches deep and then filled level full of soil, which was 84 bushels of marketable potatoes per acre; to those planted in furrows about eight inches deep and covered with three inches of soil which made forty-seven bushels per acre. The deep furrows were gradually filled by cultivation.

The seed should always be planted in moist soil and covered immediately. The potato planters do almost ideal work in this respect, but in small patches where the rows are laid out with a plow and the seed dropped by hand, the soil in the open furrow is dried and the sprouting of the seed retarded thereby. This can be observed every year but it is especially noticeable if the planting is done during a dry spell. Last spring potatoes planted in furrows that had been left open for one to two days and exposed to the wind, were as much as two weeks later in coming up, than those planted in fresh furrows on the same day.

TIME OF PLANTING.

The best time for planting early potatoes varies with each season, and no definite date can be named. The seed should not be planted until the soil is warm enough to start it into growth at once. If the seed lies in moist, or wet soil a week or two before growth starts, a good part of it will be destroyed by rot. Last spring, potatoes planted March 14 came up as early and matured the crop as early as those planted February 27. The crop planted about the middle of March has usually been as early as that planted in February and has made a larger yield by having a better stand of plants. On sandy soil and in the southern part of the territory, the planting can be done much earlier.

CULTIVATION.

Shallow cultivation, frequent enough to keep down the weeds and the surface of the soil well pulverized, is best. The early cultivation should leave the land as level as possible, but later on the soil

should be drawn to the row enough to make a distinct ridge. The land must be kept free of weeds and grass. Small patches of midseason and late potatoes can be mulched profitably with old hay or straw. The early crop frequently can also be mulched with profit. A comparison of the yield of cultivated and mulched plats shows greatly in favor of the mulched plats. Sixteen cultivated plats of the crop of 1899 made an average yield of eighty-four bushels of marketable potatoes per acre. Five mulched plats made an average yield of 111 bushels of marketable potatoes per acre. This was a midseason crop. The crop of 1900 gave practically the same results as that of the year before. In the crop of 1901 the mulched plats made about four times as large a yield as the cultivated plats. This however, was an exceptionally dry season and such results are far out of proportion for the average season.

KEEPING POTATOES.

The early potatoes usually make a fair crop and there are few questions asked about methods of planting and cultivating them. The crop of midseason and late potatoes is usually very poor. There seems to be no method of cultivation that will enable any variety of late potatoes to make even a fair crop each year. Mulching the patch with old hay or straw gives the best results. The mulch should be from six to ten inches deep when first spread on the ground.

The trouble that confronts almost every farmer in Oklahoma is, how to keep a crop of early potatoes through the summer and early fall so that he can have his own potatoes for use during the winter. This year is an extreme but it illustrates the situation all the better.

In July potatoes sold for fifty cents per bushel in Stillwater and now, December 13, they are worth $1.20 per bushel. If the farmer could have kept the early crop the price would not have been so low in July and August nor so high now. Most farmers lose a large per cent of their potato crop each year by the rot and count on losing it. The result is that few farmers keep enough of their own crop for family use, others buy all they use during the winter and spring and many others are not using potatoes this year.

Many methods of keeping the early crop have been tried but only a few have been even partially successful. Several methods have proved quite satisfactory one year and have been entire failures the next year, and no method that can be used by the average farmer has to our knowledge given even a fair degree of satisfaction for two or three successive years.

Four different methods of keeping the potatoes through the summer

in the soil where they grew have been advocated. The first and most common method attempted is to let the potatoes remain in the soil undisturbed till fall. This plan is almost regularly a failure. The potatoes are only two or three inches under the surface of the soil and are heated through till they rot. A rain in the middle or latter part of the summer will cause most of the sound ones to sprout. Last summer one plat was treated this way and when the crop was dug early in the fall eighty per cent of the potatoes were rotten, and the remaining twenty per cent have not kept well since then. In 1900 the loss on a similarly treated plat was somewhat less. In some plats where the weeds and grass were very thick the loss was about forty per cent.

Another method is to leave the potatoes in the ground and go through the field with a lister or turning plow and throw up a ridge over the row. This, if well done, will cover the potatoes with six to eight inches of soil. This work should be done as soon as the crop is mature. In 1900 a plat treated in this manner lost twenty per cent of the crop before fall. In 1901 this plat lost sixty per cent of the crop before September 1. There was no appreciable loss either year from sprouting. This plan is better than leaving the land level but is a very poor method. It has given fair results on sandy soil but even there failures are frequent.

In the third method the land is left level and about the time the last cultivation is given or shortly before the crop is mature, a row of cowpeas are drilled on either side of the row of potatoes as close as the drill can be run to the vines. The peas will make a good growth over the row and shade the land and reduce the amount of moisture in the soil during the summer. This plan was followed with two plats in the summer of 1900 and about sixty per cent of the crop rotted. No difference could be seen between these plats and those left without any covering. In 1901 this plan was followed again and about seventy-five per cent of the crop rotted.

The fourth method of keeping the crop in the field is to mulch the patch with straw or old hay in the spring or in the summer after cultivation has ceased. Plats mulched in the spring of 1900 and the crop dug in the fall lost by rot about five per cent. Plats treated in the same way in 1901 lost about fifteen per cent by rot. This is by far the best of the four methods just discussed. It is a practicable method to follow on farms where potatoes are grown only for use. The potatoes kept in this way in better condition and have a better appearance than those kept through the summer in a cave. The mulched plats will on an average keep as

many bushels per acre until fall as the cultivated plats will yield if dug as soon as the crop is mature.

Keeping the potatoes by packing them in sand in the cave resulted in a loss of twenty-five to fifty per cent by rot. In the first lot the potatoes were packed in a box of sand so that no two touched each other or the sides or the bottom of the box. In the second lot each potato was wrapped in paper and then packed in the sand the same as the first lot. There was very little if any difference in the per cent rotten in the two lots. Both lots sprouted worse than other potatoes in the cave. A few were wrapped in paper and placed in a box in the cave. This bunch lost about twenty per cent.; the same as other potatoes placed in the cave at the same time.

Quick or unslacked lime was pulverized and dusted over the potatoes, in a bin in the barn, so that every potato was covered with the fine dust. They were placed in the bin July 6, 1901, and the lime dusted on immediately. They were removed October 1, and had lost forty-one per cent by rot. Another lot was dusted with lime in the same way at the same time and placed in the cave. This lot lost ninety per cent by rot.

Copper sulfate (blue vitriol) was pulverized and dusted very lightly over one lot of potatoes on July 6 and they were immediately placed in a bin in the barn. This lot lost forty per cent by rot by October 1.

Salt was pulverized and dusted over a lot of potatoes about the middle of July. They were placed in the cave where it took about four weeks for the entire lot to decay.

One lot of potatoes was coated with paraffin by dipping each one in melted paraffin. The temperature of the paraffin was 160 degrees Fahrenheit, and the potatoes were simply dipped in and lifted out immediately. This gave a very thin but practically air-tight coating to each one. The potatoes were all clean and sound. The work was done in July 1901 and the entire lot decayed in two weeks.

Dipping the potatoes in Bordeaux mixture, ammoniacal copper carbonate, and formaldehyde, was tried but the results indicate that the work does more harm than good. The potatoes dipped in any one of these solutions rotted two to six times as rapidly as those not treated.

Keeping potatoes in an open shed has been advocated and practiced by some farmers. Mr. J. W. Poling of Oklahoma City says: "I kept some potatoes one year by placing them in a corn crib as soon as they were dug. The crib was well covered and so situated that the sun could not strike the potatoes. They were simply placed on the floor of the crib in

early summer and left there until fall, and kept in fair condition. The second trial, however, ended in a failure."

This method was tested here and resulted in a failure. The potatoes were sorted and only the good ones used. The sound potatoes were spread about two or three deep on the floor of a small bin in a closed shed at the north end of the barn. They were not handled or moved in any way during July, August and September. When they were taken from the bin, October 1, twenty-one per cent were rotten. A similar test in the summer of 1900 resulted in about forty per cent rotten.

Good results have been obtained at times by piling the potatoes on straw in the shade of trees and then covering the pile with about two feet of straw. A heavy rain will cause all of the potatoes to sprout or rot. The test of this method here last summer resulted in seventy-seven per cent of the pile rotting. The test lasted from July 6 to September 30. There was not enough rain during the summer to wet through the covering and wet the potatoes.

The average cave will not keep the crop through the summer. The Bliss Triumph lost about fifteen per cent of those placed in the cave early in the summer in 1901. The average temperature was 73 degrees. Those that did not rot sprouted badly and are now unfit for table use. There is a great difference, however, in results, depending upon the way potatoes are handled and stored. Those piled on the floor of the cave rotted badly, those left in sacks kept somewhat better but are in a very bad condition now. Those kept in small boxes or crates did the best and justify the statement that in good caves good potatoes may be kept through the summer with little loss if properly handled.

If the potatoes are to be stored in the cave through the summer they should be dug as soon as growth has ceased. If they remain in the ground until they are ripe their keeping qualities will be greatly impaired. This is especially true if the patch is not mulched. The potatoes that are a little green when dug keep better in caves than those that are mature. The green ones will wilt if kept in too dry a place but if the cave floor is a little moist they will keep in fair condition. They require ventilation but should not be in a direct draft of air.

The heat is no doubt the principal cause of decay. In testing this last summer, it was found that freshly dug potatoes were badly damaged by being heated to 110 Fahrenheit degrees while those that had been dug for some time and wilted a little could be heated to 120 degrees without any noticable harm being done to their keeping qualities. Heating potatoes to 100 degrees for one hour each did more harm than heating to 110 degrees for the same number of hours taken consecutively. Potatoes placed in

closed or nearly air-tight vessels and heated to 100 degrees and left in these vessels decayed in two weeks.

The best method tested is to grow the potatoes under a mulch of hay or straw and leave them in the ground till fall. If rain should cause them to start to sprout or decay they should be dug and stored in small boxes or crates in a cave. If the patch is not mulched the crop should be dug as soon as matured and stored in a cave. The potatoes should not be left in the sun but should be taken to the shade as fast as they are dug.

O. M. MORRIS.

VARIETY TESTS OF CABBAGE.*

A variety test of cabbage has been carried on for the last two years. The plants were started in the hot bed and set in the field as soon as the conditions of the weather would permit. The plants were set three feet apart in rows three and one-half feet apart in 1900, and in rows six feet apart in 1901. The following table gives the name and yield of each variety. In 1900 twenty-five plants of each variety were set. In 1901 thirteen plants of each variety were set.

	1900			1901		
	No. of Heads	Total Weight		No. of Heads	Total Weight	
		Lbs.	Oz.		Lbs.	Oz.
North Carolina Winter	18	65	14	Not Planted	.....	.....
Augusta Early Trucker	20	43	9	Not Planted	.....	.....
Early Jersey Wakefield	17	34	1	Failure	.....	....
Early Winningstadt	5	4	6	Failure	.....	....
Large Early York	10	15	1	Failure	.....	.....
Dwarf Early York	6	9	6	3	.....	6
Extra Early Etampes	7	11	10	Failure	.....	.....
Surehead	19	26	12	2	4	14
Early Express	6	6	5	Failure	.....	.....
Fottler's Improved Brunswick	8	11	1	Failure	.....	.....
Large Late Drumhead	16	25	4	3	6	9
Henderson's Early Summer	13	25	10	5	4	2
Allseasons	20	50	10	1	.....	12
Premium Late Flat Dutch	16	24	.....	2	2	12
Drumhead Savory	2	1	5	Failure	.....	.....
Mammoth Rock Red	14	9	1	1	.....	6
Early Dwarf Flat Dutch	14	31	1	Failure	.....	.....
Mammoth Marble Head	17	24	4	1	.....	6
Excelsior	13	28	6	6	9	8
World Beater	18	20	4	Not Planted	.....	.....
Vandergraw	21	27	11	Not Planted	.....	.....
Henderson's Early Summer	20	32	15	Not Planted	.....	.....
Lupton	22	44	11	Failure	.....	.....
Allhead Early	22	62	14	2	.....	9
Henderson's Succession	14	21	14	Not Planted	.....	.....
Green Glazed	1	.....	12	Not Planted	.....	.....
Safe Crop	20	35	13	Not Planted	.....	.....
Early Spring	17	27	11	Failure	.....	.....
Filderkraut	21	21	12	Not Planted	.....	.....
New Savory	6	1	11	Failure	.....	.....
Hollander	Not Planted	.....	.....	3	2	6
Succession	Not Planted	.....	.....	2	1	6
Golden Sugar Winter	Not Planted	.....	.....	Failure	.....	.....
Louisville Drumhead	Not Planted	.....	.....	Failure	.....	.....
Large Jersey Wakefield	Not Planted	.....	.....	Failure	.....	.....

North Carolina Winter; stem short; head nearly round, soft until almost grown; leaves large; midseason.

Augusta Early Trucker; stem short; head round to flat; medium firm throughout growth; rots badly at stem; midseason.

Early Jersey Wakefield; stem medium length; head long, conical, medium firm; sun-scalds badly, decays as soon as mature; early.

*From Bulletin No. 52, December, 1901.

Early Winningstadt; stem medium length; **head conical, firm; sunscalds and decays** badly; early.

Large Early York; stem medium length; head long, firm rots soon after maturity; early midseason.

Dwarf Early York; stem short; head long, very firm, decays and **sunscalds badly;** very early.

Extra Early Etampes; stem short; head long, firm. A good variety.

Surehead; stem medium length; head round or flat; late. A good variety.

Early Express; stem medium length; **head conical to round; sunscalds badly;** early. Very poor.

Fottler's Improved Brunswick; stem short; head flat, very firm; **midseason.**

Large Late Drumhead; Stem long; head flat, firm when mature; late.

Henderson's Early Summer; stem very short; head flat, **cracks badly, but does** not rot; early midseason.

All seasons; stem medium length; round or slightly flattened, very firm throughout growth; late. Good.

Premium Late Flat Dutch; stem short; head firm, flat; stands drouth very well. A very good late cabbage.

Drumhead Savory; did not head.

Mammoth Marble Head; stem medium length; head round, firm, **free from rot**

Early Dwarf Flat Dutch; stem medium length; head round, very firm; early; sunscalds and rots badly.

Mammoth Marble Head; stem medium length; head round, firm, **free from rot** and sunscalds, late.

Excelsior; stem medium to long; head, round firm, free from rot; late. **Good.**

World Beater; stem medium length; head round, very firm; late.

Vandergraw; stem short; head round, free from sunscald and rot; late.

Lupton; stem long; head flat, firm; midseason; good.

Henderson's Succession; stem medium length; head flat, firm; midseason.

Green Glazed; stem long; head small. Not good. Late.

Safe Crop; stem short; head flat, firm; late.

Early Spring; stem short, head flat, firm; late.

Filderkraut; stem medium length; head conical; late.

New Savory; stem short, head very small, soft. Not good.

Hollander; stem tall; head small, round, firm throughout growth; late.

Succession; see **Henderson's Succession.**

O. M. MORRIS.

Reprints from the Eighth Annual Report,

1898-1899.

AGRICULTURAL EXPERIMENT STATION.

ANNOUNCEMENT.

The Oklahoma Agricultural Experiment Station is a department of the Oklahoma Agricultural and Mechanical College. It receives no funds from the Territory and is supported by an annual appropriation of $15,000 from the National Treasury.

The act of Congress establishing this and similar institutions defines their duty in the following language:

"That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories."

Due regard to the conditions and needs of this Territory has determined which of these permissible investigations should be pursued by this Station. And due regard for careful work and results of ultimate value

has made the choice of a few definite lines pursued to their end preferable to a little work on each of a great many lines.

The proper work of the Station is, therefore, to determine and suggest applications of general principles rather than to formulate rules of practice. The work of the Station should be of value to the largest possible number rather than to a few individuals. This fact and the limitations of time make it impossible for the Station to undertake investigations unless it is probable that the results will be valuable to many.

Suggestions as to desirable lines of work are invited and will be carefully considered when planning future experiments.

The Station will gladly give any information in its possession on any subject connected with agriculture, in response to request.

Members of the Station staff will aid in the work of farmers' institutes whenever possible.

A cordial invitation is extended to all to visit the Station at any time and inspect the work which is being done.

The bulletins of the Station are now sent to more than 13,000 farmers and others. They are sent, without charge, to any one in the Territory sending name and address.

Address all communications to

AGRICULTURAL EXPERIMENT STATION,
Stillwater, Oklahoma.

FEEDING EXPERIMENTS.

1896—1899.

G. E. Morrow and J. H. Bone.

SUMMARY AND GENERAL CONCLUSIONS.

Oklahoma is well adapted to rearing and feeding horses, cattle, sheep and hogs. Few things would add more to its prosperity than a large increase of attention to stock rearing by a majority of its farmers.

Where corn can be raised with reasonable certainty of a good crop it will be found the best fattening food. Its fodder and stover are also valuable foods, although the long time after ripening before winter feeding begins causes more loss in the shock and much more to the standing stalks than in more northern states.

As the kernels become very hard when thoroughly dried, grinding the corn is a help; soaking is a fair substitute for this. Where hogs follow cattle there is little loss when either ear or shelled corn is fed.

Kafir corn is a healthful, palatable and nutritious food, but its feeding value is somewhat less than that of corn. As shown both by feed lot trials and by digestion experiments there is a great loss in feeding this grain unthrashed to cattle—in some cases of sixty per cent but hogs will utilize most of this waste. There is little difference in the waste whether the grain is fed unthrashed or thrashed. In some cases, at least, the loss is greater when soaked grain is fed than when it is fed dry. In some trials steers fed Kafir meal made better gains for a long time than did those fed corn meal, but this was not true in any extended period. Hogs digest the unground grain better than do cattle. In general hogs have made gains from four-fifths to five-sixths as great when fed on Kafir as when fed corn. Sheep seem to digest Kafir better than any other class of farm animals.

Kafir stover apparently has practically the same feeding value as corn stover, and often is in better condition. Running the entire stalk through a thrashing machine puts the stover in excellent condition.

Alfalfa is the best hay for either horses, cattle or sheep and is a help to hogs during winter. The value of cowpea and soy bean hay is underestimated by most Oklahoma farmers. No larger gains have been made

by cattle at the Station than when cowpea hay was their only rough forage.

The trials at the Station indicate that it is not profitable to keep good grade native steers until they are three years old and that it is possible that sales when they are "long yearlings" may be most profitable.

Apparently six months is as long as it is profitable to continue full grain feeding of cattle under existing conditions. The rate of gain decreases as the animals become fat and the quantity of food needed to produce a pound of gain greatly increases in many cases.

The result of one trial suggests possibilty of greater profit when steers are not given all they can eat of grain, taking a longer period for fattening. This would pretty certainly be true where there is an abundant supply of good alfalfa or cowpea hay, and grain is high priced.

One or two striking illustrations of the fact that an ill-formed animal may make as large gains as well formed ones have been found in the Station feeding trials. The lower price at which the ill-formed steer sells will more than counterbalance any seeming profit from his purchase.

Oklahoma native pastures are good, but the gains made by cattle on them, especially when flies are bad or there is extreme heat, are often over-estimated. It is desirable to have sorghum, Kafir or corn with which to supplement the pastures during the fall or summer drought.

Alfalfa is excellent as pasture for hogs. Pigs will make some gain with no other food; excellent gains when fed grain while on the alfalfa. Continuous pasturing will injure and may destroy the alfalfa. With rare exceptions, alfalfa should not be pastured the year it is sown. Sorghum also makes a fair pasture for hogs. Sowing cowpeas, planting peanuts or sweet potatoes and allowing hogs to harvest the crop giving them some grain in addition reduces the cost of pork production. Sugar beets are much relished by any class of stock. The greater cost of growing them as compared with other crops makes it doubtful if they are an economical crop when used in large quantities.

A large increase in the number of sheep in the territory is advised. They thrive well, the cost of keeping in summer is very small, and Oklahoma has many advantages as regards the production of lambs for the early spring market.

Shelter should be provided for all classes of stock, but expensive buildings and stall feeding of cattle are not necessary. While there is, occasionally, extreme cold, ordinarily protection from rain and cold winds by means of simple sheds is all that is needed for the comfort of farm animals.

The long continued feeding of hogs on dry feed of any class is not

advisable. Almost without exception the grain eaten for each pound of increase somewhat rapidly increases after hogs of any age have been full fed on dry feed for 8 weeks or more.

FEEDING EXPERIMENTS.

The work in stock feeding has been with chief design of using foods which can readily be grown on almost any Oklahoma farm, using simple rations and preparing the food with as little cost as is practicable.

The Station has not yet been able to provide satisfactory facilities for feeding experiments. Thus it has been found not easily practicable to determine quantities of hay, stover or other forage eaten by each animal.

Possibly in even greater degree than with experiments in crop culture, care should be taken in drawing definite conclusions from single experiments in feeding or those with small number of animals. Differences in feeding capacity of animals of like age and breeding are great in some cases. Sudden variations in the weather or some unknown cause may greatly affect results. In several trials at this station greater differences in results have been found between animals under like treatment than between selected animals and different rations.

The gains made by animals in experiment feeding are often smaller than they would be if a greater variety of food was given with occasional changes in the ration.

STEER FEEDING—1898-9.

Nine two-year-old steers were fed during winter of 1898-9, mainly to compare value of Kafir and Indian corn as grain food. With one exception these steers were of fair quality, showing considerable Shorthorn blood—except two which probably were grade Angus and Shorthorn. They had been on full feed during the previous winter, were put on pasture May 9. From this date until September they made average gain of 163 lbs., varying from 25 to 280 lbs., per steer. During September they were fed new ear corn in the pasture, making average gain of 73 lbs. each, varying from 10 to 120 lbs., each. October 1 they were brought to small pasture near stable, kept under like conditions until October 24, making average gain of only 10 lbs., each, largely because of being placed on dry feed.

October 24 they were divided into five lots, with an extra Texas steer used for inoculation experiments as second member of fifth pair, the other being a rough-formed steer and the purpose being to dispose of this pair as soon as practicable.

Lot 1 full feed of Kafir meal, average weight ..... 1005 lbs.
Lot 2 full ration corn meal, average weight ..... 945 lbs.
Lot 3 full ration corn and Kafir meal, half and half, average weight ..... 990 lbs.
Lot 4 Kafir meal, approximately one pound for each 100 lbs. live weight for 10 weeks; afterwards full ration, average weight ..... 930 lbs.
Lot 5 full ration corn meal, average weight ..... 935 lbs.

All the steers had all they would eat of Kafir stover. It was impracticable, with the facilities at hand, to determine quantity eaten by the different animals.

The Texas steer was sold after 13 weeks feeding. After this the feed given the ninth steer is known.

While some attention was paid to color and appearance the pairs were selected with chief reference to supposed uniformity in feeding capacity. The results were surprising in some cases, the differences in the gains made by the steers in each pair being very great. There was an extreme difference of 75 lbs., in weight of the lots. The average weight of the nine steers was 964. lbs.

A summary of results by four weeks periods and whole period of 24 weeks, showing gain of each steer, of each pair, average gain for each pair per day, grain eaten and number of pounds of grain for one pound gain in live weight is given in table.

Gains and grain per pound. Gain 4 weeks periods, October 24 to April 10.

Gains by Periods.

	Lot 1			Lot 2			Lot 3			Lot 4			Lot 5
	1	2	Av.	1	2	Av.	1	2	Av.	1	2	Av.	1
Period 1.	105	65	85	95	100	97	140	65	102	75	30	50	120
Period 2.	75	60	67	80	80	80	40	60	50	30	95	62	75
Period 3.	35	50	42	60	50	55	70	70	70	65	35	50	40
Period 4.	100	70	85	45	15	30	75	40	57	10	70	40	90
Period 5.	85	85	85	80	70	75	45	45	45	75	30	52	50
Period 6.	55	25	40	5	60	32	70	45	57	50	60	55	85

	Average Daily Gain.					Pound Grain Per Pound Gain.				
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Period 1.	3.00	3.48	3.66	1.87	4.30	6.58	5.74	5.67	5.35	
Period 2.	2.41	2.86	1.78	2.23	2.67	8.68	7.33	11.94	4.92	
Period 3.	1.52	1.96	2.50	1.78	1.43	15.34	11.54	9.42	8.92	
Period 4.	3.00	1.17	2.07	1.43	3.21	7.51	21.46	11.25	12.70	
Period 5.	3.00	2.67	1.60	1.87	1.78	6.75	7.90	13.30	11.16	13.20
Period 6.	1.43	1.16	2.07	1.96	3.00	14.51	18.20	10.05	12.15	7.90

There was a difference of 100 lbs. in gain made by the two steers in Lot 1; of 115 lbs. in that made by the two in Lot. 3. Those in Lots 2 and 4 made nearly the same gain. There was also much variation in the gain made from week to week. Some of these variations can be explained by changes of weather; others it is difficult to account for. No one of the steers was sick or noticeably "off feed" at any time. They were fed carefully and with regularity. During the day they had range of an open yard with Kafir stover in racks. The grain was fed in troughs in a comfortable stable.

Naturally the rate of gain declined toward the close of the feeding period as did the quantity of grain eaten. If the cattle had been fed for profit only it would have been better to have varied the ration, giving some bran or cottonseed meal and also alfalfa or some other forage with more nitrogenous matter than has Kafir stover.

The daily gain per steer in each lot is given below in two periods of 12 weeks each, except for Lot 4 which did not have full grain rations during first period:

	Lot 1.	Lot 2.	Lot 3.	Lot 4.	Lot 5.
First Period 12 weeks	2.32 lb.	2.75 lb.	2.64 lb		2.80 lb.
Second Period, 12 weeks	2.50 lb.	1.63 lb.	1.90 lb.	1.75 lb.	2.68 lb.

An exception to the rule is found with Lot 1 which gained more in second than in first period.

One of the most interesting features of the trial is the fact that the least desirable steer in the bunch, so far as form is concerned, made a slightly larger gain than any other steer, and continued good gains during whole feeding period. The grain given him for first 13 weeks cannot be determined. During last 11 weeks he ate an average of 23.6 lbs. corn meal daily somewhat more than any other steer, and made average gain of 2.73 lbs., daily, using 8.85 lbs., corn meal for each pound of gain. It does not follow that it is more profitable to feed ill formed steers than well

formed ones. The poorer steer would not sell for as high a price as would the better one on any market. The small Texas steer fed with this inferior steer made a gain of 2.25 lbs., daily for seven weeks; but only 30 lbs in next six weeks, at which time he was sold.

The bunch of nine steers attracted much favorable comment as unusually well fattened. They sold in the quarantine division of the Kansas City Stock Yards at $4.75.

Lot 4 was fed for ten weeks a limited grain ration, averaging 10.8 lbs. Kafir meal each per day. The average weight per steer for this period was almost exactly 1,000 lbs. They made creditable but not large gains per day, but the rate of gain in proportion to grain fed was very good, as they used but 5.51 lbs., grain for each pound gain during the whole period —less than this for first eight weeks. It is easily possible that the profit was greater from this lighter than from full grain feeding of the other lots. The relative cost of grain and rough forage, the importance of getting the animals ready for market in a given time, and other considerations must decide which course should be adopted.

STEER FEEDING. 1897-8.

Ten steers of fair quality, eight of them yearlings, two two years old, were placed on pasture May 1. From this time until September 28, they made average gain of 102 lbs. each. During October they were fed Kafir fodder on a small pasture, making average gain of 44 lbs., each.

From November 1 to December 6, five weeks, they were fed broken ear corn in troughs with cowpea hay and Kafir stover. Five steers made average gain of 103.5 lbs. or 2.95 lbs., daily. The second lot made gain of 94.4 lbs. or nearly 2.70 lbs., daily.

During week Dec. 6-13 they were stabled, accustomed to being haltered and to eating meal. For four weeks from Dec. 13 to Jan. 10, Lot 1, fed Kafir meal, averaged 102 lbs., gain or 3.64 lbs., daily eating a little over 7 lbs., meal for each pound gain. Lot 2, fed corn meal, made average gain of 62 lbs., or 2.21 lbs., daily eating 10.7 lbs. meal for each pound gain.

The difference in gain was so great that it was thought advisable to change the feed of the two lots. For two weeks all were fed a mixture of corn and Kafir meal. During this time Lot 1 gained only 24 lbs., Lot 2, 54 lbs.

From Jan. 24 to March 1, Lot 1 was fed corn meal, instead of Kafir as before, making gain of 305 lbs., average 61 lbs., or 1.69 lbs., daily eating 12.93 lbs., meal for each pound gain. Lot 2, fed Kafir meal made gain of 255 lbs., average 51 lbs, each or 1.42 lbs., daily eating 17.9 lbs.,

meal for each pound gain. These results leave it inconclusive whether differences in gain were principally because of feed or of difference in the cattle.

STEER FEEDING. 1896-7.

Various circumstances made this work unsatisfactory. During a part of the winter satisfactory scales were not available; there were breakages of the grinding machinery making some changes of ration necessary.

Twenty young steers, part calves, and part "long yearlings," not very uniform in character were fed in five lots of four each. One lot was fed in racks and troughs in a well protected yard; the other four lots were fed in large box stalls, too small for greatest comfort of the animals. During the day they had access to a large lot. The average weight of the steers in the several lots, October 15, when the preliminary feeding began, was: Lot 1, 715; Lot 2, 760; Lot 3, 605; Lot 4, 545; Lot 5, 450 lbs.

The gains during the preliminary period varied much: Lot 1, 25; Lot 2, 265; Lot 3, 165; Lot 4, 150; Lot 5, 236 lbs. This inequality did not continue in so marked a degree.

In the eight weeks from Oct. 31 to Dec. 26 there was some variation in the feeding—shelled corn being fed for three days at the last and no cottonseed given for last five days. The table shows results as to each lot.

	Gain	Corn Meal	Cotton Seed	Grain per lb. gain	Gain per day
Lot 1.	595	2476	1761	6.14	2.66
Lot 2.	610	2456	1140	5.09	2.72
Lot 3.	520	4115		7.91	2.32
Lot 4.	455	2026	1033	6.72	2.03
Lot 5.	495	2400	355	5.56	2.22

While accuracy of the scales used was not absolute it is believed there was no material error from this source. The rate of gain is good and the gain per pound of grain very good. The lot having corn meal only used more grain for each pound of gain than either of the others. The lot having only small quantity of cottonseed made next to best showing.

During four weeks from Dec. 26 to Jan. 23 all the steers were fed shelled corn as exclusive grain food, except that, by mistake, about seven pounds of cottonseed for each steer was fed during last few days of the period. This counted as corn in total feed.

	Gain lbs.	Shelled Corn	Lbs. Grain per lb. gain	Grain per day
Lot 1.	320	2228	6.81	2.85
Lot 2.	190	2268	11.93	1.69
Lot 3.	295	2128	7.21	2.63
Lot 4.	260	1736	6.61	2.32
Lot 5.	245	1732	7.06	2.18

The showing is a good one except for Lot 2. No explanation can be given for the small gain made by this lot.

For the five weeks, Feb. 13 to March 20, Lots 1 and 2 were fed corn; Lot 5, younger and lighter steers corn and bran. Neither lot made large gains, ranging from 1.28 to 1.37 lbs., per day, but Lot 5 used but 10.53 lbs. grain for each pound gain, while the others used over 13 lbs. for each pound gain.

For the 23 weeks, Oct. 31 to April 10, the daily gain per steer per day was: Lot 1, 2.19; Lot 2, 1.63; Lot 3, 1.84; Lot 4, 1.67; Lot 5, 1.78. For the three weeks following, up to May 1 the rate of gain of all the lots was unsatisfactory, probably because of warmer weather and the practical necessity of letting the steers have access to a small pasture affording enough grass to unfavorably affect their appetite for dry food.

EFFECT OF DEHORNING.

Eleven of these 20 steers were dehorned Nov. 11. Three days afterwards these eleven showed average loss in weight of 11 pounds in weight, while those not dehorned showed average gain of 15 pounds. One week later the recently dehorned steers showed average gain of 30 lbs., the other nine of 21 lbs., thus showing an apparent average loss of 17 lbs from dehorning. No one of the dehorned steers was "off feed" at any time.

FEEDING COTTON SEED.

No injury has been found from feeding cotton seed to any class of cattle, although it has not been fed to young calves. In the case in which it has been sole grain food the gains have not been satisfactory. Feeding moderate quantities, say four pounds per day per steer in connection with corn or Kafir has given satisfactory results. Great differences have been noted in the readiness with which different steers ate the seed, some not seeming to like it at any time if they had access to grain.

GAINS ON PASTURE.

The rapid improvement in appearance and in weight of cattle in thin flesh when turned on good pasture has led many to overestimate average

gains. Oklahoma native grasses are palatable and nutritious. With favorable weather the "short grass region" keeps cattle in fair health throughtout the winter. But flies and hot weather come early in the season and tend to retard growth. If there be summer drouth there is little gain.

In no case have the gains on good upland prairie pasture on the Station farm been large for any long period. Partly this is to be explained by the fact that in all cases the Station cattle were in good flesh when put on pasture. The gains made by different lots of steers during the summer are given above.

May 1, 1899 a small bunch of cattle were put on pasture. Up to June 14, 55 days, they had made gains as follows: Jersey bull 90 lbs.; yearling steer, fat, 50 lbs.; two young cows 35 lbs.; two calves 65 lbs.

At suggestion of Board of Regents two well fattened two year old steers, ready for market, were placed on pasture. They made less gains than yearlings; as they did when fed through the next winter. Oklahoma may not be ready to produce "baby beef," profitably, but it is better to sell fat native two year olds rather than keep them for another year.

A supply of green food, corn, sorghum, Kafir, alfalfa or cowpeas with which to supplement the pastures in August and September is desirable.

VARIATION IN GAIN.

A half-Jersey steer, about one year old was fed during the winter of 1898-9, showing remarkable variations in gains in equal periods. For first four weeks, although not "off feed" at any time, he gained only 10 lbs., eating 282 lbs. of Kafir meal and 114 lbs. cotton seed. For next four weeks the gain was 60 lbs., with 408 lbs., Kafir; next 65 lbs., next 35 lbs., with 448 lbs. Kafir in each period.

A young cow made gain of 115 lbs., in four weeks, 95 lbs in second, 110 lbs., in third period of same length, and then fell to gain of 10 lbs, in next two weeks at which time she was sold.

PIGS ON PASTURE.

April 27, 1899 eight pigs were divided into two lots, one weighing 250 lbs., the other 270 lbs. They were placed in alfalfa plats of about one-half acre each, one lot receiving no other food, the other full feed of Kafir meal or shelled corn.

During five weeks the pigs with no food but alfalfa made gain of 61 lbs., or 15.25 lbs., each. For next three weeks, to June 22nd, they gained

only seven pounds, less than two pounds each. While there was a good stand of alfalfa and the season was favorable for its growth, the four pigs, averaging 80 lbs., each kept it well eaten off.

The four pigs full fed grain with the alfalfa gained 199 lbs., in five weeks or practically 50 lbs., each in 35 days. In next three weeks they gained 125 lbs., or nearly one and one-half pounds per day.

With this last was a sow with a litter of pigs. She gained 61 lbs., in first five weeks, when she was removed, her five pigs gained 146 lbs., in first five weeks and 96 lbs in next three weeks. A young boar in same lot gained 46 lbs., in 26 days, and 29 lbs., in next three weeks.

There was fed to all the pigs in this plat 1688 lbs., corn and Kafir. They made total gain in eight weeks of 764 lbs., using only 2.21 lbs. grain, in addition to the alfalfa for each pound of gain. Counting the small pigs with the others the grain eaten was less than three pounds per day each.

Obviously the grain feeding was profitable. Possibly equal or greater profit might have resulted if only partial feel of grain had been given.

The plat pasturing the pigs with grain feed carried at least one-half more stock than the other, but the alfalfa remained green and fresh.

Six young brood sows, with pigs, were kept during same period on a small native grass pasture with access to a very small quantity of the droppings and waste from feeding the work teams. They gained 50 lbs., in five weeks, and 90 lbs., in next three weeks. The sow which had been full fed grain on alfalfa pasture during May, was put in this pasture June 1 and lost 11 lbs., in three weeks. This trial illustrates the fact that our native grasses will enable pigs to make some gain during the early part of the season. They become less palatable as the season advances.

WEIGHT AND GAIN OF YOUNG PIGS.

At different times the weights of litters of pigs have been taken weekly. In no case had the pigs more than ordinary care and no great gains have been recorded.

The average weight at birth of litters from sows of different breeds was: 2.44 lbs., 3.05 lbs., 2.6 lbs., 2.25 lbs., 2.43 lbs., 2.7 lbs., 2.77 lbs., 2.75 lbs., 3.07 lbs., each; general average 2.65 lbs.

The weights of six litters at seven days old were: 4.25 lbs., 5.3 lbs., 4.6 lbs., 5 lbs., 5.6 lbs., 4.05 lbs., each; general average 4.8 lbs.

The weights of nine litters at 28 days were: 13 lbs., 13 lbs., 11 lbs., 13.8 lbs., 8 lbs., 11 lbs., 13 lbs., 13.8 lbs., 12 lbs. each; general average 12.1 lbs.

The average weights of nine litters at 56 days were: 32 lbs., 21.7 lbs., 23.3 lbs., 23.75 lbs., 22 lbs., 24 lbs., 23.8 lbs., 25.2 lbs., 18.4 lbs., each; general average 23.8. lbs.

In nearly all cases the typical "runt" was found in each litter.

A case of unusually rapid gain in hog feeding was that of a mature high grade Duroc-Jersey sow, thin in flesh from suckling pigs. For the six weeks from Jan. 16 to Feb. 27, 1899 she made gain of 135 lbs., a little over three pounds per day, being fed 708 lbs. Kafir meal, or 16.85 lbs., per day, using 5.24 lbs., meal for each pound gain. Not all of this was eaten as more than usual waste occurred. In next four weeks she made gain of 60 lbs., as did smaller sow put in pen with her, or 2.14 lbs., each per day, using 5.73 lbs. meal for each pound gain.

GAIN OF PIGS FOLLOWING CATTLE.

The gain made by hogs getting the waste food from cattle is much less when the cattle are fed meal instead of ear or shelled corn or unground Kafir. Five pigs having access to droppings of a lot of steers full fed on corn and Kafir meal gained only 195 lbs., in 56 days or 39 lbs. each. In another case five pigs gained 100 lbs., in 56 days. In a third case six moderate sized sows gained 245 lbs., in 56 days, a little less than three-fourths of a pound each per day. While these gains are small they are worth saving. The difference between profit and loss in feeding cattle often depends on the use made of the food wasted or undigested by them.

COMPARISONS OF CORN AND KAFIR.

Six pigs averaging about 135 lbs., weight at beginning of trials ate 2,482 lbs. Kafir heads in six weeks, making 280 lbs. gain or 1.11 lbs. each per day. This is one pound gain for about 6.65 lbs grain.

Three pigs averaging 220 lbs., ate 728 lbs. corn and Kafir meal in 24 days, making gain of 130 lbs., or 1.8 lbs. per day each, using 5.6 lbs., meal for one pound of gain.

Two young sows, averaging 125 lbs., ate 640 lbs., ears corn in 35 days, making gain of 107 lbs., or 1.53 lbs., per day each. Counting the ear corn equal to 529 lbs., shelled corn they used 4.94 lbs., corn for each pound gain. In the next two weeks they ate 258 lbs., Kafir meal, gaining 28 lbs. or one pound per day each, using 9.21 lbs., meal for each pound of gain. This is the least satisfactory gain made in any trial where Kafir was fed.

Four pigs averaging 105 lbs., ate 987 lbs., Kafir meal in 35 days, gaining 170 lbs., or 1.21 lbs., per day, using 5.08 lbs., meal for each pound gain. In next two weeks they ate 212 lbs., shelled corn, soaked,

gained only 30 lbs., using 7.07 lbs., corn for each pound. For next four weeks to June 26, 1899, they were fed soaked shelled corn with a daily supply of green alfalfa. Noticeable increase in gain resulted. They ate 511 lbs., corn, making gain of 140 lbs., using 3.65 lbs., corn for each pound gain. This is a striking illustration of value of alfalfa in connection with grain feeding in summer.

Four pigs averaging 170 lbs., ate 685 lbs., corn meal and 300 lbs. ground wheat of poor quality in 30 days, gaining 181 lbs., or 1.5 lbs., per day each, using 5.44 lbs., meal for each pound gain.

FATTENING PIGS ON FORAGE CROPS.

August 23, 1898, nine pigs belonging to the same litter except one, were put in a pen and fed ear corn preparatory to feeding forage crops. The pigs were farrowed February 28, 1898, weaned at about two months old, put on pasture for the summer and fed some corn meal to keep them growing. They were divided into three lots each, containing three pigs. They were fed the same kind of grain, ear corn until October 17, corn meal from October 17 to 24 and Kafir meal from October 24 until December 5.

Until October 10 the pigs were in permanent pens and the forage was cut green and carried to them. From this date the pigs were in movable pens where they could harvest the crops themselves.

PIGS FED ON GRAIN AND FORAGE CROPS.

	WEIGHT OF LOT		GAIN OF LOT		FEED	
	First	Last		Daily	Forage	Grain Per Lb. Gain
PERIOD I—Six Weeks						
Lot 1	195	327	132	3.14	Sugar Beets 1-22 a	3.47
Lot 2	200	340	140	3.33	Cowpeas 1-20 a	4.55
Lot 3	195	259	64	1.52	Sorghum 1-26 a	8.94
PERIOD II—Five W'ks						
Lot 1	327	420	93	2.66	S. Potatoes 1-18 a	4.75
Lot 2	340	447	107	3.03	Peanuts 1 15 a	4.29
Lot 3	259	327	68	1.66	Cowpeas 1-9 a	6.75
PERIOD III—3 Weeks						
Lot 1	420	475	55	2.62	S. Potatoes 1-30 a	6.07
Lot 2	447	503	56	2.66	Peanuts 1-25 a	5.96
Lot 3	327	393	66	3.14	Peanuts 1-18 a	5.05

The gain per day was small in all cases. Striking differences in apparent value of the different forage crops are shown.

FARM TEAM WORK, FOOD, DRINK, COST.

A pair of mules are kept on the Station farm doing all kinds of farm work. They are eight or nine years old and have weighed from 1980 pounds during the busiest part of the season to 2240 pounds in the winter. They are kept on dry feed throughout the year.

During the year 1898 the team worked 2148.5 hours, an average of a trifle more than 7 hours a day for each work day. They were fed 41 bushels of Kafir corn, 73 bushels of Indian corn, 43 1-2 bushels of oats and 455 pounds of bran. Kafir or Indian corn stover was fed about six months of the year and alfalfa and prairie hay the remainder of the year.

The Kafir was fed ground and the Indian corn in the ear. Counting Kafir 20 cents per bushel ground, Indian corn 20 cents per bushel in the ear, oats 25 cents per bushel and bran 60 cents per hundred, the cost of the grain fed to the team was $36.40.

During December the amount of Kafir stover fed was about 1400 pounds. Estimating that there were four tons of stover worth $2 per ton and four and one-half tons of hay worth $4 per ton fed during the year, the cost of roughage would be $26; making a total cost of feed for the year of about $62. This is 17 cents per day and about three cents as cost per hour for food.

The food and water used by this pair of mules and a pair of horses used on the Station farm was noted for two weeks during the spring of 1899. Each pair averaged about 2130 lbs. weight. They were at moderate work except on Sundays and one or two rainy days. The horses had an average of 30.6 lbs. ear corn, and 31.6 lbs. of Kafir stover, and drank 107 lbs. of water per day. The mules had 23.4 lbs. ear corn. 40.5 lbs. stover and drank 107 lbs. water per day. The mules did about one-third more work than the horses, ate less corn, more stover and drank more water. Not all the stover was eaten by either pair. There were marked variations in the quantity of water drank. One mule averaged nine pounds daily more than the other; one horse five pounds. Temperature much affected the quantity drank. Each of the horses and one mule drank 100 lbs. or more of water in one day. When idle the quantity fell as low as 18 to 20 lbs. per day in three cases.

In a time of hot weather in August, 1898, the water fed to the pair of mules was weighed for eight days. They were idle two of these days, reducing the average working time to less than seven hours per day. They drank an average of nearly 113 lbs. each of water daily. One day the pair drank 350 lbs.; another 307 lbs. In three of the five days they averaged less than 100 lbs. water each.

SHEEP FEEDING.

Sixteen grade Shropshire wether lambs were fed Kafir heads, with prairie grass hay and corn stover for 13 weeks in winter of 1898. They kept in good condition but made small gains—295 pounds or a trifle over one-fifth of a pound per day. They ate 1624 lbs., Kafir heads. A wether lamb made gain of 13 lbs., in four weeks, or .46 lbs., per day. A Shropshire ram lamb gained 17 lbs., in same time or .6 lbs., per day. They ate two pounds Kafir meal each day, with "crab grass" hay.

The wether lamb and three rather inferior yearling wethers which had been used in digestion experiments, made gain of 86.5 lbs., in 52 days or .41 lbs. per day each. They ate 504 lbs., Kafir grain, using 5.82 lbs., for each pound gain.

WEIGHT OF LAMBS.

The table gives weights of lambs at ages specified. They were dropped from March 16 to April 30, 1899. The weights of two pairs of twins and of two single lambs are given. They are pure bred or high grade Shropshire.

Age	No.	Lbs.	Age	No.	Lbs.	Age	No. Lbs.	Age	No. Lbs.
Birth	10	10	Birth	7	7	Birth	9	Birth	9
7	14	13	7	11	11	7	14	7	13
14	18	17	14	15	13	15	19	14	20
21	22	20	21	19	17	23	24	22	22
28	27	25	29	25	20	30	30	2[illegible]	25
35	32	29	36	31	22	37	35	36	30
42	35	32	43	33	25	44	40	43	40
49	40	38	50	33	28	51	42	50	45
56	43	41	57	37	31	58	49	57	49
63	49	43	64	42	33	65	53	64	53
70	55	48	71	45	37				
77	59	51							
84	65	54							
91	67	60							
98	70	72							

WHEAT CULTURE EXPERIMENTS—1898-9.

G. E. Morrow and J. H. Bone.

The tests were made, as in previous years, on the medium upland prairie soil of the Station farm—the same tracts being used as in 1897-8. The land on which the variety tests were conducted had been manured in the winter of 1895, and had the roots and stubble of a crop of cowpeas plowed under in September 1898. Except where otherwise stated the other experiment plats had been manured in summer of 1898 at rate of about 16 tons coarse stable manure per acre.

Varieties. Thirteen varieties, with one or two exceptions grown on the farm for the last four years were used in the variety test, having been selected from a much larger list as being most promising. The seed used was that of the crop of 1898 and was of light weight. All the plats were sown at rate of five pecks per acre, Sept. 19 or Sept. 21, except Turkey which was sown Sept 29. The land was plowed Sept. 10 after a crop of cowpeas, following wheat had been removed. The seeding was done with a press drill, rows six inches apart. The wheat came up well in six days. The first heads appeared from May 7 to 11. The wheat was cut June 12—except Turkey. The wheat was thrashed June 22.

Three plats each of Fulcaster and Red Russian were sown as check plats. There was a difference of four bushels in yields of these plats, the average yield of the three of Fulcaster was 25.8 bu., the Red Russian, 23.3 bu. These averages are taken for these two varieties.

The average yield of the 13 varieties was 22.6 bu. Only the Turkey yielded less than 20 bu. per acre. The five varieties giving largest yields were: German Emperor, Fulcaster, Sibley's New Golden, Red Russian and Early Ripe. The average weight per bushel was about 59 lbs., varying from 58 lbs. to 60 lbs. The straw varied in height from 38 to 43 inches, and as cut, from 1870 to 3333 lbs., per acre. All varieties stood up well.

The yields of the different varieties, yields of straw per acre, also the average yields for last four years for the varieties tested during this time are given in table.

Yields	Bu. Grain 1899	Lbs. Straw 1899	Bu. Grain 1898-1899
German Emperor	27.9	3,333	28.6
Sibley's New Golden	27.2	2,332	30.7
Fulcaster	25.8	2,339	27.7
Early Ripe	23.8	2,365	26.9
Red Russian	23.3	2,416	27.3
New Red Wonder	23.1	1.969	...
Nigger	22.9	2,365	29.8
Fultz	22.9	2,035	26.6
Mo. Blue Stem	21.1	2,100	30.3
Early Red Clawson	21.1	1,870	29.1
Pickaway	20.3	2,079	28.4
Big English	20.	2,101	28.8
Turkey	14.7	1,738	....
Average	22.8	2,334	28.5

The best yielding varieties for the last four years are: Sibley's New Golden, 30.7 bu.; Mo. Blue Stem, 30.3 bu.; Nigger, 29.8 bu.; Early Red Clawson, 29.1 bu.; Big English, 28.8 bu.; German Emperor, 28.6. bu. Fultz and Early Ripe are the only ones in the list with an average yield of less than 27 bu.

The variety called Turkey or Red Turkey has been highly praised but the results were not satisfactory. In addition to the plat in the variety test two other plats were sown on one of the rotation plats, sown Oct. 1. One was sown with seed obtained in the vicinity; one with seed from the U. S. Department of Agriculture. The latter gave yield of 20.5 bu., the other only 13 bu., a difference hard to be accounted for.

TIME, QUANTITY AND METHOD IN SOWING.

The series of experiments tried in former years was repeated. Thirty-two plats were sown with Red Russian wheat at intervals between Sept. 1 to Nov. 15; the quantity of seed varying from three to eight pecks per acre, some of the plats being rolled before sowing in addition to being harrowed.

The superiority of early sowing was shown in an unusual degree. In some years good crops have been obtained from sowing late in November but late sowing in fall of 1898 was invariably unsatisfactory. No marked differences were found from sowing at four dates in September, and fair yields were secured from sowing Oct. 5. With one exception no plat sown

after this date gave yield of more than 12.5 bu., and most were much below this.

The marked decrease in yield and in quality of the wheat from later sowing is shown in following summary: Twelve plats sown in September gave average yield of 28.7 bu., with average weight of 58.5 lb., per bu. Eight plats sown Oct. 5 and Oct. 15 gave average yield of 21.5 bu., with average of about 55 lb. per bu. Twelve plats sown in November gave average yield of 5.4 bu., with average of about 45 lb., per bu.

As a whole rolling somewhat increased the yield but not in any marked degree.

The largest yield was from plat sown with five pecks per acre. In no cases did the yields from sowing three or four pecks equal those from sowing five or six pecks. In the later sowings eight pecks gave largest yields, as might be anticipated as the late sown wheat does not stool so readily.

Four plats were sown with Fulcaster wheat, the seed varying as follows. One plat seed of full weight from exceptionally good crop of 1897; the others with seed from crop of 1898, one plat being sown with the largest kernels; one with second grade kernels and one with the wheat as it came from the thrasher. There was little difference in the yields; that from the seed of 1897 crop being slightly smallest. The second grade kernels gave same yield as the first grade.

TIME AND METHOD OF PLOWING—MANURE AND NO MANURE.

Six plats, wheat stubble were plowed July 29; two each at following depths: 4 in., 8 in., 8in., and subsoiled to 15 in. Three were manured with stable manure; three left unmanured. Plowing 4 in. deep gave somewhat smaller yields than deeper plowing. No gain came from subsoiling over plowing 8 in. In each case manuring greatly increased the yields. Two plats were plowed 8 in. deep Sept. 3, one manured, one not. The yields were noticeably smaller than from earlier plowing the two yielding an average of 16.8 bu., while the two plowed at same depth in July gave average yield of 23.1 bu.

The four manured plats gave average yields of 27.5 bu., the unmanured 14.5 bu.

An equally striking illustration of the value of manuring was shown in the case of yields on two half-acre plats devoted to continuous culture with wheat. Wheat has been grown on both plats for seven years. In fall of 1898 one-half acre was manured with about 15 tons per acre. All other treatment was as nearly the same as was practicable. The manured

plat gave yield at rate of 30.6 bu., the unmanured 12 bu. per acre. Manuring here increased the yield two and one-half times.

Two plats lying side by side were manured, one with stable manure, the other by turning under the stubble and roots of a moderate crop of cowpeas. The former gave 23.2 bu., the latter 16.3 bu. per acre. The yields in both cases were unexpectedly small but the gain from stable manure was marked.

Fifty-eight plats, including a number purposely sown to illustrate loss from late plowing or other undesirable practices, and excluding only the late sown plats, gave an average yield of 22.67 bu per acre. This is about ten bu. above the average yield of wheat in the United States in a series of years.

All experience at this Station emphasises the importance of increasing the supply of decaying vegetable matter in our upland prairie soils. It is believed the gain comes more from improving the physical condition of the soil and its relations to moisture than from the addition of direct plant food in the manure.

The result of this year's trials confirm the conclusions that, with reasonable management, wheat culture is profitable on Oklahoma prairie soils; that no one variety has been found greatly superior to all others; that five pecks per acre is a safe quantity to sow per acre and that sowing in September is safer than at any later time, aside from the valuable pasturage secured from early sown wheat.

DESTRUCTION OF INSECTS.

A part of the duties of the Station entomologist is to answer inquiries in regard to the name, nature and methods of destroying injurious species of insects. It is a part of his business to keep posted on the various methods that are being tried for the destruction of insects and at the same time make original investiations. The Station is ready at all times to furnish information on the latest and most practical methods of insect destruction. It is often the case, however, that from the nature of the insect, it is impossible to recommend any method whereby an insect may be destroyed and at the same time preserve the substance on which it feeds; the grain louse for example.

The Station has no mysterious means to be employed against insect ravages and it is often the case that the best thing that can be done is to turn to some common means that nearly everyone has at hand or may have at a minimum of expense and trouble. It is advisable to read catalogues of insecticides and spraying apparatus which if intelligently used often save many times their cost. It often happens that an insect appears without any previous warning and although a man might be disposed to purchase insecticides and apparatus, before he could get such things half way home his crop might be devoured and he would have to wait for another crop and another horde of insects before his apparatus would yield any returns.

The old saying that procrastination is the thief of time was never more applicable than in the destruction of injurious insects. A single instance will illustrate. A grape grower in the territory discovered the rose chafer coming from a grass field onto one corner of his vineyard. They came in numbers sufficient to have done considerable damage. He immediately had them picked off the vines by hand twice a day for several days or as long as they continued to come and thereby saved his vines with but little damage. This shows that one should exercise vigilance and watch over what he is trying to grow.

Fowls of all kinds destroy many insects. We have in the territory a thick, heavy beetle commonly called June bug or peach eater. In regions where figs are grown it is called the fig eater. It is on hand when the Alexander and other early peaches are ripening and attacks the best specimens sometimes eating everything but the stone which it leaves hanging on the tree. Poisoning it is out of the question. Hand picking would be

tedious. Putting a paper sack over each peach would be two expensive. One farmer in the territory noticed that the beetle is dull and stupid in the very early morning. He trained his flock of turkeys to follow him to the trees in the early morning where he with a pole would jar the beetles off the trees and they would pick them up. They soon even learned to do their own shaking and picking so that the farmer could take his morning nap while the good work was going merrily on.

One of the best animal friends the Oklahoma farmer has is the little horned toad. He thrives, like the insects on which he feeds, in dry weather when the crops are almost at a standstill. An investigation showed that the stomach of one specimen contained 235 chinch bugs besides several caterpillars and other insects.

There are often sent to the Station eggs closely stuck together into a mass about five-eighths of an inch long and half as high of a grayish color. These are the egg masses of the "praying mantis" or "devil's rear horse," an insect that has an ugly appearance and should be let alone as the only prayer it offers is for more insects such as plant lice to devour. The egg masses are often found on the branches and twigs of fruit trees and too often, through ignorance of their nature, destroyed.

The Station often receives specimens of brown scale-like objects arranged on a twig in one or two rows close together and so that one overlaps the next about half way. They somewhat resemble broad flax seeds. They are the eggs of the common katydid and will do but little harm. They are often suspected to be the San Jose Scale but each one is about twenty times as large as a scale of this kind.

E. E. BOGUE.

DISEASE AMONG HORSES.

In the early part of September, 1898, numerous inquiries reached the Experiment Station regarding a very fatal disease among the horses in Kingfisher, Garfield and Grant counties. Soon after the first inquiries were received, the disease assumed the form of an epidemic extending to a considerable portion of the counties named and to a less extent into Woods, Kay and Blaine counties.

The first appearance of the disease was reported from Sheridan in the eastern part of Kingfisher county. The first deaths occurred about September 1,, and for a time the disease in Kingfisher county appeared to be confined to this locality and on bottom pastures, but by September 10th animals were dying on upland pastures over a considerable area of country. There is in the section of country where the disease was most prevalent very little low land or timber, the greater portion of the country being a high, level prairie with very little low land along the streams.

Two visits were made to this part of Oklahoma in September. The first locality visited was Sheridan where the disease was first reported and it was found to be present over that portion of the county between Sheridan and Hennessey, a large number of farmers having lost stock or had sick animals at the time.

It was a very noticeable fact from the beginning of my inquiries that the disease was confined to farm animals. On making inquiries among the liverymen and other stock owners of Hennessey, Enid and Waukomis, I found they had not lost any horses from the disease, although their feed, and hay especially, was purchased from the surrounding country. This led to a close examination of the pastures where the disease was most prevalent. The principal grass of a large part of western Oklahoma is Grama grass (*Bouteloua oligostachya*) which makes a valuable pasture. In a large number of pastures examined the seed of the grass was largely replaced by smut (*Ustilago boutelouae*). It was so abundant that after a light rain the grass would be colored black with the smut. This smut was present in large quantities in all pastures examined where the Grama grass was found. It was also noticed that in pastures closely grazed there was no disease as the grass did not mature seed. As the Grama grass was replaced by other grasses in the northern part of Garfield county the disease disappeared, but from all information the disease was prevalent in the southern part of Grant county.

No other cause could be assigned for the disease except the excessive quantity of smut found on the grass as no losses occurred where the smut was not found or among horses that were not pastured. There is a small amount of smut present every season, but when it exists in such quantities as found last season, stock should not be allowed to graze on the pastures until they have been mowed and the grass tops destroyed, or until late in the season after heavy rains have washed out the smut.

Where opportunity offered, treatment was tried using large doses of potassium bromide and chloral, using atropine when indicated and applying cold packs to the head. This treatment was successful in many cases, but usually the disease assumed a very acute form giving little opportunity for treatment.

In many cases the animal would not live longer than six to twelve hours after the first symptoms, but animals were seen that had been sick from three to six days.

Partial paralysis of some parts of the body was usually noticeable; seen most frequently in the hind limbs and where the disease continued for several days this would become so complete that the animal would be unable to rise. Only one sick animal was seen that was violent and very few cases were reported. The most common course of the symptoms was a staggering gait at first; the animal if left alone would walk in a circle or would stand with head drooped or pushed against the wall of the stall or manger. When unable to stand longer, they remained lying quietly allowing the head or feet to remain in any position in which they were placed. In one violent case seen, the animal was unable to stand and spasms followed every few minutes lasting for a few seconds. This continued for about an hour when the animal died. In an adjoining stall was another sick animal lying perfectly quiet, apparently sleeping most of the time and would allow the head or feet to remain in any position. Breathing was very slow and stertorious.

Three postmortem examinations were made. The internal organs of all were fully examined but no variation from normal noticed. The only changes found were in the brain and medulla. In two cases examined, the base and coverings of the brain were congested and a small quantity of bloody serum surrounded the brain. In the third postmortem, the membranes of the brain were congested with a small amount of serum present around the brain and the medulla.

The symptoms and postmortem examinations all indicate that the disease was inflammation of the brain and its covering, or cerebro-spinal meningitis.

L. L. LEWIS.

SUMMARY OF RESULTS OF EXPERIMENTS.

John Fields.

INTRODUCTION.

The increased interest in the work of the Station is resulting in a demand for information contained in bulletins that are now out of print and has made it necessary that this information be summarized and published in some form. It has been thought better to treat the work of the Station by topics rather than by departments since much of the work on investigations is done by two or more departments working in conjunction. Accordingly, under each subject will be found the results of work done. All of the work of the Station is not reported but only such portions as have led to some result, either positive or negative, of a practical and scientific character. This plan serves to eliminate much distracting matter and will, it is believed, place the work of the Station in its proper light before the people. Full details of any of the experiments here reported will be gladly furnished by correspondence. The Station, because of limitations imposed by the law establishing it, is prevented from undertaking many lines of inquiry considered by some very desirable. Operating as it does under an act of Congress which prescribes the manner of expenditure of the funds from the national treasury and for the proper accounting of the same, the Station alone can determine what is the proper work for it to do. The work has been made as broad as possible as the following summary will show.

WHEAT.

1. *Variety tests.* Tests of varieties of wheat have been conducted continuously since the establishment of the Station and the results reported in five bulletins, Nos. 8, 12, 20, 28, and 36.

In 1893, 254 varieties were tested, the following being the highest yields secured: Silver Chaff, 24.0; Michigan Amber, 24.0; Missouri, 20.7; Currell, 20.3; Mediterranean, 19.3; Mennonite, 18.3 bushels per acre.

In 1894, 50 varieties were tested in duplicate on manured and unmanured land. The average yield of the two plats for the best varieties was the following: Nigger, 27.9; Nebraska, 26.8; Currell, 26.4; Velvet Chaff, 26.4; Silver Chaff, 23.8, Missouri, 22.4 bushels per acre.

In 1895, the wheat crop was a failure and no results were obtained.

In 1896, 71 varieties were tested. The best bearded varieties yielded as follows: Hybrid Mediterranean, 29.5; Nigger, 29.5; Mo. Blue Stem, 27.5; Sibley's New Golden, 27.3; Dietz Longberry, 27.0 bushels per acre. The best smooth varieties yielded as follows: Michigan Amber, 28.0; Early Red Clawson, 21.8; Fuller's German Emperor, 20.0; Badger, 19.7 bushels per acre.

In 1897, 64 varieties were tested, the following being the highest yields secured: Fultz, 57.0; Red Russian, 51.3, Mo. Blue Stem, 45.7; Sibley's New Golden, 51.0; Dietz Longberry, 50.0; Oregon Swamp 50.0 bushels per acre. The yields in this experiment were remarkable and are summed up as follows in Bulletin No. 28, June, 1897. "The eighty-three plats gave an average yield of 39.6 bushels per acre. Eight plats gave yields between 50 and 57; fourteen between 45 and 50; twenty-four between 40 and 45; fifteen between 35 and 40; twelve between 30 and 35; and eleven less than 30 bushels per acre. The smallest yield was at rate of 19.5 bushels."

In 1898, 54 varieties were tested. "The largest yields were: Early Red Clawson, 35.2; Big English, 34.5; Fultz, 33.4; Fulcaster, 32.2; Red Russian, 30.0 bushels per acre." (Bul. 36.) "Of these, the three last named were among the best in the yields in 1897 and are counted as desirable as any tested."

While it is true that these results are local and do not give a complete estimate of the value of the different varieties for all parts of the Territory, it is not probable that a variety that has continuously failed here would be a success in other localities. The following summary of results taken from Bulletin No. 36 contains a list of varieties which have done best at the Station, any one of which might give the highest yield in certain sections.

"For the two years 1897 and 1898, the followinw varieties have given average yields of over 40 bushels per acre—taking the yield from the best plat in each case: Fultz, 45; Red Russian, 42; Fulcaster, 41. The following have given average yields of from 35 to 40 bushels: Early Red Clawson, Big English, Missouri Blue Stem, Sibley's New Golden, Mealy, Crate and Lebanon. The following from 30 to 35 bushels: Dietz Longberry, Nigger, Bearded Monarch, German Emperor, Extra Early Oakley, Longberry, Miami Valley, Early Ripe, Saskatchewan, and Valley. With two or three exceptions, each of these varieties gave relatively good yields in 1896."

2. *Preparation of soil.* Trials in 1897 resulted in but little difference

in yield on subsoiled and un-subsoiled plats and in 1898 "no perceptible benefit came from rolling the land in addition to harrowing it before seeding."

In 1894, comparisons were made of 51 varieties grown on duplicate plats with and without manure. Twenty loads of fresh stable manure (from horses) were applied to the acre and plowed in a few days before seeding. The average yield per acre for the manured land was 32.4 for the un-manured, 14.4 bushels per acre.

3. *Quantity of seed.* In 1896, "no important difference in yields came from sowing widely differing quantities of seed per acre, especially in fairly early seeding. A plat sown at rate of three pecks per acre gave nearly as large a yield as one sown at rate of eight pecks per acre."

In 1897, "the best yields were from plats sown at the rate of six pecks per acre, but the largest yield from one plat was from sowing at rate of five pecks per acre. In some cases there was no great difference in yield, whether three or eight pecks per acre were sown."

In 1898, "plats were sown at intervals at rate of 3, 4, 5, 6 and 8 pecks per acre." The average yield increased with the thicker seeding and thick seeding is considered safest in unfavorable seasons.

4. *Time of seeding.* In 1893, seeding beginning October 10th gave better yields of grain than seeding from November 14th to 24th.

The results of trials in 1894 led to the following advice: "Sow wheat as early as possible after September 1st. Put it 'in the dust' if you have no rain."

In 1896, "In special trial of different dates of sowing, there was a steady decline in yield from sowing October 1st up to December 10th."

In 1897, the largest yield was from sowing September 15th and nearly as large from sowing September 25th. Good yields were obtained from sowing October 5th, but later sowing gave still smaller yields.

In 1898, "neither very early nor late sowing proved best; generally the best yields were from sowing September 25 to October 5th."

These experiments, taken as a whole, indicate that higher yields may be expected from wheat sown from September 15th to October 5th than from that sown either earlier or later. The character of the season and the condition of the soil will modify these limits which are not to be taken as absolute.

5. *Feeding wheat.* Bulletin No. 13, issued in December, 1894, at a time when low prices led to the feeding of wheat to farm animals, summarized what was known of the subject at that time. The matter was of but temporary interest and served a useful purpose when it was issued.

6. *Spring wheat.* Three varieties tested in the spring of 1892 yield-

ed as follows: Wellman, 8.2; Blue Stem Velvet Chaff, 7.7; Saskatchewan, 6.1 bushels per acre.

CORN.

The experience and observation of the Station extending through a period of seven years show that, in general, corn should be grown on the bottoms and Kafir on the upland. In the experiments mentioned later, seasons have occurred when corn on the bottoms yielded 50 bushels or more per acre while that on the upland was not worth the husking.

1. *Variety tests.* Tests of varieties of corn were reported in Bulletins No. 10, 21, 33, and 36. There is great confusion in the naming of varieties, the same one frequently being known by several different names in different localities. The tests show that seed should be selected from the best yielding varieties in the neighborhood where the corn is to be grown. Plants become adapted to the climate and locally grown seed will be found to give better results, in the long run, than any imported seed. Careful selection of perfect seed-corn by each farmer will improve the crop and usually be found most satisfactory.

Cornucopia, or "seven eared" corn was tried in 1898 and yielded less than 15 bushels per acre. "Brazil Flour corn" gave a yield of 21 bushels per acre which was less than half the yield obtained from a locally grown, medium early, white variety.

2. *Preparation of soil.* Deep plowing is preferable in all cases. Comparisons of land plowed four inches with that plowed eight inches deep resulted in the latter giving the higher yield. The deeper plowing permits the soil to take up the rain that falls and to hold it for the needs of the crop when dry weather comes.

3. *Drilling or listing?* In 1896, drilled and listed corn were planted side by side, one plat of each per week from March 21st to April 25th. The drilled corn, with but one exception, yielded better than the listed. The average yield of the plats drilled with the corn planter was 14 per cent greater than that of the listed plats.

4. *Time of planting.* This must of necessity vary with the character of the weather. In 1898, beginning March 28th, plats were planted each week until April 25th; also one on May 13th. The largest yield was from the first planting, the next from the third. Aside from this, there was a steady decrease in the yield with later planting, except that planting May 13th gave a larger yield than planting three weeks earlier. In former years, differences in time of planting did not give corresponding differences in yield.

In this, as in most other cases, it is not possible to lay down a fixed and unalterable rule. Individual judgment and experience must be brought to bear in deciding when to plant each season's crop.

5. *Thickness of planting.* Results of experiments are reported in Bulletins No. 21, 33 and 36. In 1897, a trial was conducted on bottom land, the corn being planted at different distances in rows 3 ft. 8 in. apart. The smallest yield of corn was 46 bushels per acre, the stalks being 6 inches apart in the row; the largest, 63.5 bushels, with two stalks each 30 inches; the next largest, 62 bushels with one stalk each 18 inches.

A duplicate of this experiment was conducted on upland, but on account of dry weather, no well-developed ears were produced and none of the corn was husked.

In 1898 on upland, the best yields were from planting at the rate of one kernel each 12 inches in rows 3 ft 8 in. apart. The yields averaged less where the rows were three feet apart.

6. *Cultivation.* Experiments in frequency and depth of cultivation have not been conclusive but indicate that a small number of shallow cultivations is sufficient in ordinary seasons. In 1898 the kind of implement used seemed to make little difference and a plat cultivated twice gave a larger yield than those cultivated even nine times.

KAFIR CORN.

The experiments summarized under this heading refer only to the production of Kafir corn, the thrashed grain.

1. *Variety tests.* Four varieties have been tried: Blackhulled white Kafir, white Kafir, red Kafir and Black Rice corn. The first might more appropriately be called "black-husked" white Kafir, as the grain is white and but little different from that of white Kafir, the husks of which are white. These two varieties have squared-ended heads carrying their width well toward the base. The heads of red Kafir are longer, looser, and more branching than those of the white variety; the grain is dull red in color. Black Rice corn is classed as one of the Kafirs and has smaller heads than the other varieties.

Trials conducted during the seasons of 1896 and 1897 showed that either of the white varieties yielded better than the red on the Station farm. Accordingly, in the experiments of 1898, only the black-hulled white variety was grown.

2. *Time of planting.* Experiments covering this point indicate that Kafir may be planted later than corn, due regard being taken of the character of the season. In 1897, planting on May 15th and 22nd gave

yields of 38.2 bushels per acre; planting on April 17th and May 1st yielded 22.3 bushels. In 1898, planting on May 13th and 24th gave higher yields than planting on April 4th, 11th, 18th, 25th or on June 3rd.

3. *Thickness of planting.* Experience has shown that Kafir should be planted closer than corn. In 1897 with stalks three inches apart in rows three feet apart, a yield of 53.3 bushels was secured. Higher yields were secured from rows three feet than from rows either 30 or 44 inches apart, the plants being the same distances apart in the rows in each case.

These results were corroborated in 1898 when four plats with rows three feet apart and one stalk to each four inches gave an average yield of 85 bushels per acre. Ten plats, with one stalk to each 8 inches and rows three feet apart yielded 45 bushels per acre. Greater distances gave decreased yields.

It is believed that for average upland soils, Kafir should be planted in rows three feet apart with one stalk to each three or four inches when the crop is grown for the grain that it will produce.

4. *Corn or Kafir which?* It depends upon where and for what purposes the grain is to be grown.

On bottom land when the crop is to be sold as soon as matured, plant corn. It is always a marketable article at some price, depending usually on the volume of the local supply. If the grain is to be fed to stock, it would seem advisable to replace a portion of the corn by Kafir, especially for the large amount of rough forage which the latter affords.

On upland, corn is not a sure crop while Kafir has not yet, even in the dryest seasons, failed to yield well. In 1897, when dry weather, high temperature, and hot winds affected the corn so that no well-developed ears were produced, Kafir planted alongside yielded from 25 to 53 bushels of grain per acre. In 1898 when corn did well, Kafir surpassed it on upland, one plat yielding at the rate of 102 bushels of Kafir corn per acre.

On bottom land, plant corn or Kafir; on upland, plant Kafir.

CASTOR BEANS.

This crop is increasing in importance and is rapidly taking its proper place as one of many crops, rather than the one crop, which should be grown.

1. *Time of planting.* In 1897, the largest yield, 12.9 bushels per acre, was from planting on April 13th, but planting as late as May 19th gave 10.4 bushels. There was a corresponding difference in time of first picking, the earlier planted plats being ready on July 21st; the later on

August 17th. In 1898, planting on April 8 gave 11.4 and on April 29 and May 13th, 11.3 bushels per acre.

2. *Thickness of planting.* Trials in 1897 indicated that one plant every 15 to 18 inches in rows 42 to 48 inches apart was thick enough. In 1898, the best yields were from planting in rows 3 feet apart with one stalk each 9 to 12 inches.

3. *Selection of seed.* The beans usually grown are all "castor beans" no varieties being distinguished. Well-formed spikes from plants carrying the largest number of good blooms should be selected while gathering the crop and kept separate for the next year's seed. Unless this is done, the character of the seed, on which so much depends, will be poor and give an irregular stand with many worthless plants. Careful selection of seed, on the other hand, will improve the stand, the yield, and the quality of the crop. In one trial covering this point, a gain of two bushels per acre was obtained by planting selected seed.

4. *Poisonous properties.* No part of the plant is available as food for animals. Many cases have been reported where horses ate of the beans and almost invariably died. The exact cause of death has not been determined but in the opinion of the Veterinarian of the Station, the beans contain some quick-acting poison. No trouble has been experienced from animals eating other parts of the plant.

OATS.

Variety tests of oats were reported in Bulletins 4, 16, and 33. In 1897, the following yields were obtained: Texas Red, 49.4; Negro Wonder 43.5; Black Russian 33.2; Lincoln, 31.8 bushels per acre. This is the same order in which these varieties yielded in 1896.

ALFALFA.

Ever since the establishment of the Experiment Station, an effort has been made to find some crop for hay. Grasses have been repeatedly tried, tenderly nursed, and so far proven unsuccessful. Clovers, white, red, and alsike, have had a great deal of attention but none have done so well as to give promise of permanently paying yields of either hay or pasturage. While a few grasses and clovers have shown some adaptability, none can yet be depended upon to yield a paying crop when sown on any considerable area. None of them, in so far as experience at the Station goes, can be sown with any degree of certainty that a ton of hay per acre will be obtained.

Alfalfa, on the other hand, has been proven to be reasonably well-

adapted and to give yields of hay up to three or more tons per acre. In 1897, an acre of alfalfa on the upland Station farm gave 6055 lbs. of well-dried hay at three cuttings. Good yields were also obtained in the season of 1898 and alfalfa on the Station farm in the spring of 1899 is in excellent condition.

1. *Character and preparation of the soil.* Alfalfa has a long tap-root and will not do well on soils with hard-pan close to the surface. As a general rule, the better the land has been cultivated and the deeper it has been plowed and subsoiled, the better will alfalfa thrive. Land that has been in corn, Kafir or cotton and yielded good crops is usually fitted for the production of alfalfa. Subsoiling, when practiced, should be done long before sowing to allow the soil to settle and become reasonably firm.

2. *Time of sowing.* The seed may be sown either in late summer, fall or spring. Good stands and failures may be expected any of these times, depending on the weather conditions after the plants come up and while they are young and delicate. Trials at the Station have resulted in successes from sowing twice in early August and on three occasions in the spring.

3. *Hay or pasture.* When a good stand of alfalfa has been secured, it is a permanent improvement to the farm if it is properly managed. The plants, once established, continue becoming stronger and live for a number of years.

Alfalfa should be cut for hay when in about full bloom and requires more care in making than does prairie hay. The leaves are easily broken off when dry and contain much of the nutritious material of the plant. The curing and stacking of alfalfa hay is an art to be learned by experience and observation; the stacks should be protected by a covering of prairie hay or straw. Three cuttings may be secured, one in May, one in June, and one at a later period depending on the rainfall and temperature.

Failures with alfalfa are reported frequently. Is it not possible that a large proportion of these failures is caused by too close pasturing? There is no question but that alfalfa is good for hogs but it is not so clear that hogs are good for alfalfa. Many fields of alfalfa are ruined by too close pasturing. The crowns of the plants are injured by animals tramping on them and cropping them too closely. The plant is weakened and dies and "alfalfa has failed." The Station has conducted no experiments on the effect of pasturing alfalfa but has noted the effect in many sections of the territory. This observation has led to the belief that alfalfa should be regarded mainly as a hay crop and only incidentally as affording pasture.

Rough places covered with native grasses should not be broken out but fenced and used for the latter.

4. *Feeding alfalfa hay.* The uses to which alfalfa hay is put where it is grown extensively, and its composition indicate its proper place in the economy of the farm. It is a rich feed containing more of the muscle-making nutrients than any of the coarse fodders or prairie hay. It should be fed in conjunction with corn and Kafir fodders and with corn and Kafir meals. With them, it makes more nearly what is called a "balanced ration" for growing and milk producing animals; a ration which is nearer to their actual needs than one composed exclusively of corn or Kafir products.

COWPEAS.

Realizing that some easily grown and nutritious forage crop was needed in Oklahoma, the Station for a time conducted co-operative experiments with cowpeas and encouraged their culture. The general results of these experiments were satisfactory, and showed that cowpeas do well in many sections of the territory. The following brief summary of methods of growing and using cowpeas is taken, for the most part, from Farmers' Bulletin No. 89 of the U. S. Department of Agriculture.

1. *Cultivation and Harvesting.* "Cowpeas are planted broadcast or in drills, very commonly between the corn rows after the crop is laid by. The amount of seed varies from four quarts to 2 bushels per acre, the average amount being, perhaps, about three pecks. The seed will stand being covered to the depth of 2 or 3 inches, but care must be taken to plant when the ground is neither to wet nor too cold, as the peas rot very rapidly under such circumstances. It must be remembered that this plant originated in the Tropics and that when transplanted to higher latitudes it makes its best growth in the hottest weather. Where the vines are grown for hay, the yield will be larger if the seed is planted in drills and cultivated a time or two."

"The vines should be mown for hay when the peas are well-formed and the leaves and pods are first beginning to turn yellow. After wilting on the ground or in windrows from twenty-four to forty-eight hours, the hay is placed in small, thin piles, or cocks, and allowed to cure for several days, when it may be carted to the barn or stacked under sheds. The hay-making process is a difficult one, requiring more care and attention than in the case of red clover, because the broad leaves and thick stems contain a large amount of water. The hay must be placed in cocks before the leaves become brittle, and the piles must be small enough to allow free cir-

culation of air to the center of each. Bright cowpea hay, clean and well-cured, is worth as much as the best red-clover hay. The hay is frequently stacked in the field and covered with straw or grass for protection."

"The bush varieties are the best for hay, because of the greater ease with which they may be mowed and handled." The yield of hay varies from two to four tons per acre depending on the fertility of the soil and method of growing. "Its feeding value is equal to that of the best red clover, and the hay ranks high in palatability and digestibility."

2. *For swine and cattle.* "When cowpeas are planted for green manure, it is an excellent practice to turn hogs into the field about the time the first peas are ripening. Young pigs thrive amazingly on the succulent foliage and well-filled pods, and the quality of pork raised on such a healthful and nutritious diet is very fine. This is a profitable method of fattening hogs or of preparing them for topping off with corn or sorghum for market. An acre of ripening cowpeas will pasture from fifteen to twenty hogs for several weeks, and the gain in fertility from the droppings of the animals during that period will more than counterbalance the fertilizing value of the forage eaten. The rapid increase in weight will thus represent so much clear profit, and the farmer is richer by half a ton or more of prime pork for every acre planted. Chickens and turkeys also eat the ripe peas and do well upon them.

Cattle and horses are sometimes pastured on them, but the safer and more economical way of feeding the green cowpea vines to such stock is to cut or pull and feed partially wilted. There will be less waste and destruction from trampling, and if each animal is given only so much as it can eat clean, the greatest economy as well as the greatest profit will result. Furthermore, cattle and sheep are liable to bloat if allowed to eat too ravenously of cowpea vines or any other rich and succulent forage, and by using it as a soiling crop the danger may be more readily controlled and the loss prevented."

3. *Harvesting the seed.* "The majority of farmers harvest only enough seed of cowpeas to plant again next season. The ripe pods are picked by hand and are stored in barrels until needed or are thrashed out by machine. The yield per acre varies according to the variety and method of cultivation. Eight to 12 bushels is a fair average of the amount that can be obtained when the peas are planted in the corn rows. Sown alone, broadcast or in drills, yields of from 20 to 35, and even in rare cases, 50 bushels are obtained. The Black, Unknown, Red Ripper, Clay and Calico varieties are all heavy seed bearers. The Black-eye, Red Crowder, and

Whip-poor-will or Speckled, are very widely cultivated and find ready sale."

STOCK MELONS.

Stock or "pie" melons grow readily and afford a large yield of stock food with but little trouble. An analysis reported in Bulletin No. 25 showed that they contain 93 per cent of water anl that one ton of melons contains about as much real food material as 525 pounds of green corn fodder, or 235 pounds of corn stover (fodder after husking.)

SUGAR BEETS.

1. *For sugar making.* Experiments, in co-operation with the U. S. Department of Agriculture, were conducted during the seasons of 1897 and 1898, and are being continued this season.

The results of two season's work are summarized as follows:

1. It has not been found that beets of sufficiently high grade for sugar manufacture can be grown on a commercial scale in Oklahoma.

2. During the season of 1897, 21 samples were analyzed representing 11 counties. They showed a mean percentage of sugar in the juice of 12.0 and a mean co-efficient of purity of 65.3. But one sample contained more than 12 per cent of sugar in the juice with co-efficient of purity of 80, which is the standard for sugar manufacture. A sample representing another county was analyzed at Washington; the percentage of sugar in the juice was 12.4 and the co-efficient of purity 72.5.

3. During the season of 1898, 19 samples were analyzed representing 10 counties. They showed a mean percentage of sugar in the juice of 9.4 and a co-efficient of purity of 67.6. As in 1897, there was but one sample of sufficient purity and richness for sugar manufacture.

4. Combining the results of 1897 and 1898, 41 samples representing 14 counties have been analyzed, showing a mean percentage of sugar in the juice of 10.8 and a mean co-efficient of purity of 66.5. Of the 41 samples examined, but two were of a quality suited to sugar manufacture.

2. *For stock feeding.* Yields of 20 tons per acre of sugar beets have been secured. They make excellent feed for cows and are much relished by them during the winter months when coarse forage is dry and not very palatable. It is not thought, however, that it would be found profitable to grow them extensively for this purpose. For a change of feed or an addition to dry forage, they are of value.

FRUIT ON THE STATION FARM.

Early in the history of the Station, an extended series of tests of varieties of fruits was planned and begun. Seven years have elapsed since

the first start was made, yet the time has not been sufficient to permit the making of the positive statements frequently demanded of the Station by fruit growers and others. It is yet too early to state with certainty what many varieties will do in this climate. Deductions based entirely on the results secured at the Station are not of as certain value as when supported by observation of the methods employed at different places in the territory and the results produced. The Station is working on this subject and hopes, after observing and studying the work of a few more years, to issue a reliable and trustworthy report on the fruit industry of Oklahoma.

In the brief notes that follow will be found a portion of the record of the work with fruit. Measurements of the circumference of the trunks of hte trees, one foot from the ground, are given as an imperfect estimate of the general vigor of growth of different varieties. The orchard has had clean cultivation with the exception of an occasional crop of cowpeas late in the season.

APPLES.

The following varieties of apples fruited in 1898: Broadwell, Cannon Pearmain, Cole's Quince, Crawford, Hockett's Sweet, Keswick Codlin, Lowell, Late Strawberry, Maiden's Blush, Moon, Mammoth Black Twig, Nansemond Beauty, Pomeroy, Talman's Sweet, Wagener, Water, Yopp's Favorite.

The following varieties of apples set fruit in 1899: American Summer Pearmain, Alexander, Arkansas Beauty, Arkansas Black, Bledsoe, Black Annette, Carolina Watson, Cullen's Keeper, Crawford, Cole's Quince, Domine, Dickinson, Early Ripe, Fenley, Fallawater, Gano, Hightop Sweet, Ingram, Indian, Jones' Seedling, Kittageskee, King, Kansas Queen, Lowell, Limber Twig, Maiden's Blush, Missouri Pippin, Moon, Nantahalee, Nero, Pyle's Red Winter, Porter, Rambo, Rhode's Orange, Stewart's Golden, St. Lawrence, Twenty Ounce, Talman's Sweet, Wagener, Water, Willow Twig, Yopp's Favorite.

The following varieties bloomed in 1899 but set no fruit: Yellow Transparent, Jeffries, Jewett's Best, Kentucky Red Streak, Shockley, Black Warrior, Chattahoochie, Chester Early White, Family Favorite, Vandevere, Early Pennock, Kinnard's Choice, Lawer, Mammoth Black Twig, McIntosh Red, McMahon, May, Nansemond Beauty, Roman Stem.

Trees set in 1892 that measure more than 12 inches in circumference of trunk: Rhode's Orange, Jewett's Best, Duchess of Oldenburg, Flory's Bellflower, Moon, Maverack, Arkansas Beauty, Arkansas Black, Autumn Bough, Chester Early White, Cullen's Keeper, Early Pennock, Trenton Early, Enormous, Fallwater, Fameuse, Vandevere, Indian, Law-

ver, McMahon, Minkler, Nickajack, Stewart's Golden, McAfee, Kentucky Red Streak, Ortley Bellflower, Rutledge.

Trees set in 1892 that measure between 10 and 12 inches in circumference of trunk. Early Colton, Early Harvest, May Pippin, White Juneating, Carolina Red June, Large Yellow Bough, Hightop Sweet, Yellow Transparent, Carolina Watson, Kansas Queen, American Summer Pearmain, Nantahalee, Early Strawberry, Keswick Codling, Benoni, Disharoon, Fenley, Duchess, Yopp's Favorite, Maiden's Blush, Hoover, Pomeroy, Porter, Twenty Ounce, St. Laurence, Kittageskee, Alexander, American, Golden Russet, Black Annette, Cole's Quince, Domine, Elkhorn, Jersey Sweet, Forest, Kinnaird's Choice, Mammoth Black, Mammoth Black Twig, Mammoth Pippin, Sweet Dixon, McIntosh Red, Mason's Orange, Nero, Plum Cider, Pyle's Red Winter, Rhode Island Greening, Shackleford, Wagener, White Pippin, Willow Twig, Utters Red, Isham Sweet, English Sweet, Lauren's Greening, White Spanish Reinette, Shockley, Cobbett, Mother, Pewaukee, Rambo, Talman's Sweet, Rebel.

Trees set in 1892 that measure between 8 and 10 inches in circumference of trunk: Red Astrachan, Early Ripe, Charlottonthaler, Cooper's Early White, Fanny, Primate, Northern Sweet, Lowell, Bledsoe, Carter's Blue, Carolina Greening, Bostic Queen, Mrs. Bryan, Ortley, Colvert, Ohio Pippin, Shannon, Tuscaloosa, Celestia, Dr. Walker, Moultrie's Babbitt, Chattahoochee, Clayton, Cornell's Fancy, Crawford, Dickinson, Family Favorite, Gideon, Huntsmans Favorite, Ingram, Jones' Seedling, King, Longfield, Loy, Mammoth Pippin, Marshall Red, May Nansemond Beauty Northwest Greening, Orchard Red, Poorhouse, Pryor's Red, Red Riches, Limber Twig, Romanite Gilpin, Roxbury, Russet, Scarlet Cranberry, Smith's Cider, Water, Stump, Roman Stem.

Trees set in 1892 that measure less than 8 inches in circumference of trunk: Simmon Red, Sops of Wine, Gravenstein, Jeffries, Red Betigheimer, Red Winter Pearmain, Buckingham, Late Strawberry, Rambo, Broadwell, Cannon Pearmain, Eureka, Gano, Osceola, Foundling, White Winter Pearmain.

Trees set in 1892 but now dead: Summer Queen, Stewart, Spencer Oldenburg, Tetofsky, Bailey's Sweet, Rawle's Janet, Mangum, Stevenson, Yates, Bethel, Etowah, Horn, Pickard's Reserve, Royal Limber Twig, Sonoma.

PEARS.

Trees set in spring of 1895, trunk measuring more than 9 inches in circumference. Forest Beauty, Kieffer.

Trees set in spring of 1895, trunk measuring between 7 and 9 inches in circumference. Beauty, Lawson, Buffum, Early Harvest, L. B. de Jersey.

Trees set in spring of 1895, trunk measuring less than 7 inches in circumference. Buffum dwarf; Clapp's Favorite, Seekel dwarf, Lawrence, Shelton, Duchess dwarf, Barlett dwarf, Clapp's Favorite dwarf, Garber.

Trees set in spring of 1895 now dead. Barlett.

The dwarf Bartlett is the only variety that set fruit in 1899.

APRICOTS.

The following varieties of apricots were set in the spring of 1892 and are now living. Golden Russian, Gibb, Alexander, J. L. Budd, Peach, Early Golden, Shemsi, New Castle, Luizet, Jackson, Olberg.

The following varieties have set fruit this year: Golden Russian, Gibb, Alexander, J. L. Budd, Peach, Early Golden, Jackson, Olberg.

The following varieties of apricots were set in the spring of 1892, but have died from various causes: Nicholas, Alexis, Roman.

Trees of the following varieties now measure more than 16 inches in circumference of trunk: Golden Russian, Gibb, Alexander, J. L. Budd.

PLUMS.

The following varieties of plums bloomed in 1899: Weaver, Newton, Wooten, Mrs. Clifford, Forest Garden, Lone Star, Emerson, Wolf's Free Stone, Pottawatomie, Botan, Satsuma, Yosebe, Ogon, Abundance, Burbank, German Prune, Manana, Silver Prune, Passardii.

The following varieties of plums set fruit in 1899: Abundance, Emerson, Manana, Mrs. Clifford, Newton, Ogon, Pottawatomie, Pissardii, Weaver, Wooten, Yosebe.

Trees set in spring of 1895, trunk measuring more than 10 inches in circumference: Lone Star, Yosebe, Burbank.

Trees set in spring of 1895, trunk measuring between 8 and 10 inches in circumference: Shiro Snomo, Manana, Hattakio, Wooten, Mrs. Clifford, Emerson, Pottawatomie.

Trees set in the spring of 1895, trunk measuring between 6 and 8 inches in circumference: Weaver, Newton, Botan, Wolf's Free Stone, Satsuma, Abundance, Pissardii, Silver Prune.

Trees set in the spring of 1895, trunk measuring less than 6 inches in circumference: Ogon, Forest Garden.

CHERRIES.

The following varieties of Cherries were set in spring of 1895: Early

Richmond, English Morello, Belle De Choisy, Dye House, Montmorency, Olivet.

All of the trees measure between 9 and 11 inches in circumference of trunk. All of the varieties fruited this year.

NUT BEARING TREES.

The following list of nut trees was set in 1895. A few trees of each variety are still living, but none have borne any fruit. They are arranged in order of hardiness: Black Walnut, Almond Languedoc, Early Bearing Walnut, Dwarf Prolific English Walnut, English Walnut, Mayette Walnut, Thin Shelled Walnut.

The following list of nut trees was set at the same time and in the same plat with the above list, but none are now living: American Chestnut, Large Spanish Chestnut, Japan Chesnut, Extra Early Paper Shell Pecan, Select Texas Pecan, Butternut, White Filbert, Hazelnut.

PEACHES.

The following varieties of peaches set fruit in 1899: Alexander, Barnes, Becquetts Free, Bishop, Bell's October, Bonanza, Becquetts Cling, Champion, China Cling, Crimson Beauty, Cobbler, Druid Hill, Early York, Elberta, Gen. Taylor, Heath Cling, Henrietta, Indian Blood Cling, June Rose, Champion Mark, Mountain Rose, Old Mixon Cling, Ringgold, Sylphide, Salaway.

GRAPES.

In the following list of grapes the varieties are named in order of their relative hardiness and productiveness. The black grapes have shown the best varieties both as to hardiness and productiveness, the white next, and the red last. The best varieties of the white grapes are nearly if not quite as good as the best black grapes.

Black. Admiral, Hermann Jaeger, Elsmere, R. W. Munson, Concord, Cottage, W. B. Munson, Norton's Virginia, Mrs. Munson, Black Pearl, Dr. Warder, Clinton, Janesville, Devereaux, Barry, Amanda, America, August Giant, Big Extra, Fern Munson, Carman, Ironclad, Israella, Isabella, Herbemont, Newman, Telegraph, Worden, Wilder, Rogers No. 2, Jacquez, Moore's Early, Highland, Cynthiana, Aminia, Cunningham, Early Wine, Elsinburgh, Hartford Prolific, Herbert, Beacon, Conqueror, Neva Munson, Neosho, Marion, Mary Ann, Montefiore, Rentz, Early Victor, Eumelan, Hermann, New Haven, Mills, Othello, Muench, Marguerite, Lenior, Louisiana, Merrimack, North Carolina, Peabody, Secretary, White-

hall, York, Maderia, Cornucopia, Creveling, Bacchus, Black Hawk, Black Herbemont, Brant, Hopkins, Laussel, Jaeger, Oriole, Bailey, Black Eagle.

White. Faith, Elvira, Lady Washington, Martha, Noah, Pearl, Autuchon, Ondereonk, Niagara, Wilding, Opal, Mason's Seedling, Moore's Diamond, Green Mountain, Gold Coin, Golden Gem, Empire State, Prentiss, Rommel, Grein's Golden, Hayes, Naomi, Humboldt, Jessica, Irving, Etta, Eva, El Dorado, Duchess, Uhland, Taylor, Pocklington, Transparent, Gov. Ross, Antoinette, Bell, Campbell, Centennial.

Red. Northern Muscadine, Dracut Amber, Perkins, Norfolk, Lutie, Wyoming Red, Catawba, Woodruff's Red, Brilliant, Amber, Amber Queen, Delaware, Goethe, Massasoit, Iona, Lindley, Ulster Prolific, Dr. Collier, Vergennes, Walter, Lindherbe, Venango, Diana, Beauty, Berckmans, Elvicand, Perry, Iowa Excelsior, Peter, Wylie, Poughkeepsie, Requa, Challenge, Brighton.

ANALYSES OF WATERS.

The character of the water supply has so much to do with the health of any community that it merits great attention. The chief factors which determine whether or not a given water is fit to drink are the quantity and character of the dissolved mineral matter which it contains and the nature and source of the organic matter. The mineral matter depends on the character of soil through which the water percolates before it is drawn for use. The amount and character of the organic matter is to a great extent, affected by local contaminating influences.

1. *Mineral matter.* More or less complete analyses have been made of the mineral matter contained in 162 samples of water. The samples secured represent nearly every county and condition of the soil. Further work has not given cause to change the following statement made in Bulletin 29, September 1897. "It may be said, in general, that good water is obtainable in almost every part of Oklahoma. There are a few localities where more or less difficulty is experienced, but care in digging the well is frequently repaid by a supply, small at times, of good water. The mistake of going deeper for water is sometimes made with the result that it is secured but that the whole supply is unfit for use. If the first water struck is good, and there is a fair amount of it, digging should be stopped, especially in localities where bad water is frequent. A second well may be dug if the supply is insufficient."

2. *Organic matter.* Epidemics of typhoid fever are frequently traceable to organic contamination of the water supply and this contamination is usually due to carelessness which no amount of analyzing the water will remedy. Attention was called to this in an early Bulletin (No.

7, July, 1893) and the following advice concerning location of wells was published. "Do not invite pollution by locating a well near a cess-pool or barnyard. I found a few wells very poorly walled and some very badly located, and in one or two instances the location could not have been worse had the question been carefully studied. Those of you who have not permanently located your buildings would do well to first find a supply of good water—I believe it can be obtained—then build near the water." "Should the water have a disagreeable smell after having been kept in open or closed vessel any considerable length of time, something is radically wrong and the source of pollution should be immediately looked up and removed without delay."

The importance of keeping the water of wells and springs free from organic contamination cannot be to strongly urged as it is from this source that much sickness comes. Insects, toads, mice, rats, and rabbits have a way of getting into wells that is at times past finding out but they can be kept out by properly curbing and covering the well. No amount of covering will prevent drainage from getting into the well which should in all cases be at least 100 feet from, and on higher ground than, any possible source of refuse from the house or barn.

3. *Waters for irrigation.* Much work has been done on this subject and two bulletins have been issued. The following summary from Bulletin No. 38 gives the conclusions which have been reached:

"1. The water of the Salt Fork of the Arkansas and of the Cimarron river is unfit to be used for irrigation except in very limited amounts.

"2. The water of the North Canadian and of the South Canadian may be safely used for irrigation.

"3. None of the smaller streams that have been examined, except the Black Bear, are unfit to be used for irrigation.

"4. Well waters vary greatly in the amount and character of the dissolved mineral matters which they contain and should be analyzed before being arranged to be used for irrigation.

"5. A partial survey of the conditions which must be met in the construction of reservoirs for the retention of storm river waters has been made and it is not clear that this method is entirely feasible in all cases."

Correspondence should always be had with the Station before sending samples for analysis as certain precautions in sampling must be observed to make the results trustworthy.

FEEDING CORN AND KAFIR.

1. *Introduction.* The general trend of results of feeding trials with

Kafir products is that it requires more Kafir than it does of Indian corn to produce a pound of live-weight. In an experiment with pigs at the Kansas Station (Bul. 53.) it was found that 5.15 lbs. red Kafir meal were required to produce a pound of gain while 4.38 lbs. corn gave the same result. In each case, the pigs were given all they would eat and while those fed Kafir meal gained 1.37 lbs. per day, those fed on corn meal gained 1.7. lbs.

Another trial at the same Station (Bul. 61) gave even more marked results in favor of corn meal, 3.96 lbs. of which gave a pound of gain against 6.21 lbs. of Kafir meal. The pigs fed corn meal made an average daily gain of 1.44 lbs. while those fed Kafir meal gained but one-half pound per day. An experiment in fattening heifers is also reported in the same bulletin. It is concluded "that red Kafir corn meal is not quite equal to corn meal for fattening cattle, though the difference in favor of corn is less marked than in the case of the hogs."

In another trial at the Kansas Station (Bul. 67) three lots of steers were fed corn meal, red Kafir meal, and white Kafir meal, respectively, making gains of 1.86 lbs., 1.71 lbs., and 1.78 lbs. per head. To produce a pound of gain in weight it required 9.97 lbs. of corn meal, 10.86 lbs., red Kafir meal, or 10.41 lbs. white Kafir meal. The profit from the five steers fed corn meal was $47.60; from the five fed red Kafir meal, $44.98; from the five fed white Kafir meal, $42.02. Hogs followed the steers during the experiment and made gains which bring the profit from the feeding of corn meal up to $54.70; red Kafir meal to $55.10; and white Kafir meal to $53.23, "which practically places Kafir corn on the same basis as corn in regard to feeding value."

In view of the increasing importance of Kafir in this and similar regions, it is necessary that a definite system of nomenclature be used when speaking and writing of the crop. The following, based principally on current usage among farmers, is used in this report:

Kafir, the crop in general.
Kafir corn, thrashed grain.
Kafir heads, portion bearing grain.
Kafir fodder, whole plant above ground.
Kafir stover, Kafir fodder minus the heads or grain.
Kafir meal, ground Kafir corn.

2. *Digestion experiments.* After a crop has been found to yield well and grow readily, it is most desirable to have a correct estimate of its value. Chemical analyses alone will not furnish a correct basis for this estimate. Feeding trials in comparison with a crop of known value are

practical experiments but are much influenced by the conditions of the experiments. These two, however, in connection with trials of the digestibility of the feeding stuff in question, aid in determining to a great extent the value which should be attached to a crop. With this purpose in view, several digestion trials have been conducted by the Station.

In a digestion trial, weighed quantities of feed are given to animals (usually steers or sheep) and the dung is collected and weighed. Both the feed and the dung are analyzed and from these data the per cent of food digested is determined.

Twenty-two separate trials were made with Kafir products fed to steers. The complete details of the experiment were reported in Bulletin No. 37. The essential results of the experiment may be summarized as follows:

Kafir stover contained as much digestible matter as average corn stover.

Kafir fodder contained 10 per cent less digestible matter than average corn fodder.

Kafir heads contained one-third as much digestible matter as average corn-and-cob-meal.

Kafir corn fed in the heads was neither more nor less digestible than when fed after thrashing.

Kafir corn fed after soaking in water for twelve hours was less digestible than when fed dry.

Kafir corn fed dry contained 40 per cent less digestible matter than coarsely ground Kafir meal.

Kafir meal, coarsely ground, contained 20 per cent less digestible matter than average corn meal.

It paid to grind Kafir corn—One hundred pounds of Kafir meal contained as much digestible matter as one hundred and sixty-seven pounds of Kafir corn.

A gain of thirteen per cent, in the amount of digestible matter was secured when Kafir fodder was thrashed, the grain ground and fed to steers along with the shredded stover from the fodder.

A gain of less than two per cent in the amount of digestible matter was secured when Kafir fodder was thrashed, and the resulting Kafir corn fed to steers along with the shredded stover from the fodder.

DIGESTION OF KAFIR CORN BY STEERS.

The following comparison of the composition of Kafir corn before and after having passed through the digestive tract of steers shows the slight extent to which the small, hard grains are affected during the process.

Composition of Kafir corn.

Water-free substance.

	Ash.	Protein	Fiber	N-free ex.	Ether ex.
As fed dry	1.30	12.72	1.82	81.00	3.16
After digestion, A	0.83	11.73	1.65	82.34	3.45
B	0.81	13.60	1.76	80.78	3.05
C	0.85	12.54	1.69	82.00	2.92
D	0.74	11.04	1.74	83.95	2.53
Average, A. B. C. & D	0.81	12.23	1.71	82.26	2.99

Water-free substance.

	Ash.	Protein	Fiber	N-free ex.	Ether ex.
As fed soaked	1.37	13.11	1.88	80.13	3.51
After digestion, A	0.78	12.85	2.24	80.73	3.40
B	0.77	12.49	1.70	81.51	3.53
Average, A. & B	0.78	12.67	1.97	81.11	3.47

Calculated to organic matter, we have the following composition for Kafir corn fed dry, before and after digestion:

	As fed.	After digestion,	Difference.
Protein	12.88	12.33	—.55
Fiber	1.84	1.72	—.12
Nitrogen-free extract	82.08	82.94	.86
Ether extract	3.20	3.01	—.19

In the same manner, the organic matter of Kafir corn after soaking for 12 hours has the following composition, before and after digestion:

	As fed.	After digestion	Difference.
Protein	13.32	12.77	—.55
Fiber	1.91	1.98	.07
Nitrogen-free extract	81.21	81.76	.55
Ether extract	3.56	3.49	—.07

Reprints From the Ninth Annual Report.

1899-1900.

MEANS OF PREVENTING TEXAS FEVER*

L. L. Lewis.

The subject assigned has a double interest to stockmen in Oklahoma because we are situated on the dividing line between the infected and non-infected territory. Large areas of the territory that are below the quarantine line are free from infection and cattle raised on such pastures are susceptible to Texas fever, and so in moving our native cattle from one locality to another a certain per cent becomes infected and may die from this cause.

To first consider the importance of preventing fever among our native cattle, it is of primary importance to recognize the cause of the disease. It is not my purpose to discuss this side of the question but in connection with my subject I will state that so far as any experimental evidence is concerned, the tick is the only means in nature of conveying the disease from one animal to another and in the absence of the tick there is no Texas fever. By pasturing on ground that is free from infection there is no danger of cattle dying from Texas fever. This means is not always possible in infected territory and requires more care and attention than most men will give it in order to make it successful, but if this method is carefully followed out there can be no danger of loss, but the slightest negligence in the way of introducing an infected animal into such a pasture would soon infect the pasture and probably most of the cattle in the pasture. This method of placing cattle (susceptible animals) on pastures free from infection and keeping the animals from coming in contact with infection is the only means of absolutely preventing Texas fever. Such a method of handling cattle will not produce immunity and is of little value as far as the general distribution of cattle among stockmen is concerned.

The Missouri Experiment Station conducted some experiments to determine the protective value of blood serum from southern cattle when inoculated into susceptible cattle, but so far as practical results are concerned in giving protection to susceptible cattle, the results were negative.

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It appears that experimentally the only way to produce immunity is to produce a mild form of the disease either by infesting the animal with ticks or by inoculation with a small quantity of the blood from an immune animal which will contain the miscro-parasite causing the disease. The method of producing immunity by tick infestion is not as reliable in its general results as could be desired and will hardly be practiced to any extent as more accurate and trustworthy results can be obtained by using the blood from a southern animal.

If tick infection is used at all it should be practiced in the late fall as the disease will assume a much milder form at this season than at any other time of the year, and if the infection is mild the disease may be controlled to a certain limit.

The recent publication of a bulletin from the Texas and Missouri Experiment Stations has added new interest to the method of producing immunity by blood inoculation as the record of a number of tests made in a commercial way is given. The fact that the inoculation of immune blood into susceptible animals promises to be a valuable remedy to prevent a fatal form of Texas fever in animals shipped south should not cause anyone to regard the method as being safe under all conditions or one that can be successfully carried out by every one who undertakes the work. There are certain essential things to observe in connection with blood inoculation and to neglect any of them is to cause a possible failure in the entire work. From work already reported it is certain that cattle from seven to twelve months old are to be preferred. This age or even as young as six months is preferable to bring south regardless of the method to be used in rendering them immune. Whether they are to be turned on infected pastures late in the season and receive no further attention or if they are to be infected artificially with ticks or to be inoculated with blood, the young cattle are to be preferred to mature stock.

The method of securing the blood and injecting it into the cattle are details easily understood by those familiar with similar work. The effect of the inoculation in a majority of cases is to cause a mild form of the fever but in some the fever may prove fatal. The effect of the inoculation to render the animal immune to fever cannot be compared to the effect of vaccinating to prevent black-leg in cattle.

In the latter case no noticeable symptoms follow the operation while in the former every symptom of the fever is seen and the calves will often require every attention and frequently medical treatment in order to resist the disease. After the cattle are inoculated with blood they should be

well cared for for a year and if possible exposed to a light tick infestion the first summer.

Inoculation may be performed at any time of the year but in our climate the best results will probably be obtained by inoculating during the winter or spring and giving the cattle some extra attention the first summer. They may be inoculated either before or after being shipped south but the latter method I think will be preferable, allowing the calves to become accustomed to their feed and surroundings before they are inoculated.

Further work along this line will probably change to some extent the details of the work but the method in the present stage offers every inducement to the southern breeder to ship to the southern stock farm and ranch the best breeds of cattle found in the north.

HOG CHOLERA.

L. L. Lewis.

Swine diseases do not assume the same importance in Oklahoma as they do in some of the northern and central states where hog raising is developed to a much greater extent but these diseases are of as great importance to the individual stock raiser in Oklahoma as in any other locality. As Oklahoma develops in agricultural resources it is probable that hog raising will be one of the best developed industries with the general farmer.

It is not the intention of this article to discuss at length any of the new remedies or cures for hog cholera but to describe briefly the cause and nature of the disease, how to recognize it and how to use such means of prevention as are in the reach of every farmer.

Whenever a fatal outbreak of disease occurs among swine it is reasonably safe to assume that it is either hog cholera or swine plague, or both as the two diseases are frequently found to exist in the same animal, and so far as any ordinary means of controlling the disease is concerned any method suitable for controlling hog cholera will answer equally well for swine plague. The diseases not only resemble each other in symptoms during the early stages but they are both caused by bacteria and the disease can only be checked by such means as will prevent exposure to the germs causing the disease, or that will destroy the bacteria after the hogs are infected. Hog cholera is generally more prevalent than swine plague and in mixed infections the symptoms of hog cholera are more pronounced than those of swine plague.

The first symptoms of the disease are generally not sufficiently pronounced to enable any one to say whether the disease is cholera or not and in the first appearance of the disease in a herd it frequently assumes an acute form, the animal living from a few hours to one or two days. In such cases a post mortem examination may not enable any one to make a correct diagnosis. In most cases the disease is slower and the symptoms become well marked. The most noticeable symptoms are loss of appetite, a feverish condition accompanied by fits of shivering and an unwillingness to move. The bowels may be normal at first but after one or two days there is a persistent diarrhoea which generally continues throughout the course of the disease. The eyes soon become weak, congested and watery, and later the lids are partly gummed together with a thick yellowish exudate. Coughing is frequently noticed and may become very severe.

Almost a constant symptom where the disease continues for several days is the reddening of the skin in spots on the lower portion of the body, inside of the thighs and under the neck. If the disease is swine plague instead of hog cholera the symptoms of lung disease will be more marked, as difficult breathing and a severe cough.

The duration of the disease may be from a few hours to two or even three weeks. Cholera is very fatal to young pigs and will often attack them when older hogs escape.

The principal organs to be examined in making postmortem examinations are the intestines and the lungs. If the animal has been sick one or two weeks the lesions are apt to be well marked. The intestinal ulcers of hog cholera will be seen in most chronic cases by carefully opening the small intestine where it joins the large intestine. The ulcers are located around the valve between the large and small intestine. These ulcers vary in size, are circular in shape and vary in color from a deep yellow to brown or black. They can be felt on the outside of the intestine as hard solid growths in the intestinal wall. The lymphatic glands in the region of the ulcers are frequently enlarged and firm. In the acute form of hog cholera the membrane lineing the intestines is congested and this is frequently all that can be seen on post mortem.

If the disease is swine plague the principal lesions will be found in the lungs. By cutting into the lungs they will be found to contain a large number of small yellow masses which is dead tissue. Sometimes large masses of yellowish cheesy material will be found. In some place the lungs will be found collapsed with general congestion of the lung tissue.

The bacteria which cause hog cholera grow in the blood vessels and collect in small clumps in the capillaries, plugging them causing the blood to escape into the surrounding tissue. This is the cause of the red condition of the skin and the congestion of the intestines. Small red spots are often seen in the heart muscle, pleura and pericardium from the same cause.

The cause of the disease is a germ or bacteria, the bacillus of hog cholera which causes hog cholera and the bacillus of swine plague which causes swine plague. These diseases do not occur without the presence of these germs and any neglect or bad care the animals may receive does not cause the disease but only lessens the vitality of the animal so they are more susceptible to the disease.

The germ may enter the body by the lungs or by the alimentary canal. The germ of hog cholera most frequently enters the alimentary canal

with the water and food while the germ of swine plague causes disease by entering the body through the lungs.

The germs of both diseases can be cultivated in the laboratory and the disease produced in hogs (1) by feeding them the germs (2) by causing them to inhale the germ, or (3) by injecting the germ into the circulation. Animals in infected pens contract the disease by inhaling or eating the germs.

The swine plague germ is easily killed, its vitality lasting under ordinary conditions from one to three months but they may under very favorable conditions remain virulent for a greater length of time. The hog cholera germs are very resistent to destructive agents and retain their vitality for several months unless killed by extreme cold weather. Infected pens should not be used for hogs for a year unless they have been very thoroughly cleaned and disinfected and this is something very difficult to do and practically is never done.

The fact that the cause of the disease is a germ which will live for a considerable length of time makes it possible for the infection to be carried from one farm to another by any animal going from infected pens to healthy pens, by birds, by water running through several farms on some of which the disease exists, or by people passing from one pen to another.

As a means of prevention, hogs purchased from unknown parties or even from adjoining farms should not be placed in the lots with hogs belonging to the farm until they have been kept in separate pens for three or four weeks. Carelessness in this matter is frequently the cause of the loss of almost the entire herd from cholera. Too much care cannot be used in allowing new purchases or hogs from adjoining farms to run in the pens of what are known to be healthy hogs. If a stream runs through the hog lots and cholera appears on farms above, the hogs should not be allowed to drink the water, but fenced away from it and supplied from a well. By exercising such care a considerable loss may be prevented.

Very little can be said in regard to the matter of treatment of sick animals. No treatment has been found that is considered a cure and almost every remedy that has been offered has been tried by hog raisers.

In some outbreaks of cholera the disease is in a mild form and most of the sick animals recover. If in such a case some remedy has been used it is advertised as a cure while the next outbreak may be a fatal form of the disease and the remedy is found useless.

Hogs should be allowed an abundance of green feed during the summer season. This can be secured by growing sorghum or by sowing wheat or other grains for grazing purposes.

DIVERSIFIED FARMING IN OKLAHOMA.

John Fields.

INTRODUCTION.

Ten years of experience in a new and untried section of country, such as was Oklahoma so short a time ago, has developed and indicated to a great extent its possibilities. The peculiarities of soil and climate are, in a measure, known and understood by those who till the soil, sow the seed, and reap the harvest.

Perhaps the greatest single feature that is most fully recognized is the unusual number and variety of products that may be grown and matured. The farmers who came to the new country were from every state in the union and brought with them knowledge of the crops and methods to which they were accustomed. Farmers from the states north, south and east settled in the same township and the result has been a system of agriculture which is unique in many ways. The nature of the population has been such as to preclude the hazardous system of growing only one or two crops. Exactly the opposite, a wide diversification, has contributed largely to the prosperity enjoyed during the past decade by the farmers of the territory.

In the following pages, the chief features of the present system are recorded and further possibilities are indicated. Certain lines of agricultural industry may be handled best by specialists but for the greatest number, a judicious diversification is desirable.

CLIMATE.

The climate of Oklahoma is an approximate mean between that of Kansas on the north and northern Texas on the south. In winter, the temperature seldom reaches zero, and in summer, a maximum of 105 is not unusual. The continuous breeze in summer renders the heat less oppressive than in the states north and east. Violent storms are no more frequent than in other sections of the country. The number of cloudy days is small, the records showing nearly 75 per cent of the total possible amount of sunshine during the year.

The rainfall decreases gradually from east to west, but is sufficient in amount for the maturing of crops, varying with the nature of the soil

and location. Much of the high land is used to best advantage when the native grasses are pastured or cut for hay. This is true of all parts of the territory. It is equally true that almost any crop may be grown on bottom land in even the dryest sections. And between the moist bottoms and the dry uplands are large areas which yield profitable returns to the farmer when intelligently handled.

CROPS.

The location and character of the soil should be carefully considered when planning for the crops to be grown. There is probably no single farm in Oklahoma on which all of the crops mentioned in what follows can be grown with profit, yet on every farm, many of them will give profitable yields. Experience and judgment after trials on a small scale must determine what shall be grown. Constant changing and shifting is worse, if any thing is worse, than growing but a single crop. Seeking after novelties and marvelous things usually results in loss. A series of crops that keeps the farm force at work during the whole year is good business and it pays. When this condition is reached and each crop yields a profit, the ideal possibility of farming in Oklahoma has been attained. Farming then is not a combination of spurting and loafing, but is a steady business.

WHEAT.

History is repeating itself in Oklahoma. Too many farmers are growing nothing but wheat. They did the same thing elsewhere and left when the soil ceased to produce wheat. There is no magic here which will make the result different from what it was there. Continuous wheat growing may not exhaust the fertility of the soils, but it will make them cold and clammy and hard and useless.

There are, however, many mitigating circumstances and Oklahoma wheat growers have had excellent reasons for growing nothing but wheat up to the present time. Money was needed and wheat growing has brought the money. The change from the sod house to the comfortable dwelling has been rapid and tends to inspire increased confidence in the crop that has brought it about. There is perhaps nothing else that would have done it so quickly. The trying period is now happily past—wheat growers have plunged and won. It is now time that they should make their winnings secure.

To do this they need not abandon wheat entirely nor suddenly. A gradual change to a more diversified system should be brought about. In part, this is already being accomplished by the wheat itself. The ex-

cellent winter pasture which wheat affords is being partially utilized and the number of cattle is increasing. With these cattle must come other crops for their support and fattening.

Little need be said of methods. Early plowing and early seeding are advised by nearly all and practiced by those who can. The one great mistake that is nearly always made is the waste of manure and straw which so greatly increases the yields when worked into the soil. The city manure pile on the outskirts of one of the principal cities in one of our great wheat counties is a smouldering and, in some respects an impressive pile typical of improvidence and waste.

Many farmers could grow more wheat to advantage and many could grow less. A decrease in the total acreage need not result in a decrease in the total crop and ultimately, will prove of lasting benefit and advantage. It cannot be too strongly urged that strawburning should cease and that the straw and manure should be returned to the land. If this is done, the period of continuous, profitable wheat culture may be greatly extended. If it is not done, experience the world over teaches that the end will soon be reached, no matter what the original fertility of the soil may be.

CORN.

This great crop is next in importance, perhaps to wheat. In common with wheat, it is a staple crop for which there is always a market at some price. From the nature of the crop, there is little danger to be feared from exclusive corn culture. The corn-grower is usually something of a stockman and feeds a portion, at least, of the product on the soil where it is grown. The character of the crop is such that its profitable culture is safe only on low lying soil. On upland, corn is at the mercy of the weather and lack of moisture at the critical period has in some years resulted in complete failure. On the contrary, corn on the bottoms has not yet failed to be profitable.

Corn matures in August and an increasing proportion of the fodder is cut and shocked each year. Corn stover makes excellent roughage for cattle and the gain by cutting is large. The long period of hot, dry and frequently windy weather following the ripening of the corn destroys nearly all of the value of the fodder if left standing.

Much of the corn that comes to market is badly mixed showing lack of care in seed selection. No other crop is so readily susceptible of quick improvement as corn. Stalks and ears of individual excellence are easily found. The corn-grower should have an ideal type of corn in mind and go through the field when the crop is mature and select the kind of ears

that he wishes to perpetuate. Tastes differ but seeds from large ears with small cobs well covered with uniform grains and from stalks bearing tow or more perfect ears is easily secured in this manner. This plan should be the regular method of selection of seed corn. The ears selected should be stored in a cool, dry place, sorted during the brief leisure of the cold weather, and the corn shelled in preparation for seeding. There is no need of paying high prices for seed from distant localities and tales of varieties that will yield, without fail, fifty or seventy-five or one hundred bushels per acre are fables in which the purchaser is left to find the moral.

COTTON.

A recent inquiry conducted by the Station showed that fifteen acres was the average grown by eighty growers of cotton. This was in Payne, Lincoln and Logan counties. In a few other districts, the average is perhaps larger.

Not every farmer will find it profitable to grow cotton as the crop is one that requires considerable hand labor. Its culture has, however, proven profitable to many and it is an important crop that if rightly used, will be permanently desirable.

Here, as with many other crops, sufficient attention is not paid to the character and purity of the seed. Selection and improvement of cotton-seed is a matter of some difficulty, and requires skill and patience. There seems to be a field here for the work of a few skilled cotton-growers who should have for their object the improvement and development of a type of cotton well-suited to this region. Several varieties of cotton differing widely in character may be developed from a single seed in the course of a few years. This tendency to variation makes the opportunity and the necessity for selection greater than with almost any other crop.

The general plan of improvement consists in the selection of well developed bolls from plants of individual excellence both as to yield and quality of fiber. The cotton so selected should be hand-ginned and a sufficient amount of seed obtained to plant an area large enough to give seed for planting the entire crop the second year. Further selection should be made from the plants grown from the first selected seed and seed thus selected taken to grow the seed for the general crop the third year. The grower who improves his cotton in this manner will find but little difficulty in disposing of the seed from his general crop to others who don't go to the trouble that he does. This steady improvement should be kept up all the time and will result in larger yields of better quality in a very short time.

Cotton should be grown in rotation and not continuously on the same piece of land. It is a crop that draws heavily upon the fertility, and in time impoverishes the soil so that neither it nor other crops will give a profitable yield. If, however, it is grown once in three or four years on a given field, and other suitable crops are grown in the meantime, the soil has time to recuperate and is in better condition for a crop of cotton.

OATS.

Some modification of our present methods seems yet necessary before the oat crop can be relied upon. Weeds and rust seem to be the greatest difficulties in the way. It is possible to overcome the former in a great measure by sowing oats after one or two clean-culture crops, such as corn and cotton, have been grown on the land. In this way, weeds and grass are partially eradicated and the crop has a chance to cover the ground before they get a start. Early sowing of an early maturing and rust-proof variety is perhaps the surest method of avoiding rust. The Texas Red variety has yielded well at the Station and is preferred by many farmers.

Oats is excellent feed for horses and the crop is desirable in a rotation leaving the ground in good condition to be followed by wheat. The amount grown at present is insufficient for local demands and but little of it is shipped to market. An increased acreage would be profitable in many sections.

CASTOR BEANS.

The growing of this crop is confined chiefly to Logan, Payne and Noble counties, but almost every county has a small acreage. The extent of the crop in the counties named is due to the fact that it has been grown there for a longer time than elsewhere and probably not because of any special climatic or soil conditions. This crop could perhaps be extended with profit to other sections of the territory. It requires considerable hand labor at picking but no special machinery for cultivation or preparing for market.

The seed should be planted during the latter half of April, the soil having had the same preparation as for corn. The rows should be from 3 to 3 1-2 feet apart with one seed each 12 to 18 inches. Clean, shallow cultivation should be given until the ground is shaded by the plants. After this, no attention is required until the first crop of spikes is ripe. This stage is indicated by the drying up of the seed pods and the tendency of the bean to "pop out." Picking should be begun before the "popping" stage is far advanced. A box is fixed on runners and is drawn between the

rows and the picker cuts off the ripe spikes and throws them into the box, taking two rows at a time.

After picking, the spikes are spread on a previously prepared piece of hard soil from which the weeds and grass have been scraped. The piles of spikes are forked over and placed in a thin layer so that they may dry rapidly. The beans "pop out" and may be cleaned by running through a fanning mill. Care should be taken that the beans do not become wet and in case of rain, they should be covered.

Three pickings are usually necessary, and some of the crop is unavoidably lost on the ground during the ripening stage. The seed-pods, or hulls as they are usually called, are equal in fertilizing value to wood ashes and form an excellent mulch and manure for fruit trees.

No part of the plant can be used as food for animals. Horses seem to have a special fondness for the beans and they must not be allowed to eat them. The beans contain a specific poison and horses almost invariably die from the effect of eating even a small amount of castor beans.

The profits from the crop are not large, twelve bushels per acre being an average yield, selling at seventy-five cents to a dollar per bushel. Those who grow it, however, think a small acreage of the crop each year desirable and profitable.

This crop is fully as susceptible of improvement by seed selection as any other. Selected seed on the Station farm produced two bushels per acre more than unselected seed. Large spikes from vigorous plants of individual excellence are easily selected when the castor beans are being picked and kept separate for seed for the next crop.

KAFIR CORN.

This is a comparatively new crop and one that is practically unknown to eastern farmers. It has much to recommend it to those in Oklahoma who have upland farms and is being largely used by them as a substitute for corn. It is well suited for this purpose. The absence of an outside market for the grain is an advantage rather than a hindrance as it makes stock-raising almost a necessity.

Black-hulled white Kafir is the variety usually grown in Oklahoma, though in Kansas, the red variety is preferred by some. Trials at this Station have resulted favorably for the former.

Kafir when grown for grain should be planted closer than corn. For the average upland soils, it is probably best to plant in rows three feet apart with one stalk each three to five inches. At this distance, yields of from 04 to 85 bushels per acre have been secured on the Station farm.

When grown for the forage, it should be planted much thicker. When grown in this manner, the crop may be cut by hand or by machinery and shocked until used. There are many unanswered questions concerning the best and cheapest methods of growing, harvesting, and feeding the Kafir crop. Farmers have had to feel their way in a large measure, though several of the published bulletins of this and other Stations have reported results of quite extended experiments. It is probably true that on upland soils, more pounds of pork or beef can be produced by feeding the crop from an acre of Kafir than from an acre of corn. This is the case, even though the results of practical feeding and digestion trials have placed Kafir and its products nearly twenty per cent below corn in feeding value. A better understanding of methods of growing and feeding will result in reducing this percentage of difference very materially.

HAY.

The chief hay crop of the territory is made from the native grasses. None of the true, cultivated grasses have yet shown value for hay here. There are cases in which timothy has taken hold and given a light yield, but generally speaking, it has not succeeded. Little dependence is placed upon hay for feed on farms, and much that is made is marketed in the cities.

There is one hay crop that succeeds in Oklahoma, and that is alfalfa. A large increase in the acreage of the crop is most desirable. In saying that alfalfa succeeds, it is not meant that it will do so on all soils. Very hard, dry upland and very sandy soils are not suited to alfalfa, and while it may be grown on them, yields are light and a good stand difficult to secure. The amount of such land in proportion to the total area is, however, small and there are few farms on which some land may not be well used in alfalfa growing.

COWPEAS.

This crop, and soy beans as well, is not appreciated and understood as it should be in Oklahoma. Cowpeas take the place of clover and do it well but the crop differs from clover in being an annual.

SORGHUM.

Sorghum when sown thickly and cut for hay gives a large yield of forage which is rich in fat-forming but poor in growth-making materials. It gives a larger yield per acre than almost any other crops; but for growing animals, is not so nutritious as Kafir fodder and far inferior to

cowpea or alfalfa hay. Its culture might well be confined to the poorer, upland soils, where it serves a useful purpose. Even on these soils, it is yet questionable if Kafir is not the more profitable.

The summary of digestion trials published in Bulletin No. 46 illustrates the main points of difference between sorghum and Kafir.

Sorghum may be used to good advantage to supplement pasture during July and August when the latter is frequently short. If sown reasonably early near to the pasture, it may be cut daily, allowed to partially wilt, and then hauled or thrown into the pasture, or feed lot. A succession of plantings may be made and used in this manner and will in most cases, give a fair yield of hay for the second crop.

MINOR CROPS.

Among the minor crops grown successfully in some localities are peanuts, broom corn, water melons, canteloupes, and garden vegetables. Success with the last named requires skill and close attention, but the efforts of the specialist are rewarded here as elsewhere.

PASTURE GRASSES.

The native grasses are the best yet found for pasture in Oklahoma. This statement sums up the experience and observation of all who have given the subject close attention. Up to the present time, nothing has been found that may be sown with reasonable certainty of securing a good stand. English blue grass and orchard grass come nearest to being successful. The trials with Bromus inermis, or smooth brome grass, made at the Station have not been sufficiently extended to determine its value, though it will probably be fairly successful. Most of Oklahoma is a little too far north for the successful growing of Bermuda grass, though it does well in sunny locations and is fair as a lawn grass. Kentucky blue grass requires much nursing and a good stand is exceedingly difficult to procure and maintain.

Native grass pastures may be strengthened by keeping down the weeds and harrowing or disking the thin spots and seeding to some of the grasses mentioned above. The pasture land is a valuable asset of the farm and should not be overstocked. It is better to have two pastures and use them alternately. The native grasses mature seed in succession from May to September and rotation in pasturing is necessary for reseeding. This applies with special force to western Oklahoma where much dependence is placed on native pastures.

LIVESTOCK.—CATTLE, HOGS, HORSES, MULES, SHEEP, POULTRY.

No single factor will make more for the permanent success of agriculture in Oklahoma than a steady gain in the number and quality of the livestock reared and matured here. There is but one right way and that is gradual improvement by the introduction of pure-bred stock wherever and whenever possible. Even with poor foundation stock, it is possible to build up and improve the quality of the stock in a very few years if none but pure-bred sires are used for breeding purposes. The first cross is a half-blood, the next is three quarters, and the next seven-eighths and practically as good for work, and beef, and pork, and mutton, and fried chicken as pure-bred animals. Farmers should co-operate in this matter and unite to improve their herds by the purchase and use of pure-bred sires and the absolute exclusion of scrub animals for this purpose.

Breeders of hogs are very active and the grade of hogs in the territory is excellent and improving rapidly. More interest is being manifested in the improvement of the grade of cattle, though there is yet much to be done.

Insufficient attention to horse breeding is manifest in the character of many of the horses. The mark of the broncho and Indian pony is much in evidence. The Percheron and Clydesdale and other breeds of horses for farm work and road service should be more frequently seen.

Sheep could be kept on many farms and be made to yield a good profit. The number of sheep in the territory is small and should be increased. Sheep have been kept on the Station farm for a number of years with no losses from disease, and have proven quite profitable.

The poultry industry is well represented in the matter of breeders and poultry associations, but there is a lack of interest among farmers generally in this important feature of farm products. This should not be so, for the climatic and other conditions are such that poultry may be cheaply reared and sold at a good profit. A little thought and care in selection and feeding of chickens and in their marketing is well repaid. The great trouble seems to be that poultry fanciers and farmers do not get together and work for their mutual interests. The local demand for poultry products is good and the supply insufficient at many times.

SUMMARY OF PRESS BULLETINS.

KAFIR FODDER.

There is quite a difference in opinion as to the best method of handling Kafir fodder when it is planted thickly, and is to be used for feeding and wintering stock cattle. In general it is believed that the fodder should be cut and placed in small shocks when the grains have passed from the soft stage and become firm. The fodder will yet be green, and if put in large shocks will spoil, but will be excellent feed if properly shocked. In feeding it when prepared in this way the amount given should not be more than the cattle will eat up reasonably clean, if too much is given they will eat only the heads and waste a large portion of the fodder.

COWPEAS.

The cowpea belongs to the great order of plants called legumes that have the power through the aid of microscopic organisms of using the free nitrogen of the air in their growth. The crop is thus a soil renovator and builder and leaves the land much richer after a crop of cowpeas has been grown upon it, even if the vines are removed as hay. In addition to the above valuable qualification, the grain and vines contain a large proportion of that important ingredient, protein. This is the material that makes growth and is so essential in all food stuffs for young, growing stock and dairy animals to make them do well and yield their owner profit. Hence the crop has two very valuable points in its favor. Much has been said in the past of the great adaptability of the crop for Oklahoma, but still it is grown to a limited extent only. In small areas, at least, it should have a place in the regular crops on every farm. The crop can be utilized to greatest advantage by pasturing off with cattle, sheep, or hogs. In this way almost all of the valuable fertilizing ingredients are returned at once to the land.

The difficulty of properly curing the hay bars the use of the crop for this purpose to any great extent when it can be used otherwise. It is however, advisable to put up a small stack of hay to use in special cases, and it will be found of much value. As an example, at the Oklahoma Experiment Station, shoats weighing about 115 lbs. at the beginning of the experiment were divided into two lots. The first was fed what cowpea hay

the pigs would eat in addition to a mixture of one-half Kafir and one-half corn meal. They consumed four and three-quarter pounds of grain for each pound of gain while another lot fed the same kind of grain but no cowpea hay consumed eight and one-fifth pounds of grain for each pound of gain. The lot receiving cowpea hay had a better appetite, ate more grain, and made better gains than the lot that did not receive cowpea hay.

This is only one of the many examples that might be cited to show the value of cowpea hay when fed properly. Used in ways similar to this it is found to be an exceedingly valuable material.

While a very valuable crop to plow under for green manuring, in the majority of cases it will pay best to first pasture it off with stock.

The crop may be planted at any time from after corn planting until after wheat harvest and in some cases later. It should be used more as a catch crop than it is, for instance after wheat and oats. At the Oklahoma Experiment Station, the wheat stubble is opened up with a lister and the cowpeas drilled in the furrow. They are given little or much cultivation as time affords and a fair growth of vines is obtained. The land was enriched and cultivated and not left to grow up to weeds and seed the land. With little preparation, it was ready for another crop.

Cowpeas do well either in drills or broadcast. In drills about two and one-half feet apart, two to three pecks of seed per acre will be required. Of the many varieties, the whippoorwill, or speckled, is the most suitable for general use in Oklahoma. For special cases, other varieties may give somewhat better results. It takes time to build up a soil by growing crops on it, but it may be done in this way and is certainly the most economical method. At first large yields, even of cowpeas, should not be expected on very poor soil.

WEIGHT OF KAFIR CORN.

A bushel of Kafir corn, fairly well cleaned, weighs fifty-six lbs., and this is the legal weight adopted in Kansas; but this point has not been passed upon in Oklahoma. The above is pretty generally known, but what weight of heads is necessary to make a bushel of grain, and how to ascertain the amount of grain in the heads by measurements are questions very frequently asked. The last two questions are not so easily answered and considerable judgment must be exercised in each case in determining the proper answers. Are the heads with stems from eight to twelve inches long, containing more or less leaves, or are they cut close and free of trash? Are the heads, to be measured, lying loose in a box, or have they

been tramped in or settled by a long haul? Referring to data obtained in thrashing out several hundred bushels of Kafir corn from weighed heads, and extending through several seasons, the percentage of grain in a hundred lbs. of heads varies from 65 to 80 per cent. This would mean from seventy-five to eighty lbs. of heads are required to produce a bushel of grain. The average runs about 70 per cent., or about eighty lbs. of heads to produce a bushel of grain. The maximum amount was obtained in a case where the heads were large and well developed, cut close and well cured. The minimum amount of grain was obtained where the heads were rather small with long stems, and not well cured, having some leaves among them. The past fall the Station as received some 300 bushels of Kafir corn in the heads, and the heads were weighed before and the grain after thrashing. Eighty lbs. of the heads were required to produce fifty-six pounds of grain, with very little variation.

Roughly, every two inches in a common wagon box, "120 inches by 36 inches by 41 inches deep," contained one bushel of grain. This determination was made with but one man's Kafir, consisting of seven loads. In this case it was tramped in the wagon as loaded, and then hauled several miles.

NEW PLANTS.

The enthusiasm of seedsmen frequently leads them to make statements in their catalogues that are not borne out by actual practice under all conditions. A given forage crop may produce abundantly under favorable conditions in a climate very different from that of Oklahoma. A forage crop that does well here may yield very poorly elsewhere. For this reason, farmers everywhere should be cautious before buying largly of untried seeds and plants. There is an Experiment Station in each state that is on the watch for new and good things and these Stations are in a position to know the truth about such things. The Oklahoma Experiment Station is located at Stillwater and inquires of any sort concerning farm topics are always cheerfully answered.

WEEVIL IN WHEAT.

Considerable complaint is received at the Experiment Station that the weevil is injuring stored grain, particularly wheat. This can be stopped by the use of a liquid known as carbon bisulphide. As purchased at the drug stores, the liquid costs about twenty-five cents per pound but can be purchased in quantity at about ten cents plus transportation. The liquid evaporates readily at ordinary temperatures and the vapor being heavier than air, sinks and is death to all animal life that breathes it although a

small amount taken into the lungs does no injury. The gas is also highly inflammable and therefore not even a lighted tobacco pipe or cigar should be brought into contact with it for fear that an explosion may result.

To use the gas the grain to be treated should be in reasonably tight bins. The gas will not penetrate more than about three feet in depth if used in wheat and it should therefore be introduced into the central part of the bin by fastening a wire screen over the end of a pipe of sufficient length and forcing the pipe down and pouring the liquid into the pipe when it may be withdrawn and forced into another place. If the weevil is working on or near the top, the liquid may be poured onto the grain and the bin covered with blankets or canvas for about 24 hours when the gas will have nearly or quite all disappeared. The gas does not injure the grain for growing or milling purposes.

COOKING FEED FOR STOCK.

There is danger of some farmers being misled by the extravagant claims that are put forth by manufacturers of different apparatus for cooking feed for stock. Many alluring statements are made and plausible arguments deduced to convince the possible purchaser that a great saving in feed and larger gains may be secured by cooking feed for hogs and cattle. If cooking feed is an economical practice, the farmers ought to know it, and if the reverse is equally true, they should know that.

The Oklahoma Experiment Station has not conducted any experiments in cooking feed for stock. This has not been necessary as records of experiments made elsewhere are available and the results are as true for Oklahoma as for anywhere else. These experiments have been summed up by Prof. Henry of Wisconsin in his book on "Feeds and Feeding," from which what follows is taken. Numerous experiments in feeding cooked and uncooked feed to pigs were made in Kansas, Iowa, Ottawa, Ohio, and Wisconsin. Prof. Henry summarizes these trials as follows:

"Including all the trials, then, so far as known that have been favorable to cooking feed, and omitting many, for lack of space, that are unfavorable to the operation, the average shows that 476 pounds of uncooked meal or grain were required for 100 pounds of gain with pigs, while after it was cooked 505 pounds were required. This shows a loss of six per cent of the feeding value of these substances through cooking." In Maine, "The results have in every case pointed to the superior value of uncooked meal for the production of pork."

Looking at the whole matter of cooking feed in the most favorable light, the best that can be said is that "The advantages are very slight and

not worth the trouble of either building the fire, cutting the wood or erecting the apparatus, to say nothing of all these cominbed, with danger and insurance added."

CULTIVATION.

While there are many questions in connection with the relation of soils to moisture that are not well understood, it seems quite well established that the chief thing that is necessary for the growth of good crops is to keep the soil cultivated. Primarily the object of cultivation is to keep the moisture from being lost, either by evaporation or through the growth of useless palnts. Weeds use a large amount of water that ought to go to the crop that is being grown and it is fortunate that in killing the weeds, the surface of the soil is put in good condition for retaining moisture already present in the soil and absorbing that which falls in the form of rain.

There is no new method and none will be found by which crops may be grown without work and by which moisture may be produced in some mysterious way. It is a fact, however, that there is less evaporation from the surface when the soil is loose on top than when it is hard and compact all the way down. The reason for this is that the loose soil acts as a mulch through which the moisture from below will not pass and evaporate. The practical method that is open to Oklahoma farmers is to keep the surface of the soil loose, cultivating as soon as possible after the soil has been compacted by heavy rains. This plan will keep the water in the soil for the use of the crop that is growing. The implement which will do the work most economically is the best, and must be determined by what is available for the purpose.

Crops are grown for the money that may be made out of them. A special method that costs more than the crop is worth is worse than useless, but neglect of a crop when once planted is equally unadvisable. There is a happy medium which each farmer must determine for himself, even though the method that is pursued seems to be at variance with the best practice.

POISON THE POCKET GOPHER.

The pocket gopher, which does so much damage to meadows and alfalfa fields by throwing up numerous mounds of earths, is causing trouble in some parts of Oklahoma. This pest is easily and cheaply eradicated by poisoning. Generally where there are three or four dozen mounds, one to four gophers are doing all the work. When they are not checked in any way, a whole field of alfalfa is sometimes destroyed.

Rought-on-rats or strychnine are good poisons and either sweet or Irish potatoes may be used to induce the gophers to eat the poison. The potatoes should be cut into quarters, a slit made in each into which poison is introduced by dipping a knife blade into the poison, sticking it into the slit made in the piece of potato, and then closing up. The potatoes are then taken to the field and the underground runs of the gopher found by punching a rod into the ground in a line between two freshly made mounds. When the run is found, which is indicated by the rod going down easily, make an opening into it with a spade, but a piece of the poisoned potato into each end of the run, and close the opening. The mounds should be leveled so that new ones may be easily seen.

This operation should be repeated for every group of mounds and doing it once, if the work is well done, is usually sufficient. Fall or early spring is the best time for the work.

Gophers may be trapped by making an opening into the run large enough so that a steel trap can be set in the run level with the bottom. The trap should be covered lightly with dirt and the opening closed with a board which is covered with dirt so as to exclude all light. Persistent effort using either of these methods will result in the killing of the gophers and the prevention of losses in alfalfa fields.

INSECTS AND REMEDIES.

Injurious insects seem to be present in unusual numbers this season. The Experiment Station at Stillwater will help what it can toward their control, but every one interested should make it a point to study out means of combat for themselves, often using very vigorous measures because it is frequently a week before a reply from a letter addressed to the Station can be received, and during that time the insect may do several dollars worth of damage.

CUT WORMS.

The cut worms are very abundant this season, eating all kinds of garden crops and alfalfa and even climbing trees and destroying fruit and foliage. The remedy to be applied must depend largely on the nature of the food plant. In gardens poisoned bait consisting of sweetened, poisoned bran may prove effective. For trees, they should be jarred to the ground and something tied around the stem of the tree over which the worms can not climb. On alfalfa, spraying so as to poison the food or to kill by contact by the use of kerosene emulsion may prove effective, depending upon conditions. In all cases if poultry can be coaxed to eat the worms it is the best way of getting rid of them.

CHINCH BUG INFECTION.

The Experiment Station is distributing chinch bug infection to all who request it. In several cases it has been found already established in fields either from previous distribution from the Station or naturally. Where bugs are plentiful it will pay every farmer to investigate a little and see if the infection is not already in his crop before requesting more. It will be found under loose earth or dead leaves or between the leaf sheath and the stem of the plant. It will be recognized as nearly white, moldy growth on dead bugs, sometimes nearly covering the bug. It can be easily distinguished from the silvery spots on the wings. If this is found in comparatively small quantities the bugs in the field are in the presence of infection as well as they can be.

GRAIN LOUSE.

Many inquiries are received at the Station in regard to a small green insect found in the heads of wheat. They are not found in some wheat but in other places they are very numerous nearly covering the heads of wheat. The pest is not so serious as it might at first seem. Either in the egg or mature stage the louse passes the winter and in spring begins to multiply very rapidly by certain individuals bringing forth young alive. In a week to ten days this new generation begins to reproduce so that in a comparatively short time thousands may be the descendants from a common single parent. Their attack on the wheat is so late that probably but little damage will be done anywhere. The wheat would certainly be better off without them for they suck out the juice that properly belongs to the plant and should go to mature the grain. In some fields there are none and in others it is possible, judging from the reports that have come in, that the yield may be reduced 1 to 3 per cent. There are remedies that might be used on a small scale but nothing that is practical on large fields of wheat at this season.

BROWN LOUSE.

Many plum and locust trees are infested with a brown louse. They work chiefly on the underside of the leaves and on twigs. The lice should be carefully sprayed with kerosene emulsion made as follows: Dissolve 1 1-2 pounds soap in a gallon of hot rain water and when cool add two gallons of coal oil and agitate vigorously until a creamy mass is formed; use one part of the emulsion to nine parts of water for all sucking insects. Apply in a fine, even spray so as to wet the insects thoroughly. A second application may be necessary.

THE PEACH LEAF CURL.

This disease is much more abundant this season than usual in the territory. The symptoms are a curling and yellowing of the leaves, due to the presence of a fungus on them which destroys the green color and causes the leaves to grow into abnormal shapes. The fungus may often be seen as a light mildew. A part of this fungus makes its way into the young buds which are already forming for the next year's growth. In this place the fungus passes the remainder of the year and is ready to start into growth as the leaves develop the following spring. No opportunity for experiments on this disease has occurred at this Station, but extensive work has been done by W. M. Scott in Georgia on the same disease with the result that Bordeaux mixture made as follows, has proven successful:

1. Dissolve six pounds of blue stone in six gallons of water in an earthen vessel.

2. Slack four pounds of fresh lime in six gallons of water.

Pour 2 slowly into 1 and add twenty gallons of water. Mix thoroughly and strain through coarse gunny-sacking into a barrel. Reject the undissolved material and add eighteen gallons of water and the mixture is ready for use. The mixture will keep in this condition as long as desired.

This should be applied to the trees with spray pump just before they come into bloom. One application is usually sufficient if made at the right time. In orchards that have not thus been treated the disease may be slightly checked by spraying with the same mixture, but leaves that have once been curled can never be restored to usefulness. Then the best thing to do is to keep the trees cultivated and in a vigorous condition so that they will throw out a second set of leaves with which to mature the fruit of the season.

WINES AND WINE MAKING.

A. G. Ford.

Science has given to the wine making industry the possibility of many definite results. To follow out the operation scientifically and according to the most recent methods would call for the expenditure of some money and considerable time. It would be wasting both time and money to attempt to follow out one of these systematized methods unless the wine maker was properly located and then desired to follow the industry on an extensive commercial scale. All the Oklahoma farmer desires are such suggestions in addition to the practical knowledge already possessed, as will enable him to prepare his fixtures and follow out a method, using only what material he may have at his disposal.

However careful the practical farmer or the experienced wine maker may be, they will both have in their cellars spoiled wines to be disposed of. By a study of the most recent methods and a careful observation of the facts brought to light by science, a sufficient amount may be gleaned from them to be of considerable value to the farmer.

FERMENTATION, THE YEAST.

The air, at the proper temperature and humidity, is filled with myriads of little plants called yeasts. It would require five hundred billions of these little vegetables cells to occupy the space of one cubic inch. These little plants that may be called fungi, pass into an active state and multiply when in contact with a saccharine solution. The bread yeast, which is similar to the wine yeast, requires, however, a starchy substance for its development. The beer yeast develops in the same way as the wine yeast but does not produce as much alcohol. There are also numerous kinds of wine yeast all producing varying quantities of alcohol from the same kind of grape juice, and some producing or causing to be produced very different flavors or aromas.

The yeasts that float about in the air seem to exist in a kind of dormant condition, and do not immediately attack the sugar solution on coming in contact with it. If then an active yeast be used to start the ferment, it will possess very many advantages over the one that lives in the air.

Besides the three yeasts mentioned above, there are many other kinds that live in the air; and unfortunately many of them vastly outnumber

the true wine yeast. Many of them develop and grow in the grape juice right along with the wine yeast, setting up conditions that later spoil the wine. Their growth may be very much retarded or practically prevented by keeping the temperature of the solution at a point which is most beneficial to the wine yeast and yet detrimental to its enemies.

The juice which is expressed from the grape contains, on an average about twenty per cent of grape sugar. This grape sugar constitutes the saccharine matter upon which the wine yeasts become active and greatly increase in number. In the process of this germination, the grape sugar in the grape juice is converted into alcohol. Authorities differ as to how this conversion is brought about, some saying that the yeast in its process of growth breaks up the sugar compound into several parts, one part forming into alcohol, another being wasted, while another goes as a food constitutent to the fungus. Other authorities believe that the yeast does not perform such a function, but that it is brought about through chemical changes, initiated by some substances produced by the growth of the fungus.

PERIODS OF FERMENTATION.

The fermentation that takes place in wine production is generally divided into three periods, the first occupying from three to eight days; the second lasting to the following spring, and the third from the close of the second on for any number of years until the wine is said to be "bottle ripe."

The first period is characterized by a rise in temperature, frothing, and, at the close, a partial settling and clearing up of the wine. In this period, the sugar is changed into alcohol.

The second period may be characterized by a further clearing up of the wine, the development of some aroma, and the assumption of a distinctly wine taste and odor. Some indications as to the success of the operation can generally be detected in this period.

In the third period, the characters that were taken on by the wine in the preceding periods are matured.

PRODUCTS OF FERMENTATION.

If all of the sugar in the grapes were converted into alcohol, the weight of the alcohol in the wine would be about one-half the weight of the original sugar. Besides this alcohol, there is produced a gas—oxide of carbon, acetic acid, glycerine, aldehydes, and numerous ethers that give the wine its aroma.

Other products that arise during fermentation and the development

of the wine are "lees" and argol. The former collects on the bottom of the vessel, and consists of about forty per cent organic matter, coming from the dead yeast cells. The balance consists of mineral salts. The argol collects on the sides of the vessel and is pink in color. This is crude cream of tartar, and from fifty to sixty per cent of tartaric acid may be extracted from the deposit. As the grape juice or "must" ferments, the per cent of alcohol increases; and the argol being not so soluble in this solution, as in the must, begins to separate, and collects on the sides of the vessel.

The increasing per cent of alcohol soon renders the solution unfit for the life of the yeast, and when the alcohol has increased to fifteen per cent, the yeast cells are all dead and fermentation stops. The fermentation may stop long before the per cent of alcohol reaches this figure, depending on the kind of yeast that has done the fermenting, its vigor, and the temperature of the fermenting solution.

THE PROCESS OF WINE MAKING, PREPARATION AND CONDITIONS.

Deep vessels are preferred to shallow ones, for the reason that the rapidity of fermentation can be controlled more easily. All vessels should be thoroughly cleaned, dried, and cooled before receiving the must. If a cellar be used for fermenting, it should be dry and perfectly free from any kind of mould or suspicious odors.

The grapes should be allowed to fully mature before picking. Green grapes contain very much acid, and very much acid is detrimental to the health of the yeast—they require a neutral solution to accomplish their best results. The picking should be done in very early morning in order to have the grapes as cool as possible when the crushing and fermenting begins. Only ripe and healthy grapes should be used, especially avoiding any soured fruit as this would introduce the acetic ferment, which in all probability would prove fatal to the wine.

If possible, a small vat of must should be started to fermenting a day or two before the large pickings are brought on, and when this small vat is at its highest point of fermenting, some of the yeast foam from it should be taken to start the new vats. This gives a fairly pure wine yeast, and one that is in its active state, and one that will begin work on the new vats immediately.

TEMPERATURE.

Authorities say that ninety per cent of the failures to produce good wine are due to an improper temperature during the first period of fermentation. The most favorable temperature lies between 75 and 80 de-

grees Fahrenheit; and never should the temperature vary more than ten degrees above or below this. It would be much better if the variation were but five degrees above or below.

The heat generated by the action of the ferment will raise the temperature of the solution thirty degrees, if no cooling device is employed. Starting with a temperature of 75 degrees, would ensure a temperature of 105 degrees, sometime during the process, if the vats were placed in a hot room to remain throughout the fermentation period. When the temperature passed to 95 degrees or 100 degrees, the action of the wine yeast would diminish, while that of its enemies would increase. Here, perhaps the true wine yeast would die or else refuse to go on with the process of changing sugar into alcohol, while at the same time, some other yeast would be excreting a product that was destined to destroy the wine. If the temperature should fall below 65 degrees, the wine yeast would again become dormant and refuse to do its task, while at the same time, another yeast would take up the work, but would produce a far less amount of alcohol from the same quantity of sugar. Of the two evils—high or low temperatures—the high seems to be the most formidable, yet it is the most difficult to prevent.

If a cellar is convenient, it should be used, as the temperature in summer is not so high as the interior of a house. If there be no cellar or if the temperature goes too high with the use of it, the proper temperature may be maintained by setting the fermenting vessel into a large vessel of cool water. The practice of keeping wet woolen blankets around the vessel and placing it where the wind may have free access to it is often followed. Numerous other schemes as well as machines have been invented to cool fermenting wines, but as they all entail some cost and labor, they will not be discussed here. If some device is not employed to reduce the temperature, when fermentation is carried on in hot weather, the resulting wine will generally spoil sooner or later or else will be of a poor quality.

TREATMENT OF WINES.

Both water and sugar are very often added to the musts before fermentation begins. Water should never be added if the best wine attainable is desired. If a sweet wine is desired, a little sugar may be added. If the grapes are sweet, use very little, if they be sour, more may be used. It would seem best, however, to use only sweet grapes for sweet wines, and then add to the juice a small quantity of sugar.

If the average grape contains about 20 per cent of grape sugar and if all this is converted into alcohol, the wine would contain about

10 per cent of alcohol. This is about the average per cent for a wine. When much sugar is added, the per cent of alcohol averages about 12 per cent, or perhaps a little less; and this is about as much alcohol as the wine yeast in Oklahoma will ferment.

Cane sugar, when fermented, will give 54 per cent of alcohol. Now, in order to raise the per cent of alcohol in a wine from 10 to 12 per cent—its maximum, there would have to be added one-third of a pound of cane sugar to the gallon. Should sweetness now be desired, add sugar to suit the taste, remembering that the wine is already sweetened by about one or two per cent of glycerine.

The above calculations are only approximately correct and are founded on the assumption that all the sugar would be fermented. It will serve, however, as a guide when sugar additions are practiced.

Alcohol is very often added to wines, and the process is called fortifying. Besides increasing the intoxicating power, it renders the wine a much better keeper. Examples of such wines are Port, Sherry and Maderia, containing, at times, as much as 20 per cent alcohol. This addition should be made just at the close of the first period of fermenting; adding it sooner would kill the yeast or adding it later might give the wine an alcoholic taste and odor.

Tannic acid is sometimes added. This gives the wine better keeping qualities, and, in fact, will cure some of the diseases of wine. It accomplishes its work by precipitating out of the wine some nitrogenous matter that furnishes food for the disease germs. This effect can, in a measure, be produced in red wines by allowing the fermentation to take place in the presence of the hulls. The hulls contain considerable tannin and the water and alcohol will extract it. Care should be taken to always keep the hulls below the surface of the fermenting liquid, as they will quickly sour in the air and thereby produce the acetic ferment.

"Pasteurizing" is a process of treating wines by which their keeping qualities are almost assured. It consists in heating the wine to 140 degrees Fahrenheit and then stoppering the cask so that no air can get in. This temperature kills all the germs usually contained in a wine, and by letting no new germs in, the wine is safe. This process is said not to injure the wine.

CARE OF WINE.

When the first fermenting period is over, the wine should be carefully racked off into bottles, jugs, kegs or barrels, and for a time, loosely stoppered. Care should be taken to leave all sediment of dead yeast and other matter behind. The wine should now be stored away in a cool, dry

place,—preferably a cellar. If, upon shaking up the vessels later, there should be much cloudiness, they should be racked again. Repeat this operation as often as is found necessary. The wine should, by all means, be racked off into new casks by the following spring. The casks should be watched after at all times in order that no stoppers are pushed out and the cask remain open. If any wine should spoil, it should be removed from the good wines, thus preventing the cellar from becoming inoculated with disease germs.

ANALYSES OF WINES.

The following analyses made by the writer while a senior student of the College in 1898, will give some idea of the composition of Oklahoma wines.

No.	NAME OF SAMPLE	SPECIFIC GRAVITY	ALCOHOL BY VOLUME	ALCOHOL BY WEIGHT	SOLIDS
1	Concord	.9928	8.52	6.85	1.25
2	Herman Jaeger	1.0297	10.20	8.20	11.57
3	Devereaux	1.0263	12.10	9.75	11.79
4	Mixture of Grapes	.9890	14.60	11.80	2.85
5	Mixture of Grapes	.9855	13.57	10.97	6.22
6	Concord	.9939	8.95	7.19	1.78
7	Norton's Virginia	.9975	11.60	9.28	3.27
8	Herbemont	.9949	8.87	7.01	1.71
9	Catawba	.9925	10.35	8.33	1.78
10	Concord	1.0204	13.90	11.23	10.09
11	Concord	1.0332	13.65	11.02	14.43

The first five came from the Experiment Station wine cellar. The next three came from a local wine-maker, one mile west of Stillwater. The next one—number nine—came from Oklahoma City; and the last two came from ten miles south of Stillwater.

It will be seen that these wines are quite variable in percentage of alcohol; and the solids are extremely variable—ranging from a per cent that is entirely too low to that which is absurdly high. The last two wines had considerable sugar added to them. It will be noticed in both that their specific gravities are high as well as their alcoholic and solid contents.

The grapes from which these two wines were made came from different localities, but were fermented in the same season, by the same person, and by the same process. These wines were fermented without exposure to the air.

The following analyses were made by the writer in January 1899 and in January 1900. They are wines taken from the same corresponding casks, one year having intervened between the sampling. The wines were all dark red in color.

Station Number	1899 Name of Sample	No.	Specific Gravity	Alcohol by Volume	Alcohol by Weight	Total Acids as Tartaric	Solids
1409	Norton's Seedling	1	1.0018	10.33	8.25	.58	3.29
1410	Norton's Seedling	2	.9959	15.43	12.53	.72	3.92
1411	Norton's Seedling	3	1.0078	17.30	13.92	.71	7.35
1412	Norton's Seedling	4	1.0513	14.65	11.26	.67	17.90
1413	Norton's Seedling	5	.9945	16.30	13.27	.64	3.98
1415	Norton's Seedling	7	1.0707	13.80	10.41	.54	22.70

Same wines as analyzed one year later:

Station Number	1900 Name of Sample	No.	Specific Gravity	Alcohol by Volume	Alcohol by Weight	Total Acids as Tartaric	Solids
2050	Norton's Seedling	1	.9998	9.90	7.44	.89	3.27
2051	Norton's Seedling	2	.9961	14.00	11.26	.92	3.95
2052	Norton's Seedling	3	1.0075	16.00	12.74	.89	7.41
2053	Norton's Seedling	4	1.0510	13.70	10.44	.86	18.02
2054	Norton's Seedling	5	.9948	16.10	12.98	.81	4.05
2055	Norton's Seedling	6	1.0248	16.40	12.84	.78	11.76
2056	Norton's Seedling	7	1.0710	14.20	10.62	.63	23.29

The analyses of 1899 show the wines to contain considerable alcohol and as a whole are fairly uniform in amount. The acids are a little low, while the solids are all too high.

The analyses of 1900 show a slight decrease in per cent of alcohol, except number seven, which has slightly increased. All the acids have increased, bringing the amount up to full strength. All solids have increased excepting number one which stands at about the same per cent during the entire year.

The cause for the decrease is alcohol is probably due to part of it passing into ethers and some going into acetic acid, which has raised the acid per cent. This increase in solids is perhaps due to cane sugar passing into glucose, the resulting product being heavier than the cane sugar alone; also to the development of small amounts of glycerine during this and other changes.

Sample one had no sugar added to it at any time, and as a result it is lowest in alcohol and solids. Numbers two, three and four had one, two, and three pounds per gallon respectively added to the mashed grapes. Numbers five, six and seven had one, two and three pounds respectively added to the must. Theoretically, there should be no difference —getting the sugar in before fermentation is quite sufficient.

All of these wines were racked on September 30th, October 10th, and November 30th, 1898, but since then no further treatment has been given them.

SUMMARY.

Everything about the winery should be kept perfectly clean.

Only sound, ripe grapes should be used.

The temperature during fermentation should be kept between 75 degrees and 85 degrees Fahrenheit.

The wines should be racked until no further sediment is deposited.

GRAPE GROWING.

O. M. Morris.

Grape culture is fast becoming an important industry in Oklahoma. The vines make a good growth and bear well in most parts of the territory. According to the reports received at the Experiment Station, grape vines have proven to be the most uniformly hardy and productive of any of the fruit-bearing plants. There are many varieties that are well adapted to the soil and climate and have been grown here long enough to prove their worth.

Many new and promising varieties are being introduced and successfully grown in different parts of the territory, and it is to be hoped that this work will be continued until each locality has its own list of varieties. The reports published in Bulletin No. 43 of this Station placed Moore's Early, Concord and Worden as the best three black grapes; Delaware and Catawaba as the best red grapes, and Niagara, Moore's Diamond and Goethe as the best white or pink grapes. These are named in order of ripening under each color. There are many other grapes that are doing as well as these where planted, but are not so well distributed over the territory. The Concord is the most common grape in Oklahoma and in most localities is giving fair satisfaction. In many vineyards, however, it does not ripen its fruit evenly and is beginning to fall into disfavor on that account. The Herbemont, Jaeger, Cottage and Brilliant are gaining favor and promise to become popular and profitable varieties. Other varieties of special promise are Rommel, Admirable, Early Ohio, Fern Munson and Green Mountain.

PROPAGATION.

The vines can readily be grown from seed, but as they do not come true from seed, this method of propagation is seldom employed and only when it is proposed to rear new varieties. The vines are usually grown from cuttings. These are made in the late fall or winter from the mature wood of the last season's growth. The cuttings are made from 6 to 12 inches long. Some prefer a three joint cutting, but this is too long to be handled economically in long jointed vines. The cut at the base of each cutting should be made just below the node. The cuttings should be made as soon as the wood is cut from the vine and placed in moist earth or saw-

dust, out of the reach of frost, but in a cool place, until spring. The best practice is to bury the cuttings in well drained soil, covering them with about 6 inches of loose soil. They should be kept in their winter storage until the trees and vines have started well into growth. They are then taken up and placed in the nursery row. If the cuttings contain three buds, they are placed so that the top bud will be just above the ground; if the cuttings have but two buds they are placed with the top bud at or a little below the surface of the soil. The soil is well firmed around the cutting to keep it moist and to give the roots the best opportunity to grow. The cuttings are set from 10 to 18 inches apart in the row. The rows are about 4 feet apart. The soil should be rich and in a high state of cultivation. The age of the plants dates from the time the cuttings are set. They are commonly cultivated in the nursery until they are two years old when they are ready to be transplanted to the vineyard.

Good strong plants can be started from layers of the ripe wood. To start plants in this way the strongest canes should be selected and bent to the ground in the spring and covered with soil. The vines will send up a new plant at every bud and if strong plants are desired it is best to remove all but one bud on each layer. The plants should be separated from the parent vine in the fall and transplanted either to the nursery or to the vineyard.

Some varieties do not start well from cuttings. These may be grafted on cuttings or roots of other varieties and grown with entire success. It is usually best to leave the work of grafting to the nurserymen, but the following directions are given for the benefit of those who wish to make a trial at the work.

The whip or tongue graft is most commonly used in grafting cuttings or young vines. The stock should have two buds and the cion one or two buds depending on the length of the joints. The top end of the cuttings to be used as a stock is cut with a long sloping cut. The knife is then placed just above the upper edge of the pith and pressed down to split the end of the cutting and form a tongue. This split should not extend down further than the lower edge of the cut, across the end. The lower end of the cion should be cut and split in the same way. The two pieces are then pushed together so the tongues will hold them in place. The grafts are then wrapped with twine or some similar material to hold them together. In placing the cion and stock together the edge of the wood of the two pieces must meet at least on one side. After the grafting is done the grafts are treated the same as cuttings. When set in the nursery row the point of union should be placed below the surface of the soil. The opera-

tion of grafting on rooted cuttings or small plants is performed in the same way as just described. If the plants are taken up they should be handled the same as cuttings, only using more care to prevent their drying. If the plants are not taken up to be grafted the soil should be removed below the first joint roots and the cion inserted below this point in the same way as on a cutting. However, if the stock is large, this will be impossible and it will be necessary to split the stock and insert the cion in the side, or make a sloping cut in the side of the stock and insert the cion. The soil must be well packed around the graft to prevent it drying out.

PREPARATION OF THE LAND.

Vineyard lands should be in good cultivation before the plants are set. Bad weeds can be eradicated more easily while the land is planted to annual crops than after it is set in vineyard and every precaution should be taken to see that it is free from such. Coarse trash and litter should be removed, and not plowed under, so that the soil will be in a uniformly fine condition. It is best if the land be plowed early in the fall before the vines are set. The land should be cropped for several years before being set to a vineyard, in order that a good deep bed may be ready to receive the plants.

Much of the land in Oklahoma does not contain much vegetable matter, hence it bakes and crusts badly and does not retain moisture as well as it should. This defect should be corrected as much as possible before permanent planting is done. The best treatment for such land is to add large quantities of barnyard manure and turn under green crops. This work should be well done in order to give the vines a good start. After the vineyard is started the manuring will be rather a difficult process and usually shallow cultivation will be the only stimulus and aid to the fertility of the land.

SETTING THE PLANTS.

The plants are set in the fall or spring. The arrangement of the farmer's work is usually the controlling factor in this matter. There seems to be but little difference in results whether the plants are set in the fall or spring, if they are in good condition and well set. If the plants are received in the fall they will usually have better winter quarters if set in the vineyard immediately. The plants should be set the same depth in the vineyard that they were in the nursery row but better be set deeper than shallower. The roots are placed in their natural position and the soil well firmed around them. But little if any pruning will be needed. The roots should not be exposed to the air and become dry. Neglecting to keep

the roots damp while transplanting causes nearly as much loss as all other causes combined.

The plants should be set in rows 8 or 9 feet apart in the row. The weak and medium growing varieties like Delaware and Moore's Early may be placed from 6 to 8 feet apart in the row while the stronger growing varieties like Herbemont and Lenoir should be placed from 10 to 14 feet apart in the row. The character of the soil and the method of pruning and trimming will also have some influence over the amount of space that each plant should occupy. If the plant is pruned very close each year, it will require but a small amount of space, but if a large amount of wood is left the space for each plant should be increased proportionally.

It will be of advantage to have the rows run north and south. This will place the trellis so that the trunk and base of the vine will receive the most protection from the sun. This will be of great advantage in spraying as a spray can be thrown across a strong current of air better than it can be thrown against it. The wind will not tear so many vines from the trellis if the rows run parallel to the prevailing winds, and in large vineyards the expense of keeping the vines on the trellis is of considerable importance.

CULTIVATION.

Clean cultivation should be followed from the first. A crop of early potatoes or something similar may be grown between the rows for the first year, or two, but this is not to be recommended lest the crop and not the vineyard receive the favor in cultivation. A regular system of cultivation should be determined upon when the vineyard is planted and should not be changed from year to year.

The surface soil is usually hard and compact in the spring, and it is a good practice to turn it with a small turning plow, running shallow so that it will not strike any of the large roots of the vines. This plowing gives an opportunity to turn under any trash or manure that may be upon the ground. This early stirring of the soil is beneficial in several ways. It increases the chemical activities in the soil; it increases the water holding capacity of the soil; and if carried on from the time the vineyard is set, will induce a deeper root growth. After the plowing, the land should be smoothed down with some lighter tool, as a harrow or cultivator.

The spring and summer cultivation should be shallow and frequent. No weeds or grass can grow in the vineyard without doing it harm. The vines alone should have all the moisture that the land contains. Cultivation may be stopped about the last of July or the first of August.

Little growth should be made after this and the force of the vines should be spent in maturing the growth already made and the fruit. The soil should be in good condition the entire year. The greater part of the winter-killing of buds and vines is due to the dry and baked condition of the soil. This condition can not always be avoided but a little cultivation would greatly improve it in most cases.

When one system of cultivation has been adopted it should not be changed without some good cause. The principal object of the summer cultivation is to conserve moisture and destroy the weeds. Where shallow cultivation has been practiced entirely for a few seasons and the vines are giving fair returns, the deep plowing should not be attempted, as it will result in a very severe root pruning. But when it is determined to begin deep cultivation after shallow cultivation has been practiced, the start should be made in early spring, and the vines should be pruned very close. If the vines do not receive good care with such treatment it will result in more harm than good.

PRUNING.

Pruning and training are separate and distinct operations. Pruning is the cutting away or removal of some part of the plant for the purpose of benefitting the plant or its fruit. All the different modes of pruning are intended to bring about the same results and are based on the same principles. The vines can mature only a small portion of the fruit and wood that would be formed from all of the buds of one season's growth. This fact makes pruning a necessity. The fruit is borne on a few clusters near the base of the shoots of the season; these shoots start from buds on wood of the previous year's growth. These are the facts and conditions upon which all intelligent grape pruning rests. Training refers to the arrangement of the vines on the trellis. Some systems of training are better adapted to certain modes of pruning and can not be used with certain others. While there are only two principal methods of pruning, there are as many different systems of training as there are fancies among grape growers.

In the following discussion the green leafy branches are called shoots. The ripening shoot is called a cane. An arm is a branch two or more years old and bears the canes and shoots, but does not change its form from year to year. An arm is designated as upright, horizontal, or sloping according to its position on the trellis. By some writers, an arm is called a cordon. A spur is a cane cut back from one to four buds. A renewal is a cane left for bearing wood but cut much longer than a

spur. A stem or trunk is that portion of the old vine that reaches from the ground to the trellis.

EARLY PRUNING.

The vines should be cut back to two or three buds when set and to about the same number the following winter. If the vines are strong they may form the cane the second summer, but little more than the cane should be left. If the plants are weak they should be cut back about the same as after the first year's growth, and not be permitted to form the cane until the third summer. The pruning should be so done as to prevent heavy bearing for the first three or four years.

WHEN TO PRUNE.

The pruning may be done at any time during the winter. The vine ceases to grow when the leaves fall and is dormant until growth starts in the spring. Tender varieties do best when pruned in the fall, and laid down and covered with earth or straw to protect them during the cold weather. The strongest growing and most hardy varieties suffer less from winter drouth if pruned in the fall. The roots are dormant and take up but little moisture and when the winter is excessively dry the vines suffer for water and many of the buds are killed. If the most of the vines were removed in the fall much loss from winter-killing would be avoided. The pruning should not be done while the vines are frozen, as the canes will be broken and split in removing the extra wood. The work should be finished two or three weeks before growth starts in the spring in order to avoid bleeding. The cut should be made two or three inches from the last bud that is intended to grow, so that the cane drying at the end will not injure the bud. Ten or fifteen buds will usually be enough for the vine to support for its first crop. This number can be increased from year to year until the fourth crop, when the vines should be in full bearing and should support from twenty-five to thirty buds of bearing wood.

The most convenient tool for cutting the vines is a pair of small hand shears. These may be purchased from any hardware store for 50 or 75 cents.

SUMMER PRUNING.

Most of the successful grape growers in Oklahoma are strongly opposed to summer pruning. The results of the work done in the Station vineyard seem to be very strong argument against it. It is a good practice however to clip off the ends of the most advanced shoots just

before the plants bloom. This will check the growth of the most forward shoots, and give the tardy ones a start. The strongest shoots will be at the outer end of the cane or arm; and this condition must be overcome as much as possible. Cutting off the ends of the most advanced shoots is the best remedy and gives the shoots near the trunk a greater food supply. This pruning however should not be continued till summer, but just while growth is starting in the spring. Summer pruning prevents the fruit from maturing and if carried on for a number of years, will weaken the vines and in some cases kill them. The cutting back or removal of the shoots that start from the base and side of the trunk may be of positive benefit, but more than this is scarcely advisable.

MODES OF PRUNING.

The bearing top or head of the vine for the succeeding year is formed either by spurs or renewal. The spurs do not vary much in length but the renewals vary from six or eight buds to nearly the entire vine. With the spur method a large amount of old wood is carried in the spurs and arms. The spurs add only a small amount of wood each year, but this can not be removed without changing the method of pruning or the loss of a crop. Each year adds a spur to the spur of the preceding year, thus moving the bearing wood further from the trunk. The accumulation of large quantities of old wood is injurious to the growth and health of the vine. The old spurs form excellent hiding places for insects and diseases. This system of pruning is not so popular as it was a few years ago and is now rapidly passing into disfavor. The renewal usually starts near the head of the trunk but in some vineyards it is brought from the ground each year. This latter method requires a very low trellis and very strong growing vines. The vines that come from the ground are usually less productive than those that come from an arm or trunk. The position, number, and length of the renewals will depend on the system of training adopted. The strongest unbranched canes should be used where choice is left. The canes that are branched will not bear fruit as uniformly as the unbranched canes. This mode of pruning is very simple and easy to follow and can be readily adapted to any form of trellis or system of training. The amount of old wood is reduced to a minimum. The position of the bearing wood is largely under the control of the pruner. This method of pruning is gaining favor and is practiced by most of the successful vineyardists in the south and west.

TRELLISING AND THE TRELLIS.

The vines should be placed on the trellis as soon as large enough. If permitted to spread at will over the ground they prevent clean culti-

vation and encourage the spread of disease and insects, and are in such shape that these pests can not be fought. It is seldom necessary to place them on a permanent trellis the same year they are set. If the vines make a very strong growth they may be placed on a temporary trellis to keep them out of the way of the cultivator. A very good temporary trellis can be made by placing stakes about two feet higher in the row so there will be two or three vines between each two stakes and placing the wire on the top of these stakes.

Good sound posts should be used on the permanent trellis. Cedar, catalpa, black locust, osage orange or bois d' arc and post oak make good posts for trellis. If the posts are set they should be placed not less than two feet in the ground. If they are driven they should stand six or eight inches higher than is necessary for trellis, in order that they may be driven deeper and tightened from time to time. They should be placed so there will not be more than three vines to the post and two vines to the post will be better. Two or three large vines make a heavy load on the wires and a strong wire must be used to support such a load. A number 8 or 9 smooth galvanized wire will best serve the purpose. The iron wire may be used but it will not last as long nor stand the strain as well as the other wire. It is better to run the wire through the post than to trust to staples to hold the wire.

There are two forms of trellis in general use. The most common form is an upright trellis composed of two or three wires placed one above another. The wires are placed from fifteen to twenty inches apart with the lower wire twenty or twenty-four inches from the ground. This trellis is seldom more than five feet high and usually less. It is simple and easy to build and admits of many different forms of training. It is intended that this form of trellis will hold the vines so that the fruit will be exposed to the sun and the air the same as if trained to a wall.

The canopy formed trellis is entirely different from the one just described. This trellis contains three wires all placed about the same distance from the ground. The three wires may be on a level with each other or the center one placed a little below the other two. The Munson trellis is the best example of this form. It consists of three wires so placed that the center wire is five feet and six inches from the ground, and about six inches below the other two, which are two feet apart. This trellis may be made by placing posts for each of the outside wires and attaching the center wire to a cross wire fastened to the posts. A simple form is to have the center wire fastened to the posts and the two outside

wires fastened to a cross bar on the same post. This will usually be cheaper and easier to maintain. Mr. Munson in the Farm and Ranch of October 21, 1899, states some of the advantages of the Munson trellis as follows:

"1. It accommodates the nature of the vine by furnishing a leafy well ventilated canopy over fruit, vine and root, and allows the fruit to hang in free air, so no chafing occurs against the wires, or post or vine.

"2. It puts the work of pruning, tying, spraying and harvesting in the most convenient position possible to save backache and do the work most expeditiously, with the least inconvenience, and permits passing from row to row through the vineyard, at any point by slightly stooping.

"3. It allows more readily of cultivation than any other continuous trellis.

"4 It permits free circulation of air and wind storms, thus keeping the ground better aereated in wet weather, helping to restrain disease, and avoiding blowing down of trellis, hence enabling it to last longer. The sheet of leafy vine, being held horizontally and edgewise to the winds, gives little resistance, and furnishes even exposure of the fruit to light, heat and air; hence secures even ripening.

"5. In cold climates, where vines have to be covered in winter, it permits the vines, as soon as pruned, to be readily laid down to be covered, and easily raised to be tied up in spring."

The mode of pruning and training must conform to the trellis and but little choice is left in this matter with the Munson trellis.

TRAINING.

The fan system of training on the upright three wire trellis is the one most commonly used in small vineyards in the territory. The vine usually has but one trunk leading to the first wire. Hence the trunk branches and the bearing wood is spread upon the trellis in the form of a fan. The shoots run in all directions, some along the wires, some up over the top of the trellis then down and others start down directly from the cane. The top wire is very heavily loaded and the two others bear but little weight. If the vine is a very strong grower the shoots will form a dense canopy from near the ground to the top so the fruit will get but little light and air and will be in the most favorable condition for insects and diseases to work upon it.

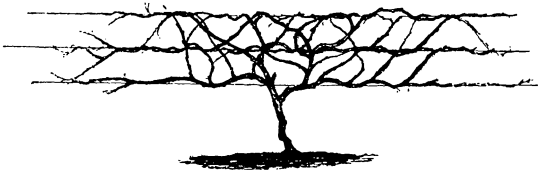


Figure 1.

Figure 1 shows an unpruned vine trained according to the fan system. The previous pruning has been done according to the renewal method. Figure 2 shows the same vine pruned and tied according to

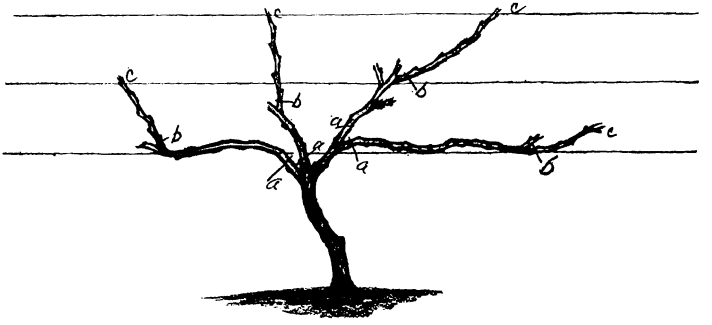


Figure 2.

the fan system of training as practiced in many vineyards. The canes from *a* to *b* bore the fruiting shoots of last season and the wood between *b* and *c* is to bear the fruiting shoots the coming season. The shoots nearest the tip of the cane have grown the strongest and have been kept for that reason. This system of training greatly encourages the growth

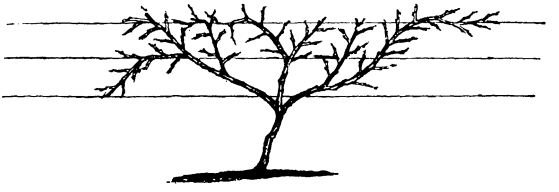


Figure 3.

of the outer shoots and unless care be taken in pruning the bearing wood will soon be removed a long distance from the trunk. It would have been better to have left a good cane near *a* for the bearing wood. Figure 3 shows a common form of vine, spur pruned and trained according

to the fan system. The open space near the top of the trunk has been caused by leaving too much wood, which has resulted in smothering out the lower vines. This vine would be better if one-half or two-thirds of the wood was removed.

The horizontal arm system of training is quite common and has many good points to recommend it. It allows free circulation of air among the vines and places the vines within easy reach of the spray. It makes pruning a very simple operation and does not confine the practice to any one method. However the expense of keeping the vines on the trellis is greater than with any other well defined system of training. An upright three or four wire trellis is always used. The arms or bearing canes are laid along the lower wire, one in each direction. The shoots are trained to run up and over the top wire and are then let run at will. Figure 4 shows a vine pruned according to the renewal method.

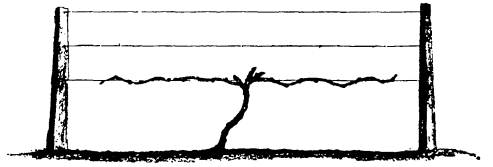


Figure 4.

The Kniffin system of training is not as widely known as its merits deserve. This system is practiced on an upright two or three wire trellis. The lower wire should be about two and one-half feet from the ground and the top wire about three feet from the first one. The bearing wood is supported by a single trunk. The arms or bearing canes are placed in a horizontal position, one extending in each direction along the lower wire and one in each direction on the top wire. The young shoots are not trained to the trellis, but let hang from the cane. The vines require no attention to keep them in position after they are first placed on the trellis in the spring.

Figure 5 shows a vine before pruning. Figure 6 shows a vine pruned.

The Munson trellis will hardly admit of more than the one system of training that is always practiced upon it. The bearing wood is supported by one, or sometimes two trunks that reach from the ground to the trellis. The renewal method of pruning is most always practiced. The strong unbranched canes starting from near the trunk are preferred for bearing wood. The canes are trained along the lower wire of the trellis and the shoots reach out to the wire on either side and wander over the trellis at will. About the only training necessary is to

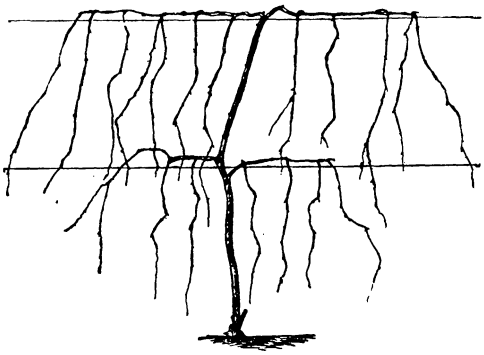


Figure 5.

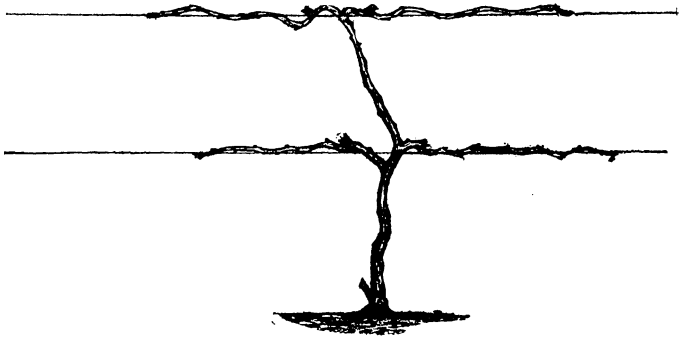


Figure 6

fasten the canes on the trellis in the spring. There will be an occasional shoot that does not start in the right direction to reach the outside wire, but these can be quickly placed on the outside wire and fastened. After the shoots become attached to the wire by the tendrils they can hardly be loosened by the wind.

Figure 7 shows the position of the renewal in early spring. Some

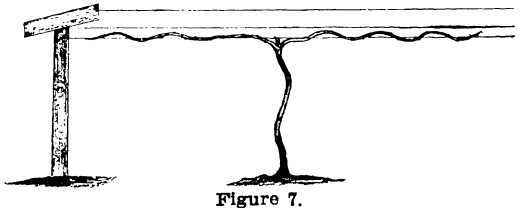


Figure 7.

prefer to leave four renewals in which case there will be two extending in each direction from the trunk.

FUNGUS DISEASES OF GRAPES.

ANTHRACNOSE: SCAB: OR BIRD'S EYE ROT.

This disease is scattered over a good portion of the territory but has not caused much damage yet. It is one of the worst of plant diseases, as it attacks the fruit and all green portions of the plant and is very difficult to handle. Most of the methods of treatment prove unsatisfactory. The first appearance of this trouble should be vigorously met and all possible care taken to prevent its spread.

This disease may appear at any time during the growing season. It commonly appears on the shoots soon after growth starts in the spring. Its presence on the shoots is first indicated by the darkening and sinking of the bark in small oval or oblong spots extending lengthwise of the shoots. If the disease is abundant the shoots soon have a speckled appearance. These spots usually enlarge, the greater portion remaining black with a more or less distinct line of purple around the edge. After a time the center turns gray and forms a scab; this is the fruiting portion of the disease. Limbs badly affected are severely checked in growth or killed. The leaves are attacked on the stem and vines show the same marks as on the shoots but on the blade of the leaf the spots turn brown. The stems of the clusters are also attacked, and where the spots girdle a stem the fruit below the girdle does not ripen but remains green and withers.

The disease usually appears on the berries when they are about half-grown. The diseased portion is brown with the characteristic red or purple margin and round in outline. The discolored part is sunken and later turns to a lighter or gray color, which is caused by the fruiting portion of the fungus rupturing the skin and forming a scab. Some varieties are more susceptible to the disease than others. Among those most susceptible to its attacks are Goethe, Agawam, Vergennes and Diamond.

Treatment:—Treatment should begin early, before the buds open in the spring. The following solution is very good to apply as a wash before the growth starts in the spring.

Iron Sulfate (Copperas) 70 lbs.

Sulfuric Acid 1 pint.

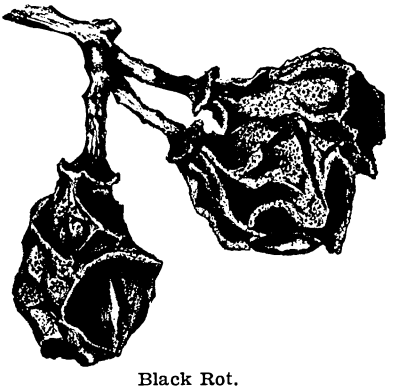
Warm water 16 gal.

The acid should be poured over the crystals of iron sulfate and then the water added. This if well applied will kill all of the spores that have

lodged on the vines over winter. When this solution is used the vines turn black and any part of the vine that has not turned black within a day or two after the first application should be washed again. Bordeaux mixture is of value in holding the disease in check on the growing vines. The first application should be made soon after the buds have started in the spring and repeated about every two weeks till the fruit is about half grown. If it is necessary to spray after this time, the ammoniacal solution of copper carbonate should be used as it does not stain the fruit and is nearly as effective.

BLACK ROT: OR CHARBON.

The fruit when affected with this disease turns to a deep black color, hence the name. The fungus causing the disease attacks all parts of the plant. On the stem it causes black, oval, sunken spots which soon show a few dark pimples in the center. These pimples are the fruiting



Black Rot.

portions of the disease and make this disease easy to distinguish from others. The affected portions of the leaves turn to a dark reddish brown color and are usually near the large veins but are not centered upon them as in the Anthracnose.

This disease seldom attacks the fruit till it is full grown. If the fruit is green the affected portion turns to a purplish brown, and this color soon spreads over the entire berry. Minute black pimples appear scattered over the surface and finally the berry withers, turns black and ultimately dries up, but, as a rule, remains firmly attached to the stem. These little pimples soon break through the skin and throw off the spores of the disease. It requires from two to three weeks after infection for the

disease to complete its growth. The rapidity of growth and spread of the rot depends much on the condition of the weather. A warm moist atmosphere is very favorable to the development of the disease.

Treatment:—Much can be done to prevent the disease by training the vines on a good trellis to admit as much air and light to the fruit as possible. Although the disease does not appear till late in the season the preventive measures should be in operation before there are any signs of the attack. Spraying the vines with Bordeaux mixture or ammoniacal solution of copper carbonate are perhaps the best remedies known. The first application should be made about the time the vines have set three or four leaves. The second application should be made about two or three weeks after the first and the third about two weeks after the second. If the vineyard is badly infected the applications should be repeated about every two weeks till the fruit is ripe.

BROWN ROT: GRAY ROT: DOWNY MILDEW.

This fungus attacks the leaves, young wood, flowers and fruit. It is first distinguished on the leaves by greenish-yellow spots on the upper surface while the corresponding undersurface is covered with a white frost like growth. As the growth progresses the mildew disappears, leaving the leaf dead and brown. The young wood and flowers present much the same appearance when attacked. This disease seems to develop in two forms on the fruit. One form is called brown rot the other gray rot. The brown rot does not make its appearance till the fruit is nearly grown. As this time small brown spots appear and soon cover the entire berry. The berry becomes very soft and falls from the stem at the slightest touch or jar. The skin remains unbroken till the berry falls. In the gray rot the berries are covered with the same kind of growth that appears on the leaves and stems.

Treatment:—This disease is most abundant on wet land and on vines that are on the ground or a very low trellis. If the vines are on a good trellis and so trained as to give the air a chance to pass freely through or under the vines but little trouble need be had. The Bordeaux mixture is a sure preventive for this disease. The first application should be made when the shoots are six or eight inches long and every two or three weeks thereafter.

RATTLES OR DROPPING.

What is known as Rattles, or Dropping of the Grape has caused considerable loss in some vineyards. The trouble is not due to any definite

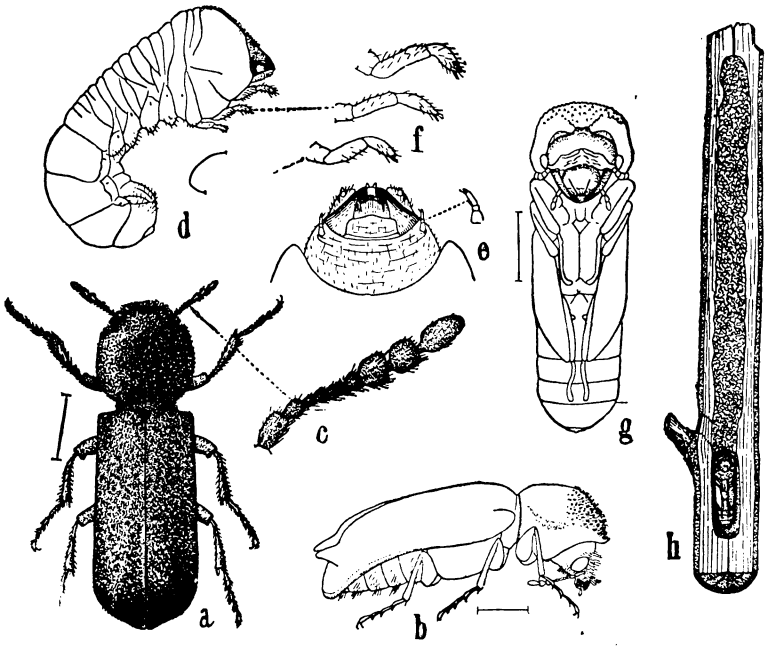
disease or insect but to the combined effect of drouth, disease, and insects in which drouth is the most prominent factor. Preventive measures should be directed towrad improving the health and vigor of the vines. It will usually be beneficial to fertilize the land and improve the method of cultivation.

INSECTS AFFECTING THE GRAPE.

E. E. Bogue.

STEM BORER.

The damage caused by this insect—unlike that produced by some other borers—is done, not in the larval stage of the insect, but in the perfect stage, by the beetle itself. It works on the apple, pear and cherry.



The apple twig borer, "a," beetle as seen from above; "b" same in outline as seen from the side, showing projections on wing covers; "d," larva; "g," pupa; "c," antenna; "e," head of larva; "h," pupa in burrow; all but "h," much enlarged.

It attacks the twig just above a bud and bores a cylindrical hole for several inches in the center of the twig causing it to wither and die. The early stages of this insect are not well known.

Remedy.—The injured twigs should be cut out and burned. No sure preventative is known.

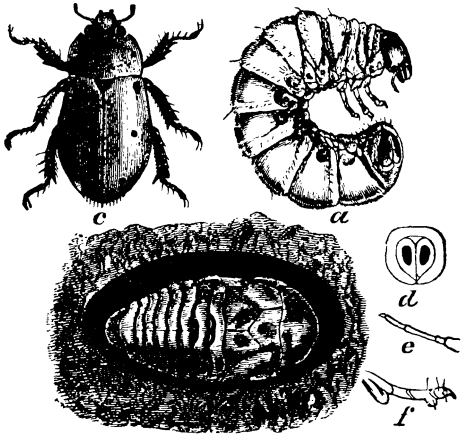
GRAY SKELETONIZER.

This beetle much resembles the Brown-backed skeletonizer in the character of its work but is less than a quarter of an inch long and one-eighth of an inch broad. It is dark-gray in color and when disturbed it falls to the ground and lies stupid where, on account of its color, it is hard to see.

Remedies.—It succumbs to poisons, but if poultry can be induced to feed upon it there need be but little trouble in getting rid of the beetle.

SPOTTED VINE-CHAFER.

This is a large beetle about one inch long and half as broad and rather thick. The wing-covers are tan yellow or reddish brown, and each has a black spot at each end and one in the middle of the margin, and there is also a black spot on each side of the thorax. The under



The spotted vine chafer, "a," larva; "b," pupa; "c," mature beetle.

side of the body is a deep bronze-green. The legs of some individuals are the color of the wing-covers and of some others the color of the under side of the body. The larva feeds on decaying roots and stumps. It is not usually a troublesome insect, but some complaint has been heard of its eating the foliage of the grape.

Remedy.—On account of its large size, hand picking can be recommended. Spraying with poisons is also effective.

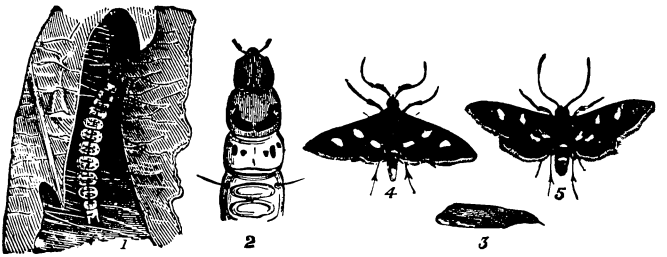
BROWN-BACKED SKELETONIZER.

This beetle is about five-sixteenth inches long by half as broad, varying in color from reddish brown to black. It works in spots in the vineyard eating out the green pulp of the leaves and leaving only the frame work or skeleton.

Remedies.—It may be destroyed by poisoning the foliage, spraying with Paris Green or London purple but it would probably be more satisfactory to induce poultry to feed on the beetle.

THE GRAPE-VINE LEAF FOLDER.

The work of this insect is known by its beginning on a small portion of the leaf of the grape, rolling the upper surfaces together and fastening them with silk. It feeds on the inside of the roll and is thus out of the reach of ordinary insecticides. The full grown larva is about



The grape vine leaf folder. "1," larva, natural size; "2," front part of body, enlarged; "3," pupa, natural size; "4" male moth, natural size; "5" female moth, natural size.

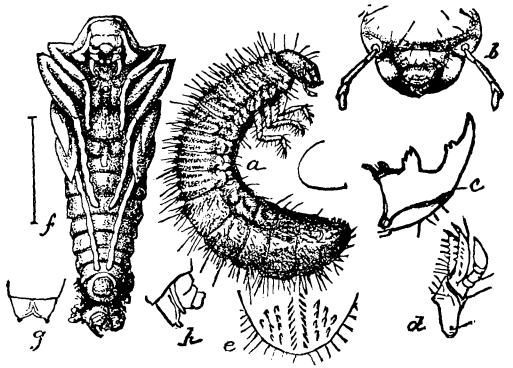
three-fourths of an inch long. It changes to the pupa stage within the folded leaf, from which the moth emerges. The moth is about one inch broad when the wings are expanded. The wings are nearly black, with a few white spots and a faint white margin. There are two broods each season. The larva of the first brood appear in May or June in Oklahoma and the last one in August. The last brood passes the winter in the rolled leaves.

Remedies.—The insect has a parasite that doubtless does a good deal toward keeping it in check. This may be preserved and the enemy destroyed by collecting the rolled leaves before the moths escape from them and enclosing them in any kind of a receptacle that may be covered with a piece of loosely woven cloth that will allow the small parasites to escape, but will hold the moths. With a little care and observation this can be done very successfully. However, some recommend that

no attention be given the parasite, but burn the leaves as soon as collected, which will destroy both parasites and moths. Spraying with Paris Green as soon as the first insects appear is effective.

THE ROSE-CHAFER.

Most of the fruit growers of the territory are familiar with this beetle. Its habit of feeding on the flowers of the rose gave to the beetle its common name but the number of its food-plants has been extended until it is now nearly omniverous. The flowers and leaves of the grape are relished by it but the leaves of the apple, pear, plum, cherry and



The rose chafer, "a" larva; "f" pupa; "b, e, g, h," structural details.

leaves of many other plants are greedily eaten as well as young fruits.

The rose-chafer appears in Oklahoma in May and begins feeding voraciously and continues for from four to six weeks. During this time each female lays from one to two dozen eggs, singly, in the soil. Soon the eggs hatch and the larva begin feeding on the young grass rootlets if such are in reach. If not then the rootlets of other plants that are within reach. In autumn the larva have reached maturity, when they are yellewish in color with a brownish head. They descend to below the frost line; come near the surface in early spring, pupate, and soon emerge as perfect beetles to begin again the cycle of life. The insect prefers a light sandy sod soil for a breeding ground, so that if the grape growers guard their vineyards against this condition it will be a good preventive measure.

Remedies.—The beetle can not be easily poisoned. Hand picking twice a day, from the first appearance and as long as the beetles last, may

be practicable. Coaxing poultry with wheat to where the insects are and then jarring them onto the ground may be a means of getting rid of the pest.

GRAPE-BERRY MOTH.

This insect passes the winter in the pupa stage concealed in the old leaves. The first brood in the spring feeds on the flowers, leaves and tendrils of the grape and the second one feeds in the young grapes. Infested berries show a round scar on one side. If a berry is cut open, the larva will be found within. When fully grown, it is a little over a fourth of an inch long and dark colored. It comes out of the berry and passes the pupal stage in a piece of a leaf. The expanded moth is a little less than half an inch across. The front wings are mottled bluish and gray and the hind wings dull dark colored. The moth itself does no harm but lays the eggs which hatch into pupae.

Remedies.—From the nature of the case, poisons are of no value for preventing injury from this insect. About the only way of preventing loss from them is to cover each bunch of grapes with a small paper sack, and this method is too expensive to be used extensively. In the fall, all poor fruit and old leaves should be destroyed to prevent the insect from passing the winter in them.

INSECTICIDES AND FUNGICIDES.

BORDEAUX MIXTURE.

Copper sulfate (blue vitriol) 4 pounds.
Quicklime (not air slacked) 4 pounds.
Water, to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better by suspending the sulfate contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag, a longer time is required. Pour the sulfate solution into the barrel or tank used for spraying, and fill one-third to one-half full of water. Slack the lime by addition of a small quantity of water, and when slacked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime but stone lumps or sand is shaken up in the milk of lime. Now add water to make 50 gallons in the tank. After thorough agitation the mixture is ready to apply. The mixture must be made fresh before using, any left over for a time, should be thrown out or fresh lime added.

AMMONIACAL SOLUTION OF COPPER CARBONATE.

Copper carbonate, 6 ounces.
Ammonia, about 3 pints.
Water, 50 gallons.

Dissolve the copper carbonate in the ammonia and add the water.

Caution. Use no more ammonia than is required to dissolve the copper carbonate. Ammonia is variable in strength, and the amount required must be tested in practice.

To make copper carbonate: Dissolve 10 pounds copper sulfate (blue vitriol) in 10 gallons of water, also 12 pounds carbonate of soda in same quantity of water. When cool mix the two solutions slowly, stirring well. Allow the mixture to stand twelve hours and settle, after which pour off the liquid. Add the same quantity of water as before, stir and allow to stand the same length of time. Repeat the

operation again, after which drain and dry the blue powder, which is copper carbonate.

POTASSIUM SULFID.

Potassium Sulfid (liver of sulfur) 3 ounces.
Water, 10 gallons.

This solution is valuable for the gooseberry and other powdery mildews, for which it seems even more effectual than Bordeaux mixture, although its effects are less lasting. It does not discolor the fruit and is quite harmless.

PARIS GREEN.

Paris Green, 1 pound.
Water, 100-200 gallons.

For the destruction of insects that eat the foliage or fruit, Paris Green is a valuable remedy. It can be used in water in the above proportions, the stronger mixture being used for potatoes, while for fruits it is seldom advisable to use more than 1 pound in 200 gallons of water, unless in connection with lime water or Bordeaux mixture. It is always advisable to first form a paste with a small amount of water before preparing it for spraying. For low plants Paris Green may be used in a powder form, either alone or with one hundred times its weight of plaster. London purple is sometimes used in place of Paris Green, but it is more apt to injure the foliage.

KEROSENE EMULSION.

Dissolve one-half pound hard soap in one gallon of water (preferably soft water) and while still hot, remove from the fire and add two gallons of kerosene. When soft soap is used, take equal quantities of soap and oil and omit the water before mixing. Stir the mixture violently by driving it through a force pump back into the vessel, until it becomes a creamy mass that will not separate. This requires usually from five to ten minutes. The emulsion is then ready to be diluted with water and applied. For the common scale insects and hard bodied insects, like the chinch bug, use 1 part emulsion to 8 or 10 parts water. For soft bodied insects (plant lice, etc.) use 1 pint emulsion to 15 or 20 parts water.

Kerosene emulsion kills by contact and therefore the application should be very thorough. It may be used against a great many different pests, but is especially valuable for destroying those with sucking mouthparts, for they cannot be killed with arsenical poisons.

HELLEBORE.

Fresh White Hellebore, 1 ounce.
Water, 5 gallons.

Hellebore is often employed in cases where arsenical poisons would be objectionable. For insects that chew, and especially for the currant and cabage worms.

PYRETHRUM OR BUHACH.

Pure fresh Pyrethrum, 1 ounce.
Water, 5 gallons.

Valuable against both chewing and sucking insects, especially upon maturing fruits or vegetables, and upon flowering plants. It can also be applied in a powder form with a bellows.

CAUTION.

The copper solution should be made in wood, glass or earthen vessels, and should not be prepared in iron or tin.

Care should be taken against spraying plants of any kind with lime or poisonous mixtures within four or five weeks of the time they are to be used as food.

Study carefully the nature of the insect or disease and select the remedy that is most likely to destroy it without injuring the plants.

Do not spray while the trees are in blossom as the bees will be destroyed; they help to fertilize the flowers.

Pumps for the application of insecticides and fungicides should be sufficiently powerful to cover the trees or plants with a fine mist, and where copper compounds are to be used, the working parts should be of brass, and if all portions that are to come in contact with the spraying mixture are of brass, the durability of the pump will be greatly increased.

STOCK FEEDING.

F. C. Burtis.

It is generally conceded that stock husbandry is the most profitable branch of farming, and that for agriculture to be on a substantial and profitable basis in a given locality, enough stock should be kept on every farm to consume the greater part of the products produced there. Still it is a fact that many thousands of dollars are lost every year in Oklahoma upon poor stock and through improper methods of feeding. This is not any more true here than in many other localities. Oklahoma has made rapid progress in the stock industry, but there is still much room for improvement. At the present time too much of the stock of Oklahoma is shipped out to be finished eleswhere. With her mild winters, and great variety of feeds in abundance, no other section should excel her in the production of the finished article.

But the time has passed when stock feeding can be carried on in an ignorant and haphazard way and afford the feeder much profit. The successful stockman must be able to discriminate between good and poor animals and use the information that is given him on the composition and digestibility of feeds, and be able to combine them in the most economical form so as to produce the best gains or largest yield of products for the feed consumed. In other words he must know something of the science of stock feeding. He should know why a pound of alfalfa, if properly used is worth two to three times as much as a pound of prairie hay, and about four-fifths as much as a pound of bran, or how a ton of cotton seed meal can be made to yield $45 per ton, when corn is worth twenty-eight cents per bushel; or why a number of pounds of a certain mixture of feeds will produce a third more gain in growth than the same number of pounds of a different mixture when fed to the same animal.

For a good many years scientists have been at work solving these problems for the farmer, and of late years the results have been greatly simplified, so that now a school boy can understand them, and the number of farmers that are utilizing the information that is given in the published feeding tables and standards, is increasing rapidly every year, but still the number is not as large as it should be.

COMPOSITION OF ANIMALS.

The animal body that the farmer is endeavoring to produce is made up of a class of substances very similar to those found in plants, and these are grouped under the heads; water, ash, or mineral matter, fat, and protein or nitrogenous matter. The plant is the source from which the animal obtains these ingredients with the exception of water and that only in part comes from the plant.

COMPOSITION OF FEEDS.

In addition to the four groups of substances water, ash, protein and fat, which are found both in animals and plants, there is an additional group, called carbohydrates, found only in plants.

Water. From 40 per cent to 60 per cent of the animal body consists of this, and it is found in all feed stuffs, varying in amount from 10 per cent to 90 per cent. Dry clover hay contains about 20 per cent, field cured corn stover 40 per cent and sugar beets 90 per cent. As a rule the water in the feed has no more value than the water from the well, and generally the higher the water content of a feed, the less its value per ton, but there are times when a little succulent feed as silage or sugar beets is very important. Aside from this the value of a feed is figured on the water-free content and the water in a feed has no value. The term dry matter is applied to the part of the feed after all the water in it has been driven off by an artificial heat.

Ash. This is the part left after burning the plant. It is the source of the mineral matter of the body and as such is important. While there is only a small per cent of it in plants, the ordinary mixtures of feeds contain it in sufficient quantity for the requirements of the animal in the majority of cases. The rough feeds, such as the hays, contain a much larger per cent than the grains. Young pigs fed exclusively on corn will not receive sufficient ash for proper growth. This is one of the very few examples where it may be lacking in sufficient quantity. It is quite essential that it be present in the feed of growing animals in sufficient quantity, as it enters largely into the growth of the skeleton.

Protein is a name applied to a group of substances found in plants and animals, and to which great importance is attached, because they are the only substances in plants and animals that contain nitrogen, hence the term nitrogenous group that is sometimes applied to them. The white of egg and casein of milk are good examples of animal matter belonging to this group, and the gluten of wheat is an example of vegetable matter. All feeds contain some protein, but some a much larger

per cent than others. Most of our common feeds raised on the farm are deficient in it, and do not furnish the proper amount to give the best results in feeding. Protein in the feed is used by the animal system in forming milk, wool, muscle, and hair, and in fact all the working machinery of the body and all other substances containing nitrogen, and is absolutely indispensable in the formation of these as no other substance can take its place, no matter in what quantities furnished. Hence protein is very essential in the feeds of growing animals and others, whose functions or work require the formation of the above products.

Such feeds as cotton seed meal, linseed oil meal, and soy bean meal are very rich in protein, cotton seed, bran, clover hay and alfalfa are moderately rich in it, while Kafir and corn stover, prairie hay, and millet hay contain only very small per cents. The above is the reason why such feeds as cotton seed meal, linseed meal, etc., command high prices on the market; as it is generally the per cent of digestible protein that a feed contains that determines its feeding value.

Carbohydrates, comprise a group of substances rich in the element carbon. As was noted this group does not appear in the animal body. In the plant it constitutes the fiber, sugar, starch, and gums and similar substances. The function of carbohydrates in the animal body is to furnish heat, energy, and to build up the fat of the body. All our common feeds contain it in large quantities, and of the rough feeds as hay and fodders, over 90 per cent of the digestible portions are carbohydrates, and all feeds contain a much larger per cent of them than of any other ingredient. Present in such abundance it is a cheap article in the food and the feeder does not need to concern himself much about it only to see that it is present in the proper proportion with the protein.

Fat. The form in which this appears in the body is familiar to every one. It is stored up there for future use by the animal system. In the plants it is the fatty matter, as oils and some of the gums. It is so similar to the carbohydrates in composition and the function it performs that it might have been considered under that head. It is, however, more easily utilized by the system than the carbohydrates and it has been found to be worth 2 1-4 times as much for the animal's use. So, in finding the value of a feed the fat is multiplied by 2 1-4 and added to the carbohydrates. In the feeding tables the fat and carbohydrates are combined in this way and given in one column.

UNDERSTANDING FEEDING TERMS.

There has been some difficulty with farmers grasping the meaning of some of these terms because they are new to them, but there should not

be as they are as simple as the word "water" and carry as much meaning. In practical work one does not think of the elements that go to make up water, and neither is it necessary with these terms. Think of protein for instance as the name of a group of substances found in feeds and realize the part it plays in the animal organism, and that nothing else can be substituted for it. Animals will die without water and will not make the proper growth without enough of it; the same is true of protein. When the farmer looks at these terms in this way he will have no more trouble in comprehending them.

TERMS USED IN FEEDING.

The scientist has found that for the proper and most rapid growth of animals, or the largest production of milk, wool, etc., the foregoing substances which are called food nutrients, must be present in the food of animals in certain proportions; these proportions vary with the age of the animals and the uses to which they are put.

Now the balanced ration that the farmer has heard more or less about, is nothing more than a ration in which the feeds are so mixed as to furnish these food nutrients in the proper proportions and amounts. The nutritive ratio of a feed is an expression of the relation of the digestible protein contained to the digestible carbohydrates and fat equivalent, and is determined by multiplying the fat by 2 1-4 and adding it to the carbohydrates, and dividing the sum by the number of pounds or per cent of protein. This designates how many pounds of carbohydrates and fat equivalent there are to each pound of protein. For instance if the sum of the carbohydrates and fats divided by the protein equaled 6, it would mean that there was one pound of the latter to every 6 lbs of the former and would be expressed 1:6. The nutritive ratio is spoken of as being wide, or narrow, and the same terms are applied to a ration. The terms have reference to the proportion of the protein to the carbohydrates and fat. For example, in alfalfa where there are 3.8 lbs. of carbohydrates and fat for each pound of protein, the nutritive ratio is very narrow and in corn stover where there are about 20 lbs. of carbohydrates to each pound of protein the nutritive ratio is very wide.

FEEDING STANDARDS.

The results as determined by scientists as to how much of the different food nutrients animals must have under different conditions, have been tabulated and are called feeding standards. They are not given as inflexible rules but as guides to the farmer and will need altering in

cases. These are given in table one. Column one, designated dry matter, is given to aid the feeder in giving the proper bulk of food to the animal. It includes all the feeding ingredients minus the water. The figures given in the various columns are given for animals of a certain weight but may be calculated to animals of any weight. (Page 139)

DIGESTIBILITY OF FEEDS, AND FEEDING TABLES.

Not all the ingredients in a feed are digested, and as only the digested portions can be utilized by the animal system, in feeding tables only the per cent of digestible ingredients, the portion of value to the animal, is given. These per cents have been determined after many actual feed-trials with the work of the chemist. The results given are the averages of many determinations and of feeds in normal condition. If feeds are neglected and left to bleach in the weather or become damaged otherwise they will not contain nearly as high a feeding value as is given in the table. Table two gives the digestible nutrients of feeds in the reach of Oklahoma farmers. The only explanation that the table needs is that the work of combining the fats and carbohydrates has been performed and the result placed under one column. (Page 140.)

MIXING FEEDS ACCORDING TO FEEDING STANDARDS.

First, the feeder must refer to the feeding standards and find under what class the animal comes that he has to feed and what proportion and amount of the food nutrients are required. Is it an animal that requires a larger proportion of protein or not? If it is he must count on using some food rich in protein. The feeder should select feeds within his reach and those that he thinks will give the desired results, always giving due consideration to the market value of each. Determine the number of pounds of the feeds that the animal should have, and then refer to table two of digestible nutrients and figure out the pounds contained in each feed selected. Compare the totals with the numbers found required for the animal according to the feeding standard. If the ration does not furnish the nutrients in the required proportion and amounts, reduce the feed that does not seem to furnish enough protein, or vice versa, and add one that contains more protein or less carbohydrates. Continue this adjustment until the digestible nutrients in the ration approximate those required in the standard, and the ration would be said to be a balanced ration and the nutritive ratio a proper one. The following example may help to make the method clear. A bunch of steers, averaging 900 pounds are to be fattened. Calculate the ration per head and per day. Referring

to the feeding standard to get the nutrients, we find that for a 1000 lbs. steer, is required dry matter 27 lbs., protein, 2.5 lbs., carbohydrates and fat equivalent 16.1 subtracting 10 per cent from each one of these as the steer is 10 per cent lighter than the one given in the standard, we have the following: Dry matter 24.3 lbs., protein 2.25 lbs., carbohydrates and fats 14.49 lbs. Take a common ration for a steer of this size, 24 lbs. corn and 12 lbs. corn stover. Referring to the feeding tables we find the following for the corn:

Dry matter per cent 8.91x24 equals 21.36 lbs.
Protein per cent 7.9x24 equals 1.89 lbs.
Carbohydrates and fat 76.4x24 equals 18.33 lbs.

The same table gives us for corn stover:

Dry matter per cent 59.5x12 equals 7.20.
Protein per cent 1.7x12 equals .204.
Carbohydrates and fat 32.4x12 equals 3.9.

Tabulating the above we have the following:

	Dry Matter—lbs.	Digestible: Protein—bs.	Digestible: Carbohydrates and fat—lbs.	Nutritive Ratio
24 lbs corn contains	21.36	1.89	18.33	1: 9.7
12 lbs. corn stover	7.2	.204	3.9	1:19.9
Total contained	28.56	2.1	22.23	1:10.6
Required amount	24.3	2.25	14.49	1: 6.4

The important points to notice are that the protein lacks practically 1-4 lb., and the carbohydrates are about 8 lbs. too much, which makes 10.6 lbs. of carbohydrates to each pound of protein when there should be only 6.4 lbs. The dry matter should be at least two pounds less. With the nutrients in this proportion the steer would not make as rapid gains and it would take more pounds of feed to make a pound of gain than if the proportion of protein was nearer the carbohydrates.

The ration could be remedied as follows: Reduce the corn to 14 pounds and add 4 pounds of cotton seed, reduce the corn stover to 5 pounds and add 6 pounds of alfalfa hay. Referring to table two for the per cent of digestible nutrients in these feeds and making the computations as before we have the following:

	Dry Matter	Digestible: Protein	Digestible: Carbohydrates and fats	Nutritive Ratio
14 lbs. corn	12.46	1.106	10.69	1: 9.7
4 lbs. cotton seed	3.58	.5	1.2	1: 5.9
5 lbs. corn stover	3	.085	1.72	1:19.9
6 lbs. alfalfa	5.52	.66	2.53	1: 3.8
Total	24.56	2.351	16.14	1: 6.8
Required amount	24.3	2.25	14.49	1: 6.4

Both the protein and the carbohydrates are a little too high and the nutritive ratio a trifle wide, but near enough for practical purposes. On this ration the steer would make larger gains and on less grain per day.

The following comparison taken from the steer feeding experiments of the past winter at this Station will illustrate the value of an approximate balanced ration as compared with one carrying too large a proportion of carbohydrates, known as a wide ration.

Five steers were fed on corn meal and alfalfa hay and five on corn meal and Kafir corn stover. Taking the average number of pounds of feed per day and per head and determining the nuturients in each, we have the following:

	Dry Matter	Digestible: Protein	Digestible: Carbohydrates and fat	Nutritive Ratio
17.84 lbs. corn meal	15.88	1.36	13.62	
12.87 lbs. alfalfa hay	11.84	1.39	5.33	
Total	27.72	2.75	18.95	1: 6.9
18.67 lbs. corn meal	16.61	1.47	14.26	
10.33 lbs. Kafir corn stover	8.35	.15	4.52	
Total	24.96	1.62	18.78	1:11.6
Standard required	29.7	2.75	17.71	1: 6.4

The nutrients given as required are for a 1100 lb. steer. The steers were fed all the alfalfa hay and Kafir stover they would eat and more or less waste was left, but only the actual amount that they did eat was considered in the ration. The corn meal alfalfa fed steers required

30 1-2 per cent less grain to produce a pound of gain, and gained .53 of a pound more per head each day, than the corn meal Kafir stover fed steers.

The fact should not be overlooked that there are cases where the balanced ration is not the most economical. This will be influenced by the relative market price of feeds and the animals that are to be fed. For instance if corn is very cheap the feeder will not be justified in paying high prices for mill stuff to feed in very large quantities to fattening steers, unless it be for the finishing period. The carbohydrates that he would waste are too cheap in 15 cent corn to justify him to buy high priced protein to save them. But generally, feed containing enough protein at a reasonable price can be had on the farm at a price that will justify an approximate balanced ration in the majority of cases. Besides the loss of food nutrients, there are detrimental results caused by an unbalanced ration. Growing stock are stunted; dairy cows are dried up, in breeding stock the animal system is weakened, etc. For such cases as these the balanced ration will pay even if it is necessary to purchase such feeds as oil meal, etc., that are generally considered high priced.

SOME OKLAHOMA FEEDING STUFFS.

COTTON SEED AND ITS PRODUCTS.

The cotton plant furnishes some very valuable food products.

The seed is quite rich in protein and contains some 3 1-2 pounds more per hundred than corn. The use of it could be greatly increased with profit among farmers. It is not practical to feed it to hogs as it requires special preparation for them, but gives the best results when mixed with corn and fed to cattle.

Cotton seed meal, the product from the oil mills, is very rich in protein; in fact contains more protein than any other feed. All stock relish it and do well on it when mixed with other feeds, but it must be fed with great precaution to hogs, as after four weeks feeding on it, they commence dying. This Station has been successful in feeding it to hogs without fatal results, by discontinuing the cotton seed meal after four weeks feed, for about two weeks, and then adding the cotton seed meal again for four weeks and so on.

Dairy cows should not be fed more than 2 to 3 pounds of it per day, and steers not more than six to eight for the best result. Steers when fed large qunatities longer than 80 to 90 days go blind.

Cotton seed hulls are a dry and tasteless article of low feeding value, but have a value to the feeder as they can be readily mixed with various meals to be fed to cattle, and furnish that divisor that is so necessary with such heavy foods as meals.

COWPEAS.

While the grain of this plant contains a rather large per cent of protein, it is not economical to try and harvest it separately for feeding, but the whole plant should be utilized as hay or pastured off in the field. In this condition, it is much richer in protein than our common rough feeds and makes a valuable addition to them to help balance the ration.

SOY BEANS.

This plant should be grown for the grain it produces as it contains about 30 per cent of protein, and is relished by all stock and can be fed to them with other grain, in proper proportions, with great profit.

The plant has little value as hay but its erect growth enables it to be harvested for the grain with machinery. The plant does well in Oklahoma.

WHEAT BRAN.

This feed can generally be purchased at a price to justify quite an extensive use of it. It is valuable for the protein it contains and other beneficial effects on the animal system. It is very valuable to mix with feed for breeding stock.

ALFALFA.

This is one of the most valuable feeds grown on the farm and it does well quite generally over Oklahoma. Besides being a very palatable feed, it contains almost as much protein as bran and will give about as good results in feeding. This makes it quite a valuable crop when we consider that three to four tons of hay per acre can be harvested yearly. It is relished by all stock and it is a very economical feed to put in to balance the ration. Even the dry hay is eaten by swine and much better gains are obtained where it is fed in addition to corn, than where corn alone is fed. This is especially true with shoats.

SUGAR BEETS AND MANGLES.

As a source of succulent feed in the winter, these are very valuable. In Oklahoma where green pasture can be had the winter through, they are not as essential as in the north. At no time should breeding stock be without succulent food as part of the ration at least. When the brood sow has not access to pasture, a sugar beet or two a day will go a great way towards bringing a healthy litter. For stock feeding beets and mangles can be raised successfully in Oklahoma.

CORN.

This is pre-eminently the American stock food. Besides carrying a fair amount of protein, there are in every 100 lbs., 76.4 lbs. of digestible carbohydrates and fat equivalents, with the protein making a total of 84.3 lbs. food nutrient equivalents in each one hundred pounds of grain. It is a highly carbonaceous feed and in the majority of cases some feed richer in protein should be mixed with it to give the best results.

KAFIR CORN.

While superior to corn as a plant to grow on poor soil and to resist drouth, it is not equal to corn in feeding value. It is very similar to

corn in composition but it is not nearly as digestible. It should be ground in the majority of cases to obtain the best results.

TABLE I—FEEDING STANDARDS. A—*Per Day and 1,000 lbs. Live Weight-*

ANIMAL.	Dry Matter	DIGESTIBLE: Protein	Carbohydrates	Total	Nutritive Ratio
HORSES—					
Light work	20	1.5	10.5	12	1:6.9
Medium work	24	2	12.35	14.35	1:6.2
Heavy work	26	2.5	15.3	17.8	1:6
FATTENING CATTLE—					
Preliminary period	30	2.5	16.1	18.6	1:6.5
Main period	30	3	16.1	19.1	1:5.4
Finishing period	26	2.7	16.6	19.3	1:6.2
MILCH COWS—					
When yielding daily 11.0 lbs. of milk	25	1.6	10.7	12.3	1:6.7
16.6 lbs. of milk	27	2	12	14	1:6
22 lbs. of milk	29	2.5	14.1	16.6	1:5.7
27.5 lbs. of milk	32	3.3	15	18.3	1:4.5
SHEEP—					
Coarse wool	20	1.2	11	12.2	1:9.1
Fine wool	23	1.5	12.7	14.2	1:8.5
Breeding ewes	25	2.9	16.1	19	1:5.6
FATTENING SHEEP—					
First period	30	3	16.1	19.1	1:5.4
Second period	28	3.5	15.9	19.4	1:4.5
FATTENING SWINE—					
First period	36	4.5	26.5	31	1:5.9
Second period	32	4	25.1	29.1	1:6.3
Third period	25	2.7	19	21.7	1:7
BROOD SOWS	22	2.5	16.5	19	1:6.6

TABLE I—FEEDING STANDARDS. B.—*Per Day and Head.*

ANIMAL.	Age—months	Average Live Weight per Head	Dry Matter	DIGESTIBLE: Protein	Carbohydrates	Total	Nutritive Ratio
Growing Animals	2- 3	150	3.3	.6	2.8	3.4	1:4.6
	3- 6	300	7	1.0	4.9	5.9	1:4.9
	6-12	500	12	1.3	7.5	8.8	1:6
	12-18	700	16.8	1.4	9.7	11.1	1:7
	18-24	850	20.4	1.4	11.1	12.5	1:8
Growing Sheep	5- 6	56	1.6	.18	.974	1.154	1:5.4
	6- 8	67	1.7	.18	.981	1.161	1:5.4
	8-11	75	1.7	.16	.953	1.113	1:6
	11-15	82	1.8	.14	.975	1.115	1:7
	15-20	85	1.9	.12	.955	1.075	1:8
Growing Fat Swine	2- 3	50	2.1	.38	1.5	1.88	1:4
	3- 5	100	3.4	.5	2.5	3	1:5
	5- 6	125	3.9	.54	2.96	3.5	1:5.5
	6- 8	170	4.6	.58	3.47	4.05	1:6
	8-12	250	5.2	.62	4.05	4.67	1:6.5

TABLE II.—DIGESTIBLE NUTRIENTS IN FEEDING STUFFS.
Pounds in 100 lbs. of Feed.

	Dry Matter	DIGESTIBLE:			Nutritive Ratio
		Protein	Carbohydrates and Fats	Total	
CONCENTRATES.					
Corn	89	7.9	76.4	84.3	1: 9.7
Wheat	90	10.2	73	83.2	1: 7.2
Wheat Bran	88	12.2	45.3	57.5	1: 3.7
Wheat Shorts	88.2	12.2	58.5	70.7	1: 4.8
Brewer's Grain, wet	24	3.9	12.5	16.4	1: 3.2
Brewer's Grain, dry	92	15.7	47.8	63.5	1: 3
Oats	89	9.2	56.8	66	1: 6.2
Sorghum Seed	87.2	7	59.1	66.1	1: 8.4
Broom-corn Seed	85.9	7.4	54.8	62.2	1: 7.4
Kafir Corn, whole	87.5	4.7	32.6	37.3	1: 6.9
Kafir Corn, coarsely ground	87.5	5.8	56.5	62.3	1: 9.8
Kafir Corn Heads	78.4	1.08	21.5	22.5	1:20.9
Millet	86	8.9	52.2	61.1	1: 5.9
Flaxseed	90.8	20.6	82.3	102.9	1: 4
Linseed Oil Meal, old process	91	29.3	48.5	77.8	1: 1.7
Cotton Seed	89.7	12.5	68.9	81.4	1: 5.5
Cotton Seed Meal	92	37.2	44.4	81.6	1: 1.2
Cotton Seed Hulls	88.9	.3	36.9	37.2	1:12.3
Sunflower Seed	92.5	12.1	85.8	97.9	1: 7.1
Peanut Meal	89.3	42.9	38.3	81.2	1: 0.9
Peas	90	16.8	53.4	70.2	1: 3.2
Soy Beans	89.2	29.6	54.9	84.5	1: 1.8
Cowpeas	85.2	18.3	56.7	75	1: 3.1
ROUGHAGE.					
Fodder Corn, field cured	58	2.5	37.3	39.8	1:14.9
Corn Stover, field cured	60	1.7	34	35.7	1:19.9
Kafir Fodder	90.3	2.1	53.49	55.6	1:24.9
Kafir Stover	80.8	1.5	45.3	46.8	1:29.6
Red Clover, medium	84.7	6.8	39.6	46.4	1: 5.8
Red Clover, mammoth	78.8	5.7	36.3	42	1: 6.4
Alfalfa	92	11	42.3	53.3	1: 3.8
Cow Pea Hay	89.3	10.8	41.1	51.9	1: 3.8
Soy Bean Hay	88.7	10.8	43.1	49.5	1: 4
Timothy	87	2.8	46.5	49.3	1:16.6
Orchard Grass	90.1	4.9	45.4	50.3	1: 9.3
Redtop	91.1	4.8	49.1	53.9	1:10.2
Mixed Grasses	87.1	5.9	43.7	49.6	1: 7.4
Prairie Grass	85	3.5	45	48.5	1:12.8
Oat Hay	91.1	4.3	49.8	54.1	1:11.6
Oat Straw	90.8	1.2	40.4	41.6	1:33.6
Wheat Straw	90	.4	37.2	37.6	1:93
Rye Straw	92.9	.6	41.5	42.1	1:69
Barley Straw	85.8	.7	42.5	43.2	1:61
ROOTS AND TUBERS.					
Potato	21	.9	16.5	17.41	1:18.3
Beets, sugar	13	1.1	10.4	11.5	1: 9.4
Mangels	9	1.1	5.6	6.7	1: 5.1
Flat Turnip	9.5	1	8.5	9.5	1: 8.5
Artichokes	20	2	17.2	19.2	1: 8.6
MISCELLANEOUS.					
Pumpkins	9.1	1	6.5	7.5	1: 6.5
Rape	14	1.5	8.5	10	1: 5.7
Milk	12.8	3.6	13.2	16.8	1: 3.7
Skim Milk	9.6	3.1	6.5	9.6	1: 2.1
Buttermilk	10	3.9	6.5	10.4	1: 1.7
Whey	6.6	.8	5.4	6.2	1: 6.7

Reprints From the Tenth Annual Report.

SUMMARY OF PRESS BULLETINS

1900-1901.

PASTURE CROPS FOR HOGS.

Pasture and range are necessary in order to keep breeding swine in a healthy condition and grow the stock at a profit. The man who tries to raise swine under other conditions is playing a losing game, and his balance will be on the debtor side of the ledger just as sure as we have day and night. Although these facts have been vouched for many times by Experiment Stations and successful swine raisers and given wide publicity, thousands of farmers still continue in trying to raise hogs in a dry lot with nothing but corn as a feed, with the expectations of making it a profitable operation.

A hog pasture does not mean a dust lot with possibly a few old weeds off in one corner, but a good and commodious range, and if planned to give the best results, it will contain a variety of crops, selected as to their food value. The pasture should not be so small that the hog is compelled to eat his own filth to get the feed. Every farm should have six to eight acres of hog pasture fenced purposely for this use. This is in addition to what range may be utilized outside at times. Better far to have a little too much than not enough. If the crop gets ahead of the hogs and becomes woody cut it off with the mower and a new growth will start. This can be done with many plants and will pay even if the mowed portion is not gathered. The pasture may be greatly fertilized by this method in many cases. The enclosure should be divided into two or three parts, at least, so that while one part is being pastured, crops may be growing in the others.

While succulent food is very essential the year round for growing and breeding stock, the exercise is just as necessary. Pigs confined in pens will do much better if they have some green feed, but the results will be vastly better if the pigs are allowed a range and the chance to gather this feed for themselves.

Any green crop is much better than no pasture, but some crops for this purpose are very much superior to others, and a variety of crops,

even though they may be much alike in composition, is superior to a single crop. Many swine raisers that appreciate the value of a hog pasture do not realize the importance of giving attention to variety and composition of the plants to be used.

In selecting the crops for a hog pasture consider the composition of the plants as you would consider the composition of the grain in a ration. Bear in mind that certain crops are rich in the food nutrient protein, that is so essential in the animal system to build up the frame and muscles, and is very necessary in the food of breeding stock. Crops of the opposite nature are rich in carbohydrates, the heat and fat forming compounds.

Endeavor to have some of the former to pasture along with latter and the results will be better. Plants belonging to the former group, those that are especially rich in protein, are alfalfa, clover, field peas, cowpeas, soy beans, vetches and peanuts. Rape, sorghum, the cereals, sweet potatoes and artichokes belong to the opposite group. Aside from being especially valuable for food, the cowpea group adds greatly to the fertility of the soil while growing on it, and will give paying yields on soil too poor for other crops. While a wheat pasture, or a sorghum pasture perhaps is of great value the results will be much more satisfactory if cowpeas or some like crop can be pastured at the same time.

In selecting the crops, due attention should be paid to the point of having a succession of crops that will furnish green feed at all times. Drouth resisting crops should be included for the drouthy time of year. Some crops with proper handling will furnish feed almost the year round while others are suitable for only one of the seasons, or a part of two.

In this list of crops for hog pasture, alfalfa, wheat, rye and oats will not be taken up in full.

Where alfalfa can be grown successfully, it has no equal as a pasture crop for hogs and it furnishes a large amount of feed almost the year round when handled properly.

But about nine men in ten that use it for that purpose ruin it by too close pasturing and at improper times.

Wheat, oats and rye are standard crops for this purpose and may be so grown as to furnish green feed for almost the whole year. But many times they are overpastured and pastured too late when the crop is to be left for grain. In both of these cases other crops should be furnished to prevent the over-pasturing and at improper times.

In addition to the above named crops that may be utilzed for this purpose, should be mentioned field peas, rape and vetches.

The field pea belongs to the cowpea class and is suitable to a cool, moist climate and will withstand a hard frost, so should be seeded early in March. Broadcast a bushel and a half of peas, plow under four or five inches and harrow down and then seed a bushel and a half of oats on top of this.

The peas are ready to pasture when they start to bloom. The seed costs from $1.50 to $2.00 per bushel which will keep many from growing them. It is well to see if a more suitable crop is not available, but field peas are worthy of a trial in this country. The yield of oats and peas the past season on the Station farm was 15 tons per acre. Fair results have been obtained from fall seeding on the Station farm.

The rape plant makes the best of spring pasture. It is a plant that furnishes, under fairly favorable conditions, a large amount of green feed in a short time from planting. The color and texture of the leaves resemble cabbage, but it grows two or three feet tall and has no value only in the green stage. It is grown over a wide territory and under varying conditions but adapted to moist, cool weather and a good, rich soil. For a time it was thought suited only to the Northern states and Canada, but gradually it is working South and has given very favorable results in Oklahoma and should be tried by all hog and sheep raisers.

The following results were obtained on the Station farm the past season:

	Tons per acre.
Rape, drilled, rows 30 inches	23.5
Rape, drilled, rows 6 inches	11.
Rape, drilled with oats	12.5

The seeding was made the last week in March and the yields determined June 2nd. The plots were on well-manured land.

For this country the seeding should be made early in March. The hot dry weather of August has stopped the growth here, and the June seeding for fall pasture as advised by some will give very uncertain results as will the seeding in corn just before the last cultivation. Such methods may give fair results at times of much rain fall. It is a plant that stands a great deal of cold and frost.

Seedings made on the Station farm last fall have lived through the winter and the plants are making an early spring start. The fall growth was rather small. Both broadcasting and drilling for culti-

vation are practiced. For this country, if much dependence is put upon the crop, drilling in rows to admit of cultivation is recommended. Planted in this way it will stand the drouth much better and if pastured and cultivated properly, the period of growth may be greatly extended, and much more feed obtained. A good rich soil is more essential where broadcasting is employed.

For broadcasting, three to five lbs., of seed per acre should be used. For drilling in rows 30 inches apart, one or two pounds should suffice. The poorer the soil and the more unfavorable the conditions, the more seed necessary.

The plants reach their maximum growth in 6 to 10 weeks from seeding but pasturing may commence as soon as the plants are firmly rooted. Sheep or hogs do not like the plants at first, but by limiting their other feed, they will eat it, and when they have acquired a taste for it they eat it greedily. Care must be taken in turning sheep on it to avoid bloating. There will be several successive growths if the plants are not pastured or cut closer than 4 inches from the ground. The seed costs about 10 cents per lb. in small quantities. The Dwarf Essex variety should be used.

Rape and field peas, and rape and oats make fair mixtures for seeding.

The following may be considered summer and fall pastures: Sorghum, cowpeas, peanuts, sweet potatoes and artichokes.

Sorghum is the most reliable and largest producer of pasture for summer. While it furnishes a large amount of green feed per acre, it is highly carbonaceous, and should be pastured along with cowpeas for best results.

Its culture is well understood. Seedings may be made from spring to late summer. It will always be found a standby during drouths. While broadcasting is the common way of seeding for hog pasture, it is always advisable to drill and cultivate some as this will make better feed in a case of severe drouth. And when grown this way the sugar content is much greater and any stalks left will make good winter feed for hogs. In selecting the seed, the sugar bearing varieties should be chosen and seeded thinner on the ground than when the crop is grown for hay. Sorghum may be seeded with oats in the spring with good results. The sorghum continues after the oats are gone.

Cowpeas make a good twin brother to sorghum for hog pasture. The peas furnish the nitrogenous material that the sorghum lacks. Cowpeas are great drouth resisters and admit of many ways of planting

and over a large season. Seeded on ground from which a crop of oats or wheat have been removed, they will produce from 1 1-2 to 2 feet of growth by the first of September. For earlier feed than this they should be seeded the last of April or the first of May.

While broadcasting is a very successful method of seeding them, it is very desirable to drill and cultivate some as this will aid them to withstand drouth, and more feed will be produced at a critical time. For broadcasting about 1.1-4 bushels of seed is required per acre; for drilling in rows 30 inches apart, three pecks.

Peanuts are a crop that do well in Oklahoma, and many are raised for market, but they have greater value to the territory for hog pasture. For hog pasture they can be made to pay on any soil that is open enough to work easily. The hogs harvest them and that expense and labor is saved. Many a peanut crop harvested and marketed at a loss would have yielded a handsome profit if it had been used as a hog pasture. Peanuts should be valued as a protein producer, and for that purpose are very valuable as they contain about 30 per cent of that most valuable food ingredient. While the vines are green they are eaten and afford valuable feed. The crop should be pastured along with sorghum, rye, wheat, or oats for the most profitable results. For hog pasture the crop can be grown as cheaply as corn. Plant as soon as all danger of frost is over. Have the soil in fine tilth. Make the rows two and a half or three feet apart and drop the seed twelve to sixteen inches apart in the row. About two bushels of the nuts in the pod will be required to seed an acre. Give clean culture, and no hilling up is necessary. The Spanish variety is best suited for this purpose.

Sweet potatoes make a good feed for hog pasture. The expense of this crop is quite light up to the time of harvesting and the hogs will do this to perfection and give good returns for value received. The culture of the crop is well understood. It can be made ever profitable utilized as hog pasture.

Artichokes are a most excellent crop to furnish fall and winter pasture for hogs. Under proper treatment 400 to 800 bushels of tubers per acre may be counted on. Plow the ground as you would for potatoes; plant in April in rows three feet apart with the hills fourteen to eighteen inches apart in the row, and cultivate as you would corn. In this country the pasture is available the winter through. (March, 1901).

NEW AND REMARKABLE PLANTS.

Much money is wasted every year in the purchase of nursery stock that is "the greatest wonder of the age." People keep on buying this sort of things and probably will continue to do so. Some enterprising man, out of a job, perhaps, or possibly because there is money to be made at it, arranges with some grower of nursery stock to fill his orders with the cheapest sort of seedling apple trees. The agent starts out and names it "The everbearing pumpkin apple." Trees are sold for fifty cents or a dollar each, and the purchaser plants the "ever-bearing pumpkin apple tree," watches it closely for four to six years, and at last there are a few blossoms. What delicious "pumpkin apples" will be his! When fall arrives, and a few little, sour apples are all that are secured, there is considerable disappointment, but usually further hopes for future development. If plain, reliable trees of Missouri Pippin, Ben Davis, Winesap, Jonathan, Arkansas Black, Maiden Blush, or any other standard varieties had been planted good fruit would have been secured instead of nothing.

This is but an illustration. The principle holds good in the purchase of seeds and plants of every sort. Purchasing seeds and plants from well-known nurserymen and seedsmen is the best and safest plan. Expectations of a great deal for nothing or of securing something unusually profitable will not be realized. Fruits are mentioned particularly because of the frequency of deception in tree-selling and of the ease with which profitable, thrifty, reliable, nursery stock may be secured. (February, 1901).

CHINCH BUGS.

On September 17, 1900, a circular was sent out from the Experiment Station to over four hundred wheat growers of the territory regarding the prevalence of the chinch bug and the success attending the use of the infection and other methods of destroying this well known pest. Many of these persons had received from the Station during one or more seasons some of the chinch bug infection for trial on their places and it was desirable to collect the statements of these persons as to the results secured by them on a large scale. The following are the questions to which answers were requested:

1. Have you found any chinch bugs this year? During what year did you first notice the bug in your crops?

2. Were they more abundant this year than during preceding years?

3. What did you do with the infection which you received from the Station?

4. Do you consider that the infection has reduced the numbers of chinch bugs?

5. Have you employed any other method of exterminating the bugs?

In answer to these circulars there were received about two hundred and fifty replies of which one hundred and eight came from persons who had employed the infection on their places during one or more years. These hundred and eight replies represent twenty-two of the counties of the territory and two of the nations of the Indian Territory.

In all parts of "Old Oklahoma" the bugs were noticed during the year 1890 or shortly thereafter while in the "Strip" the bugs were present as a rule in the first wheat crop raised. They have been present during each of the following years in greater or less numbers and were present in the wheat and sorghum during the past season in many parts of the territory. According to the replies the bugs were not more numerous this year than during previous years though in a few localities they have done more damage this year than ever before. From the information at hand it is not possible to detect any evidence of migration from one part of the territory to another, though some report that such is the case.

The replies to the fourth question were rather conflicting and are therefore tabulated below for reference:

Yes—50.
No —22.
?——36.
Total, 108.

To the 50 replying "yes" might be added 16 others who answered "yes" but who were for one reason or another in doubt as to their reply. In many cases the experiment had been tried during very dry weather and failed for the very simple reason that at that time or rather under those conditions the fungus was unable to grow as rapidly as required. Experiments tried during wet weather were as a rule successful for under these conditions the fungus is able to vegetate rapidly and the "infection" spreads rapidly. Of course the death of the bugs during moist, damp weather must not be confused with the death due solely to the presence of the infection, and since the greatest damage done by the bugs is during dry weather, when the fungus is unable to grow rapidly, it can hardly be expected that great or paying success will attend the use of the infection on a large scale. The Station will be glad to supply persons with the infection for such use but suggests that it is often

possible for the farmer to find a great abundance of the infected dead bugs about the bases of the old corn or sorghum stems.

Very few persons had attempted to make use of any other method for exterminating the bugs. The most important methods suggested in these answers are tabulated for reference:

1. Many have found it wise to burn all the stubble off the ground.
2. Some form of the "barrier" method has in many places been found useful and practical on a large scale.
3. The planting of "catch crops" is highly recommended by many and seems to be worthy of trial in more parts of the territory.
4. One of the correspondents reports that the "lady bugs" were rendering valuable assistance in destroying the bugs.
5. Another person says that the Pekin ducks had eaten many of the bugs on his place. Attempts should be made to induce other domestic fowls to eat the bugs for the rapid destruction of a few when they first appear on a few rows of the crop may save the entire field.
6. Spraying the stems of corn and sorghum with boiling hot water proved satisfactory in some cases though the use of Paris Green and kerosene emulsion proved of no avail.

Experiments along some of the lines mentioned are to be undertaken at the Station during the coming season and in the meantime notes from persons who have had success with any method are very desirable and will greatly assist in combating this great insect enemy. (December, 1900.)

THE GRAIN-LOUSE VERSUS WHEAT.

It is appropriate at this time to notice this insect whose ravages in wheat in several counties of Oklahoma have greatly reduced the value of this year's crop. By extensive correspondence and by conversations with many wheat growers, uniform testimony is secured that throughout the regions named below the wheat or grain-louse has greatly damaged this year's crop. In fact the injury in some regions has been so great that farmers have preferred to replant the wheat ground to some other crop. A recommendation to this effect was inserted in some of the newspapers of the territory some time ago.

The Station received the first specimens of this louse early in April and the Entomologist has since that time given most of his time to a thorough investigation of the distribution and life history of the insect. It became at once apparent that the main damage was not due to the well known "grain-louse" (Siphonophora avenae), whose structure and

life history have been so well aired in the newspapers of late. Our form differs from the one mentioned in several details and will soon be described as a new variety closely related to the true "grain-louse."

The greatest injury to wheat has occurred in the following regions: Chickasaw and Cherokee Nations and Cleveland, Canadian, Kingfisher, Lincoln, Logan, Noble, Oklahoma, Payne, Pawnee and Pottawatomie counties. In some cases it was noted that the general trend of the migrations of the insect was from south to north. The louse, like its better known relative, is capable of very rapid multiplication and this is favored by dry weather. Males are unknown and the reproduction is by the process called parthenogenesis, or the giving birth to the living young. The viviparous females are wingless but enough winged females are produced to enable the species to migrate from one field to another in search of food. These winged females were present in large numbers from about the middle of April to the first of May.

There is no evidence that this louse has a true egg-stage. It is probable that it winters over in the adult stage and feeds upon the leaves of the wheat during favorable weather during the entire winter. The past winter was in some respects very favorable to the development of the louse in large numbers and it is not therefore a matter for surprise that such hordes of lice should have appeared so early in the spring.

There is no practical spraying method that can be recommended against this insect pest. Some have suggested spraying with the usual kerosene emulsion and this would probably reduce their number if applied before they spread over so large an area as to make the plan quite impossible and too costly. Our greatest hope lies, however, in the rapid multiplication and energy of the natural insect enemies of this louse. The most abundant and useful of these enemies in Oklahoma is surely one of the 'lady-bird' beetles (Hippodamia convergens). This is a nearly hemispherical beetle about three-sixteenths of an inch in length and of a reddish-yellow color with several black spots on the back. The head and thorax are black with reddish-yellow margins and the thorax has two elongated reddish-yellow spots.

The larvae of these beetles are even more rapacious and active than the mature beetles. The larva is a long, blackish, somewhat flattened, and very active larva with six legs of more than usual length. The larva when it reaches maturity curls upon some leaf or stem and changes to the pupa from which the mature beetle emerges in a few days. The beetles live over winter in the mature stages in crevices of trees and boards. These "lady-bird" beetles have appeared in such large numbers

in some parts of Oklahoma that farmers have written to the Experiment Station for some remedy to destroy them. Every wheat grower should look on these beetles as his best friends and in no case allow them to be destroyed.

Specimens of the wheat louse and especially specimens of all the beetles found in the wheat fields are very much desired by the Experiment Station and may be sent through the mail if enclosed in tin or wooden boxes. (May, 1901.)

COTTONSEED MEAL AS PIG FEED.

F. C. Burtis.

INTRODUCTION.

Protein, the nitrogenous part of the feed, is the most important constituent in it. Many of the common feeds on the farm, as corn, Kafir corn, etc., do not contain this ingredient in sufficient amount for the best results in feeding. A feed is generally valuable in proportion to the amount of protein it contains. Cottonseed meal is one of the very richest feeds in protein and it is a very cheap source of this valuable food ingredient. In cattle feeding, cottonseed meal is used quite extensively and with the best results where certain precautions are followed. It has been used only to a limited extent in pig feeding, as fatal results have followed as a rule in the general way of feeding it. After feeding on it from four to six weeks the pigs would commence dying, and this has usually been the case when even very small amounts of the cottonseed meal have been fed along with other grain. The writer has found a mixture of 1-5 cottonseed meal and 4-5 corn or Kafir meal to give most excellent results when fed to pigs, and with very few exceptions no pigs have died, if the cottonseed meal was not continued longer than four weeks. Later experiments at this Station indicate that there are several conditions under which pigs may be fed a small amount of cottonseed meal with other grain for an indefinite time without injuring the pigs in any way, and good gains obtained with a small amount of grain. One of the conditions is where the shoats have access to plenty of range and green feed. Again, if the cottonseed meal is dropped after feeding three or four weeks and after a lapse of two or three weeks added to the feed again for three or four weeks, and dropped again for a few weeks, and so on until the pigs are grown or fattened, good gains will be obtained with practically no loss of pigs. Once in a great while there may be exceptions to both these methods as the following experiments will show. These experiments were planned with a view of ascertaining in what ways and under what conditions cottonseed meal may be fed safely to pigs.

TRIAL I, SPRING 1900.

This experiment was planned to test the alternating method where the cottonseed meal was to be fed for a few weeks and then dropped

for a few weeks and taken up again, and this process continued until the pigs were finished. This work, as are most of the following experiments, was rather preliminary work for future experiments.

Seventeen thrifty shoats varying more or less in size were used. They were mostly late fall pigs and averaged 80 pounds per head at the beginning of the experiment, March 22nd. They had the run of a large paddock where they could get a little green stuff now and then. For the first 27 days they were fed a grain mixture containing 1-5 cottonseed meal and 4-5 Kafir meal; for the next fourteen days nothing but Kafir meal was fed; for the next fourteen days 1-5 cottonseed meal was added, and then for seven days the cottonseed meal was dropped, and then for five days it was added. This made a total feeding period of sixty-seven days. At the close of this, part of the pigs were sold and the rest put in another experiment which included cottonseed meal as part of the feed. During forty-six days of the sixty-seven, the pigs had received a grain ration containing 1-5 cottonseed meal and none of them had died, and all had made very fair gains and on a moderate amount of grain.

For comparison, the first twenty-seven days in which 1-5 cottonseed meal was in the grain ration, are taken as period I; the twenty-one days in which no cottonseed meal was fed are taken as period II; and the other nineteen days in which 1-5 cottonseed meal was included are taken as period III.

The following are the results:

Period I. Feed; 1-5 cottonseed meal, 4-5 Kafir meal.

Grain required to produce a pound of gain ..... 3.19 lbs.
Daily gain per pig ..... 1.28 lbs.
Cost per pound of gain ..... 1.72 cts.

Period II. Feed; Kafir meal and corn meal.

Grain required to produce a pound of gain ..... 5.71 lbs.
Daily gain per pig ..... 1.04 lbs.
Cost per pound of gain ..... 2.55 cts.

Period III. Feed; 1-5 cottonseed meal, 4-5 Kafir meal and corn meal.

Grain required to produce a pound of gain ..... 4.39 lbs.
Daily gain per pig ..... 1.21 lbs.
Cost per pound of gain ..... 2.37 cts.

(Kafir meal 40 cts, per cwt. Cottonseed meal $1.10 per cwt.)

Close comparisons cannot be made between these periods as they vary in length and all the days are not consecutive. But it can be plainly seen that the pigs made much better gains while receiving the cottonseed meal and required much less grain to produce a pound of pork. None of the pigs died, although they had received cottonseed meal as a part of their ration for forty-six days, twenty-seven of which were consecutive days.

TRIAL II, SPRING 1900.

This experiment was carried on with sixteen shoats. At the beginning of the experiment, April 12, they were the scrawniest, stunted pigs imaginable. Space will not be taken up to explain how this condition was produced. They were about one year old and averaged only 79 lbs. in weight. They were not only poor but small in size and had great large stomachs, caused by the feed they had received previous to this time.

For twenty-six days from April 12, these pigs were fed as follows:

They were hurdled on wheat and fed a light grain ration, consisting of 1-5 cottonseed meal and 4-5 Kafir meal. The following are the results for this period:

Grain consumed	1252	lbs.
Total gain	402	lbs.
Grain eaten per pound of gain	3.11	lbs.
Daily gain per pig	.96	lbs.

These runts took to their feed and the new conditions readily and made rapid advancement from the start and showed no ill effects of the cottonseed meal. There is no question but that the wheat pasture was a great factor in bringing out these pigs.

At the end of the twenty-six days, May 8th, the sixteen pigs were taken off from the wheat and shut up in a lot and fed the same kind of grain, 1-5 cottonseed meal and 4-5 Kafir meal, for twenty-one days. They continued to flourish and at the end of the twenty-one days showed no ill effects of the cottonseed meal. The following are the results:

Grain eaten	1770	lbs.
Total gain	576	lbs.
Grain eaten per pound of gain	3.07	lbs.
Daily gain per pig	1.71	lbs.

All of the pigs were in very fair condition at the close of this period and five of the largest and best were sold. Here was a

case where pigs were fed for forty-seven consecutive days on grain consisting of 1-5 cottonseed meal and 4-5 Kafir meal without killing any of the pigs, and all made good gains and on a small amount of grain. Further, the eleven pigs of this lot that were not sold were put in with other pigs where they had range and green feed and fed a grain ration of 1-5 cottonseed meal and 4-5 corn meal, until July 14th, when they were sold. None of these died and all made good gains. This was a case where pigs were fed part cottonseed meal for eighty-four consecutive days without killing the pigs, and good gains were obtained.

As was stated under trial I, at the close of that experiment, part of the pigs were sold and the balance continued on the ration containing cottonseed meal. Out of a feeding period of sixty-seven days these pigs had received a grain ration containing 1-5 cottonseed meal for forty-six days. This grain ration was continued without change until July 14th. Most of the time the pigs had access to pasture. With one exception the pigs continued to do well and were sold as fat hogs July 14th. The exception was a fine thrifty gilt. She had made most excellent gains. On June 18th, she died suddenly and on examination she showed the usual condition that pigs do that have died from eating cottonseed meal. The internal organs are more or less inflamed and congested and the thorax cavity filled with a fluid. This gilt had received the cottonseed meal as a part of her ration twenty-six consecutive days prior to her death, and preceding this period for forty-one days, but not consecutive days.

SUMMARY.

In these trials thirty-three pigs were fed on a grain ration consisting of 1-4 cottonseed meal and 4-5 corn or Kafir meal, for longer or shorter periods.

In one case, seventeen shoats were fed for sixty-seven days on forty-six of which the grain ration contained the cottonseed meal. These forty-six days were divided up into three periods, the longest one being twenty-seven days. All of the pigs lived and made good gains, and at the close of the sixty-seven days, part of the pigs were sold as fat hogs, and the remaining four were continued on the same grain ration. Twenty-one days from this time (after twenty-six consecutive days of cottonseed meal feeding) one of the four died from the effects of the cottonseed meal, as was clearly shown on examination. The one that died was a fine thrifty gilt. The re-

maining three pigs were continued on the same ration for twenty-six days longer, and then sold as fat hogs. This made forty-seven consecutive days of cottonseed meal feeding for these three, and prior to this time, in a period of sixty-seven days, they were fed on a ration containing 1-5 cottonseed meal for forty-six days, but not consecutive days.

In another case sixteen shoats were fed a ration containing 1-5 cottonseed meal for forty-seven consecutive days, and all lived and made good gains. At the end of this five were sold and the other eleven continued on the same grain ration for forty-seven consecutive days longer, and all the pigs lived and were sold as fat hogs at the end of this time. This made ninety-four consecutive days in which cottonseed meal was a part of the ration, and all the pigs lived and made good gains.

It should be borne in mind that in all these trials, the pigs had range and green feed most of the time. Other experiments with this problem have been completed at this station and others are under way. Some of these have been carried on to determine the comparative feeding value of a ration containing cottonseed meal and corn, with one of exclusive corn, and other mixtures. These and other results will be reported after completing further work.

Our work has gone far enough to enable us to state that excellent gains may be obtained by adding 1-5 cottonseed meal to a pig ration, and that it may be so fed that there is but a small chance of any of the pigs dying from the effects of it. We are not ready yet to say exactly how or under what conditions this should be, but under our methods the death rate was so small that the gain from feeding the cottonseed meal greatly over balanced it.

These directions might be followed by those who want to try feeding pigs on cottonseed meal:

Don't add more than 1-5 cottonseed meal to the ration.

Feed rather a light ration.

After feeding the ration containing the cottonseed meal for three weeks, drop the cottonseed meal for two or three weeks, then put it in for three weeks, then drop it for two or three weeks, and so on.

Endeavor to let the pigs have range and green feed at the same time.

Report results to the Experiment Station.

COWPEA HAY FOR SWINE.

F. C. Burtis.

A series of experiments has been under way at this Station to ascertain the value of cowpea hay as a source of protein, and to give bulk to the ration, in pig feeding. The cured hay has been fed along with a ration of grain to certain lots of hogs in comparison with others fed exclusively on a grain ration.

The up-to-date hog raiser realizes the importance of furnishing sufficient bulk in the ration as well as the proper amount of protein. The pig is naturally an omnivorous feeder and if he is compelled to subsist exclusively on a grain ration of any of our common cereals, his health will suffer and he will not make a proper, nor the most profitable, development. It is true that most of our common farm crops do not contain enough protein for the best development of a pig, but this lack may be overcome by the addition of some feed that is rich in protein, and still the pigs will fail to make the most rapid development if the ration does not contain a certain amount of bulk that is necessary for healthy, vigorous digestive action. With the properly planned hog range, that contains along with the other green crops, some such a crop as cowpeas, alfalfa, or clover (green crops rich in protein), the problem is easily solved and very economically. But some seem to find it necessary to shut pigs in small pens and very often feed them nothing but corn or Kafir corn. With mature hogs that are to be fattened only a few weeks this will be all right, but with the growing shoats or breeding stock, if some feed is not added to furnish protein and bulk to the ration, the stock will do very poorly. Several feeds could be added to such a ration that would correct the evil and the question under consideration is to what extent would cowpea hay do this. The value of green clover, alfalfa and cowpeas as pig feed is pretty well known, but as yet little attention has been called to the value of these crops in the dry condition, hay, for pig feeding. Clover hay has been used for this purpose for a good many years by some, and in the experiments, pigs receiving clover hay with corn meal have made thirty per cent better gains than pigs receiving an exclusive cornmeal ration. Other experiments have demonstrated that pigs fed alfalfa hay along with corn or Kafir corn, make much better gains and require much less grain to pro-

duce a pound of gain than a pig fed on corn or Kafir corn only. Cowpea hay is about as rich in protein as alfalfa hay and is eaten by pigs confined in pens, and should give about the same results as clover or alfalfa hay.

To test the value of cowpea hay along this line, the following experiments were planned and carried out:

TRIAL I.

This experiment was carried on during the winter of 1899-1900. The stock used was grade Poland-China, and were purchased for this experiment of a local hog buyer. They were not at all thrifty and were lean and lank. The bunch included gilts and barrows. They were probably about eight months old and averaged about 115 pounds at the beginning of the experiment. They were divided into two lots of four pigs each and were put in pens a couple of rods square, where they were kept during the experiment. Lot 2 was put on an exclusive grain ration, that consisted of 1-2 cornmeal and 1-2 Kafir meal. Lot 1 was fed from the same grain ration but was given all the cowpea hay they would eat in addition. The hay was fed just as it came from the stack, without any preparation, in a rack, in one side of the pens, so that the pigs could pick it over. A liberal amount, 8 to 10 pounds, was fed per day to the lot. From one-third to one-half of this was eaten up. The stems were eaten about as much as the leaves. The hay was of rather a poor quality but the pigs were always ready for it. Each lot was fed all the grain it could eat up clean. Wood ashes and salt were kept in the pens at all times.

The experiment began January 23rd, and closed April 3rd, making a period of ten weeks. The following are the results:

	Lot I Lbs.	Lot II Lbs
Grain eaten per lot	1,203	751.
Hay fed per lot	589	
Total gain per lot	270	108
Daily gain per pig	1.09	.43
Grain eaten per lb. of gain	4.46	6.95
Cowpea hay fed per lb. of gain	2.18	

At the close of the experiment Lot I was in a fair marketable condition but Lot II was not in as good condition.

The better appetite of Lot I was very noticeable all through the experiment. Lot I, the one that received the cowpea hay, made 150 per cent better gain than Lot II, and required two and one-half pounds less

of grain to produce each pound of pork than Lot II did. While the pigs fed cowpea hay with their grain made a very favorable showing over those fed only on grain, the results were not as would justify shutting the pigs up in pens to be fed in that way if good wheat pasture was available. In studying these results the fact must be kept in mind that these shoats were fairly well grown at the beginning of the experiment, but were not in a thrifty condition.

TRIAL II.

This experiment was carried on during the winter of 1900-1901. The stock used was twelve grade Poland China pigs, raised on the Station farm. They were late fall pigs and in a good thrifty condition at the beginning of the experiment, at which time they averaged 61 lbs.

They were divided into two lots of six pigs each and put in the pens that were used in the previous experiment. The treatment was practically the same as in the previous experiment. Lot I was fed grain and cowpea hay, Lot II grain only. As before, the grain consisted of 1-2 cornmeal and 1-2 Kafir meal. Each lot was fed all the grain it would clean up. The cowpea hay was fed as before. The quality was very fair and about half the amount fed, 7 to 10 pounds, was eaten. Both lots were kept well supplied with water, charcoal, wood ashes and salt.

The experiment extended over a period of ten weeks, December 12th to March 1st. The following are the results:

	Lot I Lbs.	Lot II Lbs
Grain eaten per lot	1,372	1,174.
Cowpea hay eaten per lot	359	
Total gain per lot	191	119.
Daily gain per pig	.46	.24
Grain eaten per pound of gain	7.1	9.8
Cowpea hay eaten per pound of gain	1.87	

For the first few weeks both lots ate practically the same amount of grain, but gradually Lot II fell behind and was still losing ground at the close of the experiment. From the start neither lot seemed to be satisfied and did not do real well, but Lot I, was more contented than Lot II and generally made better gain. The cowpea hay was always eaten with a relish. At the close of the experiment neither lot was making any gain to speak of but Lot I was doing a little the better. It was evident that a change of condition was necessary to finish the pigs with profit. In judging the results the fact should be kept in mind that the pigs were quite young and kept under confinement. Lot I,

which was fed the cowpea hay made sixty per cent better gains than the lot not fed cowpea hay and required 2.7 pounds less grain to produce each pound of pork.

SUMMARY.

The first experiment would indicate that shoats about eight months old could be put in pens and fattened on corn and Kafir corn with the addition of cowpea hay, in a fairly profitable manner and with much better success than pigs under like conditions without the cowpea hay. But the results would not justify abandoning a good range and plenty of green feed.

The second experiment furnishes further evidence that it is not profitable to shut up four-months-old pigs in small pens to fatten them, especially when they are to be fed nothing but corn or Kafir corn. But if they must be fed under such conditions a little good cowpea hay in addition to the grain will help matters very much.

THE ORCHARD.

O. M. Morris.

LOCATION.

The orchard and fruit plantation should be located on sloping land. The soil will be drained of surplus water and will not bake and become as dry and hard in time of drouth. The north and east slopes are the best. They are much cooler in summer and are not subject to as great variations of temperature in winter. The effect of the afternoon sun is somewhat weakened by the slope and the early blooming trees are not forced into bloom so early and more frequently escape the late frosts.

The protection from the wind is perhaps the greatest benefit derived from such slopes. The warm dry winds of July and August do not strike the orchard with their full force and thus a great amount of moisture is saved for the use of the trees and fruit. This protection from the wind is also of great value to young trees while they are forming their root system and becoming well established.

The southern slopes are warmer and earlier in the spring and for some purposes are to be preferred, but usually the fruit matures early enough and with apples in particular the latest varieties mature almost too early for winter use.

A sandy loam soil with clay subsoil is best adapted to the use of all kinds of fruits. The trees set on heavy clay soil will produce a heavy growth of foliage and wood but will be slow to come into bearing, and the fruit will not be as bright in color as that grown on sandy soil. The trees grown on a poor sandy soil will usually make a poor growth and begin bearing young. These trees will be short-lived and weak. The poor, thin, gray and black soils are poorly adapted to trees. The trees set on such land are almost sure to make a very poor growth and be shy bearers. Good upland is the best for orchard land. The bottom land will grow better and stronger trees but they will seldom be as productive. This is especially true of the peach, plum and apricot. The late frosts are more liable to destroy the crop while the trees are in blossom on low land. The lowland also maintains better conditions for the plant diseases that are sure to infest the orchards sooner or later. If the land was formerly in timber, it should be carefully examined for evidences of root-rot before setting out fruit trees.

PREPARATION OF THE LAND.

The land should be cultivated for two or three years and freed of all wild sod and weeds before it is set to orchard. The land should be plowed deep so as to give as deep soil as possible. Most of the prairie soil in Oklahoma is very poor in humus or decaying vegetable matter. Such lands should be well manured before the orchard is set. The manure should be scattered evenly over the field and turned under with the turning plow. The practice of applying large quantities of manure in places where the tree is to stand can not be recommended. This practice of uneven manuring is usually carried out in one of two ways. The manure is applied very thickly in the immediate vicinity of the tree and worked into the soil or it is thrown in dead furrows that are made in the row where the trees are to be set, and then covered. The manure will decay faster if evenly distributed over the land. The trees will gather food from all directions and form a better root system. Where the fertilizer is unevenly distributed, the roots seek the most fertile soil and are developed there in greatest numbers. As a result the water is taken out of such places very fast and in dry weather these spots dry out and the greater part of the root system is left without water. Trees set on such land will always suffer more for water than on soil evenly fertilized.

Subsoiling is beneficial on soil that has a hard clay subsoil. Throwing out a deep dead furrow where the row of trees is to stand and then filling again after the trees are set is often of value both to loosen the subsoil and to help drain the land. These furrows should run up and down hill and be as deep as is possible to make them with the tools at hand. The water that stands on the ground seldom does any harm to the trees but the soil becomes packed and in a little dry spell bakes and dries out very rapidly. A short time before the trees are set the land should be stirred deep and the soil well pulverized and left in a smooth, level condition free from dead furrows and ridges.

CULTIVATION.

The cultivation of the orchard should begin as soon as the trees are set and continue throughout the life of the orchard. The first work should be done with the turning plow early in the spring before the trees start to grow. The soil should be stirred deep and well pulverized. All manure and trash that is on the surface should be turned under and covered well so that it will decay rapidly. The plow should

run as close to the trees as possible without barking the trees or limbs with the harness. A little pruning of the shallow roots will not harm the tree and will often be a benefit to it by helping to form a deep root system. It is best to use a small plow, not larger than 12 inches, for this work. The furrows and ridges left will be smaller and can be reduced and leveled over with less trouble. The land should be harrowed and smoothed down as soon as plowed. This deep plowing and working the soil serves several important purposes.

Plowing and stirring the soil fines it and increases the depth thus giving a greater feeding surface, foraging, and root-hold area to the plants. The soil requires thorough pulverizing and mixing that it may give the best condition for root growth. There is but very little vegetable matter in the average soil in Oklahoma and the soil when plowed simply breaks into small clods that are hard and compact and almost impenetrable to root growth. These clods yield very little food to the plants, although they usually contain an abundance. When these clods are broken up and pulverized so that the air and moisture in the soil can act upon them the plant food is made available to the plants and used by them.

One of the most important benefits derived from deep plowing is the increasing of the water-holding capacity of the soil. The water that is held in the soil consists of a thin film of water surrounding each particle of soil. The finer the soil the more water it will hold. The deep plowing will furnish a deep bed for the water. The annual rainfall is great enough to supply the wants of all our orchard fruits but it is so distributed that during the spring and fall there is an oversupply of water and during the summer there is not enough to supply the demands of the trees. All the methods of tillage that will help to retain the moisture in the soil should be used if possible.

The spring and summer cultivation should keep the surface level and well pulverized. No weeds or grass should be allowed to grow in the orchard. The weeds and grass are sometimes let grow in the vain hope of shading the ground and thus saving the moisture. The result of such a method is that the moisture is taken out of the soil by the weeds much faster than it would be by the sun. Shallow level cultivation forms an earth mulch and is the best method of conserving the soil moisture. The orchard should be cultivated after each rain to break the crust and prevent the soil from baking. This cultivation should begin early in the spring and continue until late in the summer.

The deep plowing in early spring and shallow cultivation during

the summer are of great value in reducing the soil temperature during the hottest part of the summer. The deep bed of soil and shallow mulch act as a dead air space and prevent the heat penetrating deep into the soil. This benefit of cultivation is most apparent on large trees that are in bearing. The foliage retains a deep green color until fall and the fruit is full size and well matured. The trees can not grow and mature fruit when the roots are in dry, hot soil.

The method of cultivation described in the foregoing paragraph should be put into operation as soon as the orchard is set and followed from year to year. After the trees become large and cover most of the ground the deep plowing may be dispensed with, and the soil worked up in the spring with some form of disk or spading harrow. The shallow, surface cultivation must be continued as long as profitable returns are expected from the orchard. The practice of seeding down the old orchard cannot be expected to give good results in Oklahoma, unless the orchard happens to be in some very much favored location. The long summers with light rainfall will probably always be the main obstacle in the way of such treatment.

TOOLS USED IN ORCHARD CULTIVATION.

The ordinary two horse plow is the best implement to use in early spring. This will stir the soil to a good depth and put it in such condition that the rain will sink down and not run off the land. It also leaves the surface open and free from trash and litter that would be in the way of the cultivator. The plow can be run as close to the tree as the team can be driven without danger of barking the tree or limbs with the harness. If the plow passes too close to the tree it should be turned out of the ground or raised so as to run very shallow. A small plow six or eight inches wide is very good to finish around the trees and along the dead furrows but it is not necessary. Some form of a plow is necessary and the orchard can not be well cared for without it.

The shallow summer cultivation can be done with several different kinds of tools. The small shovel cultivator is a very good tool and can be used for a great many purposes. The one horse five shovel cultivator is one of the best tools for a small place. It can be adjusted to do almost any kind of work, and to work in narrow spaces. It destroys the weeds, breaks up the surface soil and leaves it level. There are several kinds of disk harrows and cut-away harrows that do good work and leave the soil in an almost ideal condition. The disk harrow is one of the best tools for summer cultivation of the orchard. It destroys the weeds

and leaves the soil level and well pulverized, thus forming a good mulch. The cutaway harrows are good for surface cultivation but do not as a rule work well if there is much trash or weeds and grass on the ground. The common straight and slant-toothed harrow is of great value in smoothing down the surface of the soil after the plow and heavy cultivators. It is also of value to break the crust of the soil after a rain. There are several kinds of spring toothed harrows that do good work and are valuable as surface cultivators. The roller and drag are of but little value in orchard cultivation. The roller can be used to advantage sometimes on very loose, gravelly soils.

CROPPING THE ORCHARD.

The orchard should be given clean cultivation from the start. The trees should not be compelled to share the fertility and moisture of the land with other crops. If this method is followed from the start it will be much easier to keep the land free from weeds and to give the trees better care. They will reduce the labor of caring for the orchard to the minimum. Some kinds of crops can be grown in young orchards without doing much harm to the trees. The hoed or cultivated crops are all that should be planted between the trees and then the trees should have plenty of room. Early potatoes and such early maturing crops are best to be used for such purposes.

The cultivation should be primarily for the orchard and not for the crop. The moisture should be saved for the trees as much as possible. The sowed crops, such as wheat and oats should never be grown in the orchard on account of preventing cultivation at the time it is most needed. The growing of all kinds of harvest crops should be discontinued under all conditions and circumstances after the orchard is four or five years old. The trees draw moisture from a much larger circle of ground than that covered by the top and by the time the orchard is five years old all the soil space will be drawn on for moisture.

COVER CROPS.

Cover crops are crops grown on the land during the late summer, fall and winter and left on the ground for the purpose of covering the soil during winter and thus preventing its blowing, to catch and hold the rain and snow, to form a mulch, and to add vegetable matter to the soil. In young orchards the cover crops are often of great value, but in the older orchards their value is often questionable.

The value of a cover crop depends much upon the kind of crop and the time it is sown. Cowpeas and plants of that class are valuable

fertilizing plants and form a good cover for the winter. The greatest objection to this crop is that it must be sown early in the summer so that it can make its growth before frost in the fall. This places the crop on the land during the most of the dry weather when all of the moisture is needed by the trees. The bad effect of this will be noticed most on bearing trees by the fruit falling before maturing. Wheat and rye can be sown much later and will make a good cover for the winter and furnish a good supply of manure to be turned under in the spring. These crops will remove soil moisture during the fall and winter and would not be harmful to the trees. The peach tree might suffer loss of fruit buds if the ground becomes too dry during cold weather, but most of the orchard fruits usually pass the winter without suffering much for water.

The cover crop will, if properly handled, improve the physical condition of the soil and increase its water-holding capacity but there may be a doubt as to whether it will do this to sufficient extent to furnish the extra amount of water used by the growing crop. On June 20, 1899 a plat in the Station apple orchard was sown to cowpeas. The peas grew and made a good mulch which laid on the ground all winter and was turned under in March, 1900. July 16, 1900, the same plat was sown to cowpeas as before. They made a better mulch than the previous crop and were treated in the same way. During the summer of 1899 the trees that were surrounded with cowpeas showed by comparing with trees of an adjoining plat that was given clean cultivation, that the cowpeas were robbing them of moisture. During the summer of 1900, however, no difference could be seen in the condition of the trees in the two plats. In January, 1901, the measurements of all the trees were taken and compared with measurements taken in January, 1899. There was no appreciable difference in the growth made by the two plats of trees. These plats have not been under treatment long enough to furnish definite results, but it seems to indicate that this method of growing cover crops may be beneficial on poor land.

MANURING THE ORCHARD.

The soil in most parts of Oklahoma contains a sufficient supply or plant food to produce large thrifty trees and good crops of fruit. The addition of decaying vegetable matter to the soil is the best thing that can be done in most cases. This material should be applied in the form of manure and green crops as much as possible. The plant food

contained in the manure and green crops is valuable when placed in the soil but the improvement in the condition of the soil is often of even greater importance. The soil becomes more mellow and porous and is capable of holding much more water. The air can pass through the soil much better and carry on the work of decay much faster. The application of commercial fertilizer is not necessary in most cases and would not pay for the material used. Concentrated fertilizers should be used only on land that is in good physical condition and well cultivated. It may be used on other land but it cannot yield its best returns on such land. Barnyard manure is the best fertilizer for most farms and for most crops. The use of lime and wood ashes is to be commended if the land contains a large amount of humus and is free from alkali. Alkali lands can be improved by thorough drainage and the application of large quantities of manure.

CHOICE OF VARIETIES.

The subject of choice of varieties is the one upon which most questions are asked and the one upon which the least satisfactory advice can be given. The choice of varieties brings in so many personal likes and dislikes that in the end the orchardist must and does choose his own varieties. The orchardist should first study his soil, his location and surroundings. This will enable him to tell what class of trees and fruit will be best suited to his location. With this information in hand he is able to select the varieties that suit him.

Do not covet a variety simply because it was a favorite in an old orchard in another state, but take those that are doing well in your own locality. It is probable that many of the trees claimed to be untrue to name are what they were sold for. The orchardist formerly knew them with different condition of climate and expects them to be here just like those he used to know. There has been an enormous amount of poor trees that were untrue to name sold in the territory and many are still being sold. The reliable nurseries are fast driving out these irresponsible tree dealers and should have the entire support of all fruit tree buyers.

The following varieties of fruit have been planted by fruit growers in different parts of the territory and in most cases are giving satisfaction. The varieties are arranged in order of their preference by the fruit growers.

APPLES.

1. Missouri Pippin,
2. Ben Davis,
3. Winesap,
4. Jonathan,
5. Arkansas Black,
6. Maiden's Blush,
7. Mammoth Black Twig,
8. Cooper's Early White,
9. Yellow Transparent,
10. Gano,
11. Red Astrachan,
12. Lowell.
13. Rome Beauty,
14. Janet,
15. Oldenberg,
16. Early Harvest,
17. Grime's Golden Pippin,
18. Sweet June,
19. Red June,
20. Wolf River,
21. Striped Red June,
22. York Imperial,
23. Summer Queen,
24. Romanite,
25. Sops of Wine,
26. Shockley,
27. Benoni,
28. Shannon Pippin,
29. Buckingham.

PEARS

1. Kieffer,
2. Bartlett,
3. Duchess,
4. LeConte,
5. Garber,
6. Seckel,
7. Sheldon,

PEACHES.

1. Elberta,
2. Alexander,
3. Champion,
4. Crawford's Late,
5. Crawford's Early,
6. Heath Cling,
7. Salway,
8. Amsden,
9. Chinese Cling,
10. Gen. Lee.
11. Mamie Ross.
12. Sneed,
13. Arkansas Traveler,
14. Early Rivers,
15. Triumph,
16. Hale,
17. Oldmixon Cling,
18. Oldmixon Free.
19. Indian,
20. Picquet Late,
21. Bell's October,
22. Crosby,
23. Stump,
24. Globe,
25. Wonderful.
26. Snow,
27. Family Favorite,
28. Foster,
29. Carman.

PLUMS.

1. Wild Goose,
2. Abundance,
3. Burbank,
4. Wickson,
5. Marianna,
6. Damson,
7. Botan,
8. Golden Beauty,
9. Arkansas Lombard,
10. German Prune,
11. Weaver,
12. Green Gage,
13. Quaker,
14. Wilmeth.
15. Satsuma,
16. Shipper's Pride.
17. Miner,
18. Normand,
19. Ohio Prolific.

CHERRIES.

1. Early Richmond,
2. English Morello
3. Montmorency,
4. Mayduke,
5. Dyehouse,
6. Gov. Wood,
7. Ostheim,
8. Olivet,

APRICOTS.

Observations made in different parts of the territory seem to indicate that a full crop will be very rarely obtained. The trees make a good growth and set an abundance of fruit-buds which are usually killed in the winter or by late freezes in the spring. The blossoming period may be delayed from two to four days by keeping the branches of the trees well coated with whitewash from December until the flowers open. This method will not however, be found very efficient. Last

spring, two weeks after the flowers were open, there was enough frost to kill most of the crop under ordinary conditions. Laying down as with blackberries has been tried but it is only partially successful. The orchardist must depend on selecting such varieties as will best survive the frosts and plant them in such positions that they will be protected from the heat of the sun. The Jackson and Golden Russian seem to stand the late frosts better than other varieties in the Station orchard. Although neither of these have borne half of a crop, they have ripened a few fruits each year for the last six years. The following are the varieties which were planted by the Station:

1. Alexander,
2. Budd,
3. Early Golden,
4. Gibb,
5. Golden Russian,
6. Jackson,
7. Luizet,
8. New Castle,
9. Oldberg.
10. Peach,
11. Shemsi.

BUYING THE TREES.

It is the best plan to buy the trees in the fall of some nearby nursery that the buyer can visit and buy the trees on the ground. This will save the expense of freight and enable the buyer to get the trees home in first class condition. Trees transported long distances will usually live and do quite as well as locally grown trees if they are properly packed for shipment and are delivered in good condition. If trees of the desired variety cannot be obtained of reliable nurserymen it is often a good plan to buy good thrifty stock of some other variety and then the following year bud or graft the top ones of the desired variety.

The buyer should not always take the cheapest trees. A good tree is worth more than a poor one and the difference in their value will grow greater as the trees grow older. Good trees are the best and cheapest for all purposes and should always be used if they can be secured. Exorbitant prices do not insure good trees and should not be paid. The variety of fruit that is claimed to be entirely new and the equal of which has never been known, is out of place on the average farm. A strange characteristic of such varieties is that they always originate in some other part of the country and there is no orchard near in which this variety is in bearing to prove its merits.

The buyer should take only trees that are thrifty, well grown, and free from blemishes and indications of insects and diseases. The tree should present the charactertistics of the variety to which it belongs. They should be well branched, wood firm, and buds well developed. The budded and grafted trees each have their strong points and nature of the var-

iety, the location, and the desires of the grower must decide which to take. The peach, plum, cherry, and apricot are almost always budded. The apple and pear are usually grafted, although budding on these is quite common in the east and is being used more each year in the west. Practically there is but little difference between the whole-root grafted tree and a budded tree.

The whole-root and piece-root grafts each have some advantages over the other, and the climate, and variety of the tree should determine which should be used. The whole-root graft requires one seedling for each graft. The piece-root one seedling for every two or three grafts. These are facts that interest the nurseryman more than the fruit grower. The whole-root trees will grow much faster for the first three or four years and will form a better and more evenly distributed root system than the piece-root graft . It will be better braced and will stand much better when exposed to hard winds than the piece-root grafts. The whole-root graft has a root system already developed for it to begin growth upon. The piece-root graft is reduced almost to a cutting and must grow as such. If the cion of the piece-root graft is made long and set deep in the ground it will often strike roots and soon be up on its own root. This is a great advantage in very cold climates or where the roots winter-kill badly.

SETTING THE TREES.

Fruit trees should be set in November or December in this latitude, and may be set in March. They are frequently set too close together for them to attain their full size and productiveness. Trees are wide feeders and should be set far enough apart to develop their natural form and size without being crowded by neighboring trees. There should be space enough between the trees after they are full-grown to admit of the regular operation of cultivation and spraying. These operations must continue as long as the orchard lasts and room must be left for the work to be well done. The distance at which trees should be set will depend much upon the method of pruning followed. If the trees are headed in vigorously and systematically they may be set one-fourth or one-third closer than if allowed to grow to their natural size. Heading in should always be practiced with dwarf pears and many of our best orchardists head in their peaches, plums and quinces. Thin planting is the safer rule for the majority of cases. The following distances are about the best on the average land in Oklahoma when the trees are allowed to grow to their full size:

Apples 30 to 35 feet each way.
Pears, standard, 20 to 25 feet.
Pears, dwarf, 12 to 16 feet.
Peaches and nectarines 20 to 24 feet.
Plums and apricots 20 feet.
Cherries 20 to 25 feet.
Quinces 16 feet.

Short-lived or early bearing trees are often planted between apple trees. This is sometimes practiced with good results but usually it is a bad practice and results in permanent harm to the orchard. While the orchard is young there is some unoccupied land that may be planted to some hoed crop but this land is all needed by the apple trees by the time earlier bearing trees become productive. There is not one man in a dozen who will cut out the trees that are bearing fruit before they have done permanent harm to the apple trees. This applies as well to planting blackberries and the like between orchard trees of any kind. The roots of trees spread over a much larger area than the top and the roots will be over-lapping and robbing the slower-growing trees long before there seems to be any danger of crowding. The thickly planted orchards will be more difficult to cultivate and keep in good condition.

There are many methods of laying off the land in preparation to setting the trees. A simple method is to lay off the rows in both directions with a lister or stirring plow. The trees can then be placed at the intersection of the two furrows and placed in line with but little work. The plow can be run deep enough so that only a little soil will have to be moved in order to place the tree. If the top soil is shallow and underlaid with a hard clay subsoil the hole for the tree should be made much larger and filled with surface soil.

The trees should be set at the same depth or a little deeper than they stood in the nursery row. If set too shallow the crown and roots are exposed to the dry soil and air and the tree is almost sure to perish. If set too deep the roots will be in cold earth and will not start into growth until long after the buds have started. This causes the tree to start growth in the early spring and then die as soon as dry weather sets in.

The soil should be firmed well around the roots and base of the tree to keep the roots from drying and hold the tree firmly in position. It is a good plan to lean the tree a little toward the direction of the prevailing wind. The tree should not lean more than two inches to the foot from a perpendicular line. If it leans too much it will make a very badly shaped head.

WRAPPING THE TREES.

The rabbits damage and kill a great many young trees during the winter by peeling the bark from the trunk and lower limbs. There are several methods of protecting the trees, the most common of which is to wrap the tree with corn stalks, hay, or heavy paper. Wire netting is sometimes used but it is too expensive for most such work. The aim is to wrap the tree so that rabbits cannot reach the bark. This method of wrapping trees proves very effective and is well worth the doing. Some of these protectors if properly fastened, may be left on all summer to shield the tree from the hot sun. The binding must not be tight or it will choke the tree, but simply close enough to hold the covering in place. The wrapping of corn stalks or similar material is the best if it is left on all summer. The stalks are cut diagonally and stuck into the ground as close to each other as they can be set. The top is held in place by wrapping with a wire or heavy twine. This does not form a good breeding place for the borers as is commonly supposed. There can almost always be some bugs found hiding in such places but they are usually harmless. The borers are always worse in trees that suffer from sunscald and drouth and seldom bother well-protected and fast growing trees.

WASHING TREES.

Washing trees with soft soap or blood to protect from rabbits is often quite effectual. Washing with blood is not practicable in large orchards but can easily be done two or three times each winter on the average farm. This operation depends on making the bark distasteful to the rabbits so that they will not bother the trees. This method is cheap and in many cases has proven entirely satisfactory.

The practice of washing the trees with some kind of strong solution during the spring and summer is looked upon by many as one of the necessary operations in good care of the orchard. The object of this wash is to keep the trunk of the tree free from insects and diseases. It may be a benefit to the tree by softening the dry, hard bark on stunted and bark-bound trees. Most washes are used for the purpose of protecting the tree from the attacks of borers and for such purpose the value of many washes is doubtful. Soft soap is one of the best washes for young trees. It is cheap, easily made, and can be made by any one. One pound of concentrated lye dissolved in two gallons of water is also a very good wash. Neither of these washes will entirely prevent borers and should be used only as one of the operations of cultivation and care necessary to keep the trees in a healthy growing condition.

PRUNING THE TREES.

Apple trees require pruning from the time they are set in the orchard until they cease to be of value as orchard trees. The roots necessarily receive severe pruning when the trees are lifted from the nursery row; the larger portion of the roots remaining in the ground. The roots that are broken and mashed should be removed and the ends of all roots cut clean and smooth up to sound bark. This will put them in much better condition to heal over quickly. It is best to leave as much of the roots on the tree as possible and not to prune them any more than is necessary to put them in good condition. The top should be cut back severely to balance the relation between the leaf surface and the roots. The limbs can be cut back, leaving only four to ten inches of each limb. If there are more limbs than are wanted to form the main frame work of the top, the extra limbs should be cut out entirely.

There should not be more than five or six main limbs. The top can branch from these and be formed better and with less danger of interfering branches. The first two years after the trees are set in the orchard is the time to form the frame work of the top and if the tree is cared for and pruned properly during this time, the future pruning will be light and easily done. It will consist of removing interfering twigs and thinning the top to admit air and sunlight.

The head of the tree should be formed low, the lower limbs about two feet from the ground. The low headed trees shade the trunk and surrounding soil very early in the life of the tree and in this way form a great protection against sunscald. The low headed trees are not so badly beaten and shaken by the wind. This point is perhaps of greater value than that of protecting from sunscald. This is equally true of all kinds of orchard trees.

Pear trees should be pruned the same as apple trees for the first five or six years. After the tree comes into bearing the top must be cut back each year. This is especially true of dwarf pears where heavy pruning is one of the conditions that help to keep the tree dwarf. The fruit buds are formed on the end of twigs or spurs and it seldom happens that a twig bears fruit and develops a fruit bud the same year. Cutting back the top during the winter will cause the tree to develop a large number of fruit buds each year.

Peaches and apricot trees should be set when one or two years old from the bud. When the trees are set, the roots are pruned no more than is necessary to put them in good condition and the top is pruned to almost a straight stock. The side branches are cut back to two or three

buds and the central stem is cut back to not more than two or three feet in length. The frame work of the tree should be formed about the same as that of the apple tree. The trees should be pruned each year to obtain the best fruit. The trees nearly always set more fruit than they can mature and unless the fruit is thinned it will be small and of poor quality. The trees should be headed in during the winter each year. This heading in consists of cutting back the longest and strongest branches and usually aims to remove about one-half of last year's wood. This serves the purpose of thinning the fruit and keeping the tree within bounds.

Plum trees should be cut back about the same as peach trees when set. The subsequent pruning is more like that given the apple. The trees require only a little pruning to keep the top open to admit light and air. The branches may be cut back the same as peach trees and it will answer the same purpose with the American varieties only to a less extent. The Japan varieties bear their fruit in spurs and for that reason should be pruned the same as apple trees.

Cherry trees should be pruned for setting about the same as the peach. The care given all trees in forming the head is applicable to the cherry. After the frame work for the head is started right the trees will require little pruning beyond that necessary to remove interfering branches.

SPRAYING.

Spraying if properly done will prevent the attacks of most plant diseases but will cure plants of very few diseases after the disease has gained a foothold on the plant. To spray for each and every plant disease would be an almost endless task. Fortunately about ninety per cent of all the diseases that can be prevented by spraying require about the same treatment. Four good sprayings a year will keep most orchards free from disease. The first application should be given before the buds start in the spring; the second as soon as the flowers have dropped; the third about two weeks after the second, and the fourth two or three weeks later. The following solution is the one in most common use and seems as well adapted for all special cases as for general use. The copper compound is the active part against diseases and the Paris green against eating insects:

Bordeaux mixture and Paris green.
Copper sulfate (blue vitriol) 4 pounds.
Quicklime (not air slacked) 4 pounds.
Water, to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better, by suspending the sulfate contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag, a longer time is required. Pour the sulfate solution in the barrel or tank used for spraying, and fill one-third to one-half full of water. Slake the lime by addition of a small quantity of water, and when slacked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime, but stone lumps or sand is shaken up in the milk of lime. Now add water to make 50 gallons in the tank, and add four ounces of Paris green or London purple. After thorough agitation, the mixture is ready to apply. The mixture must be made fresh before using and any left over for a time, should be thrown out or fresh lime added.

Insects that have sucking mouth-parts cannot be killed with Paris green or London purple and should be sprayed with kerosene emulsion which kills by contact.

KEROSENE EMULSION.

Dissolve one-half pound hard soap in one gallon of water (preferably soft water) and while still hot remove from the fire and add two gallons of kerosene. When soft soap is used, take equal quantities of soap and oil and omit the water before mixing. Stir the mixture violently by driving it through a force pump back into the vessel, until it becomes a creamy mass that will not separate. This requires usually from five to ten minutes. The emulsion is then ready to be diluted with water and applied. For the common scale insects and hard bodied insects, like chinch bugs use 1 part emulsion to 8 or 10 parts water. For soft bodied insects (plant lice, etc.) use 1 part emulsion to 15 or 20 parts water.

Spraying is not a fad but as necessary an operation in successful fruit growing as cultivation or pruning.

WIND-BREAKS.

Wind-breaks should be provided for the orchard and berry patches. The south and west sides should be protected by planting of trees near the edge of the orchard. The south and southwest winds have the greatest effect upon the trees and are about the only winds that do much harm to the orchard. There is time and labor connected with the planting and care of the wind-break but they are well worth their cost.

A wind-break reduces the evaporation of water from the surface of the soil thus tending to mitigate drought in summer and root-injury in winter. The value of the wind-break for this purpose can hardly be overestimated. Enormous quantities of water are carried away from the land by the dry south winds and anything that will check their force will conserve the moisture to a great extent.

Wind-breaks lessen the amount of wind-fall fruit. It is the hard gales that shake so many immature fruits from the trees. A wind-break lessens the breaking of trees loaded with fruit. It also enables the trees to grow straighter. These are not all of the benefits to be derived from windbreaks although they are the most important ones.

The following are the most common injuries resulting from a wind-break.

Fruit immediately adjoining the wind-break is apt to be much injured by insects and diseases and to be small and inferior in color. Trees immediately adjoining the wind-break are often less thrifty than others. A few other injuries are sometimes charged up to the wind-break but they are not very important. The first injuries just mentioned can be met and overcome by a little work with the spray pump, which must be performed whether there is a wind-break near by or not. The second class of injuries is caused by the wind-break being placed too near the plantation and is not a fault of the plantation in itself.

The best form of wind-break is perhaps formed by setting trees four or five feet apart in rows that are about five feet apart. There should be a space of thirty feet, and forty feet would be better, between the orchard and the wind-break. Some kind of fast growing trees should be used. The elm, soft maple, catalpa, and mulberry are good trees for this purpose. The best results will be obtained if the wind-break can be set two or three years before the orchard. The wind-break if properly cared for will also furnish a constant supply of posts and fire wood. Black locusts grow rapidly and make a good wind-break as well as furnish excellent posts. There is, however, some possibility of their being attacked by borers, as in Kansas, though up to this time, no trouble from this source has been experienced.

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SUMMARY OF PRESS BULLETINS.

PASTURING WHEAT.

While it is not possible to accurately forecast the outcome of the wheat crop, reasonable prudence would suggest that for the present, wheat should not be pastured to any great extent. The conditions have been such during the summer and fall just past that much wheat was sown in soil that had been poorly prepared, and even with the best of preparation, there has not been sufficient moisture for vigorous growth. There were heavy rains during the fall of 1900 and the soil was filled with moisture and thoroughly saturated. With these conditions and favorable winter weather, wheat furnished an unusual amount of pasture last winter and was in some cases actually benefited by pasturing. The conditions are entirely different at present. In general, the fall rains have been sufficient only to moisten the soil to a depth of about six inches while the subsoil has scarcely been reached by the water. The wheat is thus dependent upon the rains that come during the winter and while it is possible that there may be plenty of rain for the purpose, the average rainfall of past seasons has been insufficient. It is true that feed is scarce and high in price and the wheat pasture sells for good prices. Some prefer to take what is to be had in the way of pasture from the wheat crop and to plant some other crop if the wheat is harmed by pasturing, fearing that possibly wheat may not yield well next harvest even if not pastured. Looked at in this light, pasturing wheat is profitable even though it kills the wheat. But it will not do to follow the practice of last winter when it was scarcely possible to pasture wheat too heavily in Oklahoma. (December, 1901).

SELECTION OF COTTONSEED.

At ginning time in Oklahoma last year, cottonseed brought good prices at the oil mills and the greater part of it was marketed at that time. The result was a heavy demand for seed and a short supply last spring. There was seed enough, however, of one sort and another

to plant a large acreage, and the tendency will be to sell seed close again this fall.

Many questions are asked about varieties. The best answer to all of them is the remark of a southern cotton grower who said. "I can take any of the so-called distinct varieties of cotton and in a few years develop all the known varieties from it. In other words, they will develop themselves in the course of time. All that is necessary is to watch the field from year to year and when a 'sport' is noticed save the seeds and plant them by themselves."

There is abundant evidence of the fact that cotton varieties become modified and become adapted to the conditions under which they are grown. There is thus every reason to believe that proper selection will develop a type or types of cotton particularly adapted to Oklahoma. In fact, it is probable that this type already exists on the few farms where intelligent selection of cottonseed is practiced.

There are three general ways by which new varieties are originated and by which the excellence of any variety is perpetuated. These are (1) saving seed from early maturing bolls, (2) selecting seed from plants of individual excellence, and (3) cross fertilization.

The first of these methods may be carried out without difficulty on every Oklahoma farm where cotton is grown. The first few loads of seed cotton are usually picked by the farmer himself, and he is thus enabled to know to a great extent the character of the lint. If these first pickings are ginned and the seed saved and taken home as seed for next year's crop, a long step has been taken toward the fixing of any desirable characteristics that the particular variety or mixture of varieties may possess.

The selection of seed from plants of individual excellence requires more care, patience and labor than the plan just described It is not probable, neither is it necessary, that many cotton growers will go to the trouble and expense of carrying out this plan, yet there are substantial returns in store for a few who will do the work well.

Still fewer will attempt cross fertilization and there is less need of it. The improvement of the grade of our cotton can be steadily pushed forward by every cotton grower exercising care in seed selection from the present stock and when this comes to be the general practice, a sufficient number of specialists will appear to more than supply the demand for new varieties. (September, 1901).

BROOM CORN.

Broom corn is a variety of sorghum and has many of the qualities of ordinary sorghum. Like sorghum in being hardy, it is a great drouth-resister and thrives under reasonably unfavorable conditions.

It can be planted at any time from the opening of spring until as late as July 1st with fair assurance of a crop. But as early harvesting and early marketing are especially desirable, it is usually advisable to plant it as early as Indian corn is planted, or from April 1st to 15th. If planted by the middle of April it will be ready to harvest by about the first of July. There is usually a lull in farm work about this time that makes it convenient for broom corn harvest.

There are numerous methods of planting it. It is planted in rows, checked and drilled. Drilling in rows gives the best results. The rows should be about 3 1-2 feet apart and the stalks about 6 to 8 inches apart in the rows on ordinary upland and a little thicker on bottom land. If it is planted too thin on good soil, the heads become so heavy that their own weight bends many of them down, forming the "crooks." This crooked brush is heavy but because it is more difficult to make into brooms and makes a larger bulk in shipping, it brings about half-price on the market.

Owing to its being a hardy plant, the cultivation of broom corn is often sadly neglected. It will make a fair showing on poor land with very little cultivation, but it responds to good treatment and should be cultivated as often and as thoroughly as Indian corn. After the first heads appear it is not long before it is ready for harvesting, and everything should be in readiness, because it soon depreciates in value after it is once ripe enough to cut. In order to make the best brush it should be cut when the seeds are in the dough stage. A small patch for seed can be left until fully mature.

The standard varieties are harvested by breaking two rows together in such a manner as to form a table upon which the heads after being cut off are laid to cure. It should remain in the field about a day. A light rain or a heavy due injures the brush. It is well if possible to cure it entirely in a shed. But if put in while green it must be placed in thin layers, which require considerable extra shed room. If left in the field, however, about a day after cutting, until it is nearly cured, it can be piled in good sized layers under cover, and seeded when convenient. The seeding is done by holding the brush on a cylinder similar to a thrashing machine cylinder. After it has been seeded, it should be bulked down in good sized piles and allowed to dry until the stems break quite readily.

Then it is ready to bale. Both the seeder and a baler for a small farmer can be made by any carpenter at a small cost.

The yield varies of course with the soil and locality, but a good average yield is a ton of thrashed brush from 3 to 5 acres. An experienced hand can cut about one acre a day. The thrashing and baling costs about $4.00 per ton. The price varies so much that the profits for one year can seldom be assumed as a standard. Ordinary brush one year with another averages about $60 to $70 per ton.

It is a good crop on the sod. It shades the ground and helps to rot the sod besides making as good a growth as Kafir or sorghum without cultivation.

The seed and the stalks are utilized for feed, but their feeding value is low and it would hardly pay to raise it for feed alone, although in the western part of Oklahoma dwarf broom corn is sometimes sown for roughness instead of sorghum because it does not sour in the stack so badly. After the brush is harvested the stalks can be used for forage and then plowed under making an excellent green manure.

There are many varieties of broom corn, but "Mammoth Dwarf," and of the standard varieties "Improved Evergreen," and "California Golden," have proven to be very satisfactory in Oklahoma. Seed can be secured from local raisers or from western seedsmen.

Broom corn is a "cash crop" and like other cash crops has favorable and unfavorable features. Its cultivation on a very large scale is seldom successful, but if properly handled on a small scale, say from 15 to 25 acres for the average farmer and especially on new land where the variety of sure crops is limited, it will prove to be as paying as almost any crop that can be raised. Oklahoma has early seasons and can market the brush early in the season, when the highest price is usually paid, and for that and other reasons should easily become a great source of the nation's supply of broom corn. (December, 1901).

RAPE FOR EARLY SPRING FEED.

Each season's results at the Experiment Station give further evidence of the value of the rape plant as a source of green feed in this country. Not only has it proven a most desirable spring and fall pasture crop, but a crop that will furnish a large quantity of green feed during such a drouthy summer as that of 1901. The plant lived through the mild winter of 1900-'01 but the zero weather of the past winter killed all the plants.

The rape plant will be one of the first plants available for feed in

the spring and a large area should be put out, as feed is scarce and high priced.

The value of the plant lies in the fact that it will furnish a large amount of green feed in a short period from the time of planting. The plant resembles the cabbage in texture and color but the growth is erect and two to three feet tall. Good rich soil is necessary for a large growth and should be put in fine tilth before seeding.

The plant is proof against frost and may be seeded the last of February or early March in Oklahoma.

Broadcasting will do for temporary patches but if the crop is wanted to last through the summer it should be in drills and cultivated. Do not pasture too close if continuous growth is desired. For broadcasting use three or four pounds per acre. In drills one to one and one-half pounds will be required.

Twenty-three tons of green feed per acre have been taken off at the first cutting at this Station. (February, 1902).

ALFALFA IN OKLAHOMA

The farmer who knows the true value of alfalfa and has the ability to raise it has a great advantage over his fellows who do not. The time is not far distant when the greatest factor in determining the value of a farm will be its adaptability for growing alfalfa. Under no conditions nor with any combination of feeds, where alfalfa is not included, can the animal products of the farm be produced at the minimum cost, be they beef, pork, wool, mutton, or dairy products. The alfalfa crop of the past summer sold as hay in the winter market at a cash value of $30 to $40 per acre. Where properly utilized it has returned a greater value than the above when fed on the farm. For instance, a daily feed of 15 pounds per head with grain to fattening steers has saved one-fourth to one-third of the 60 cent corn, and where fed to young, growing stock, the showing is still more favorable.

Alfalfa as a soil improver stands at the head of the list. Due to its extraordinarily deep growing roots, it obtains its mineral food below where most plants feed. Like other legumes, it takes free nitrogen from the air by the aid of little organisms attached to the roots. Because of these two facts, alfalfa may be grown many years on the same land with the surface soil becoming richer all the time.

In some localities in Oklahoma, the acreage of alfalfa is considerable and the crop flourishes, while in other localities, failure seems to be the rule and of many acres seeded, very few remain now. Undoubtedly

many of these failures have been due to very poorly adapted soil, but the majority of them are due to poor methods of preparing the seed bed, disregarding conditions at the time of seeding, and improper care of the crop after it has been started. A failure may be caused by any one of these or by a combination of them. It is a safe statement that where one acre of alfalfa is now grown in Oklahoma, one hundred might be grown.

Although the plant thrives on a large range of soils, the soil is an important factor in determining the success and productivity of the crop and on certain restricted areas, failure is certain. These are on soils where the rock is near the surface or that hold water to the degree of saturation for several days at a time. Where a stiff impervious clay comes within a foot or two of the surface, the growth of the plant will be weak and will be run out by crab grass unless very carefully nursed, and in unfavorable times this may fail to save it. On such soils the yield will be small. In the valleys of creeks and rivers where the soil is deep and rich and well-drained, alfalfa reaches its maximum but it can be grown on soils not nearly so favorable and very profitable results may be obtained.

The beginner should select his very best piece of land for a start, so as to make success as sure as possible for if he once learns the value of alfalfa, he will make it succeed on almost any soil. But most of the failures of alfalfa in Oklahoma are due to poor methods of starting the crop and improper care after it has been established. Crab grass is a great pest to alfalfa as well as to other crops in this country. The writer has seen new seeding alfalfa get a start of eight to ten inches with a perfect stand and the crab grass catch it and smother it out before fall, and this when the mower was used. The point is that it is folly to seed a field of alfalfa without subduing the crab grass. On the stiff heavy clays, the alfalfa will make a weak growth and the crab grass wil flourish to perfection generally taking the field if stern measures are not employed to check it. On this foul land, preparation of the field for seeding alfalfa should commence a year or two previous to the time of seeding. One year in a crop that can be thoroughly cultivated throughout the season to keep any crab grass from going to seed is a good starter. Follow this with a crop next spring like oats that can be removed early. Plow deep and thoroughly as soon as the crop is removed and keep soil in fine tilth by frequent harrowings every week or two as the weeds start, or after each rain to break the crust. The ground wants to be well settled with a well pulverized surface. Alfalfa

seeding on newly plowed ground is a failure as a rule because the ground is too loose and open.

The time of seeding alfalfa permits of considerable variation, both spring and fall giving good success when other conditions are given due consideration. Fall seeding has a better chance to get started ahead of the crab grass. Seedings from the middle of September to the last of October have given good results in this country. Spring seedings should not be made until the ground is warmed up and the danger of cold rains is past; about the last of March as a rule in Oklahoma. Late spring seeding will be bothered more with crab grass. But the condition of the seed bed must be suitable before seeding is made at any time. There must be moisture enough to start the seed at once, if not, wait; wait if it is six or twelve months. If the soil has been in fine tilth as long a wait as this will seldom be necessary.

Twenty pounds of good seed per acre should be put in. This may be broadcasted but drilling is a surer and more satisfactory method. A common grain drill may be used. It may be necessary to mix the seed with some material such as fine corn meal to get the drill to sow the proper amount.

The first year is a critical one with alfalfa and the weeds and grass should be kept down by frequent mowings made at the proper times. No stock should be pastured on alfalfa during the first and second years. The statement is often made that when alfalfa is once established, it will take care of itself. This is not true on many Oklahoma soils. The crab grass will gradually work in and the alfalfa will go out if something is not done to check the grass. This will be the usual result if alfalfa is pastured. The only way that the crab grass can be checked is by disking several times during the crab grass season just after the alfalfa has been cut. The disk must be set deep to have good effect. Harrow down thoroughly after disking. A disking in July and one in August will be necessary to keep the crab grass down.

Alfalfa should be cut after the plants make a good start to bloom; wilting only should be allowed in the swath. The curing should be done in small piles and the hay put in the stack before it is fully dry so as not to lose the leaves. (February, 1902).

FEEDING WHEAT.

Feeding wheat to farm animals is not a novelty to the farmers who passed through the years of '93, '94 and '95 in this country, as many thousand bushels were fed during that time. Due to a very severe

drouth which has caused almost a total failure of corn the farmer now has the choice of feeding wheat; of which he fortunately has plenty; or letting his stock go without grain. At 57 cents per bushel, wheat is by far the cheapest grain within his reach, and if the price of fat stock is maintained it can be fed with profit if the proper methods are followed. The feeder has the advantage of the experiences gained from '93, and '94 and any one not familiar with them should get them as they have been widely published in reports and papers.

The value of wheat for hog food has been demonstrated by practical feeders and the Experiment Stations. Pound for pound it is equal or slightly superior to corn when properly fed. A bushel of wheat will produce from 12 to 15 pounds of pork when fed to thrifty shoats. Grinding at five cents per bushel pays well since when fed whole and dry about one-fourth passes through the hog undigested. Soaking does not lessen this materially, although the results are some better. Feeding sheaf wheat to fattening hogs has not proven economical but with pigs and stock hogs on a light grain feed it is practiced with good results.

Little definite information is on record in feeding wheat to cattle although hundreds have been so fed with good results. In the few experiments at Experiment Stations in this line, wheat has been fed mixed with other grain. When fed this way it has given results fully equal to corn. At the Ohio Station steers fed on a mixture of wheat meal and bran required 6.7 pounds of grain to produce a pound of gain. At the Kansas Station twelve steers fed on wheat meal for 63 days required 5.72 pounds of grain for each pound of gain. This is 10.5 pounds of beef from a bushel of wheat. The 63 days were the first part of feeding period. When the grain fed was limited in amount the steers ate it well without getting off feed. A thousand pound steer should not be fed over 16 to 18 pounds of wheat meal per day as wheat will surfeit a steer more readily than corn meal. Ground is the only condition in which to feed wheat to cattle and better results will be obtained with this if it can be mixed with bran or cotton seed meal.

Wheat meal makes good feed for dairy cattle but should be fed with alfalfa, bran, cotton seed or cottonseed meal, for the best results.

With sheep, wheat feeding has been very successful as the grain gives the best results when fed whole and dry, and the cost of preparation is saved. At the Michigan Experiment Station wheat fed to lambs returned 100 pounds gain for each 553 pounds of grain fed.

Opinions differ much on the merits of wheat as a horse feed. Due to improper methods of feeding, many poor results have followed but

this does not detract from its worth for this purpose. Whole dry wheat cannot be fed to horses with good results, especially to work or driving horses. Soaking it improves some but grinding is by far the best method of preparing it for horses, but if it is fed as an exclusive feed, even in this condition, care will be necessary to avoid colic at times. Much better results will be obtained by mixing half bran, oats or corn with the wheat or mixing it with chopped feed.

The composition of wheat is such that for the animal to make the best use of it some food rich in protein must be added. Cottonseed meal can be used in most cases for this purpose. When corn or wheat is 25 to 30 cents per bushel this consideration has not much importance, but with the present prices the saving made by balancing up the ration will be considerable.

There will be considerable question as to how wheat will pay out this year when fed to fattening stock, but there can be no question but that it will pay to feed it to growing and breeding stock rather than to sacrifice them or let them suffer and deteriorate. (August, 1901).

STOCK FEEDING.

This is a winter of high prices for feeds, and it behooves every feeder to put much thought and skill into his operations that he may have the balance on the right side of the ledger at the close. Fat stock are bringing good prices and no doubt will the rest of the winter; and there is as much opportunity for profit in stock feeding in Oklahoma this winter as there has been any winter in the past. All that is necessary is to feed the right kind of feeds in the proper manner and combinations, to good stock.

The Oklahoma Experiment Station has published several bulletins on the value of different feeds and their proper combinations.

To compound the proper ration, (according to feeding standards,) and the most economical ration, the feeder must take into consideration the market price of the feeds and the amount of digestible nutrients they contain and the character of the nutrients or compounds. Each nutrient in a feed performs more or less of a special office or work in the keeping up or building up of the animal body. For some purposes in the process of animal nutrition any of these compounds in the feeds will supply the want and do the work; but there are some functions in this process of building up of the animal body that require a certain one of these compounds or nutrients and no matter how much of the other compounds is present in the feeds they cannot take the place of this nutrient which is called protein. It goes to form blood, lean meat or

muscles, hide, hair, milk, wool, and other like products that contain nitrogenous material in the animal body. As a rule for feeding purposes, the value of a feed depends largely upon the amount of protein it contains. For instance, every hundred pounds of corn contains 7.9 pounds of this nutrient, protein, that is digestible. Cottonseed meal contains in every 100 pounds 37.2 lbs. When corn is worth 60 cents per bushel or $1.08 per hundred, cottonseed meal is worth about $40 per ton. This is when based on the amount of protein that the two contain, and to realize anything like these comparative values the feed must be fed in the proper combinations, etc. For instance, for an exclusive feed for almost any kind of stock, corn is worth more per hundred than cottonseed meal. There is just as much loss of the nutrients in feeding when too much protein is feed, as when too little is fed. An example of the former case would be where nothing but cottonseed meal was fed and when nothing but corn was fed would be an example of the latter case. When feeds are very cheap these losses may not count for much but when feeds are high priced, as they are this winter, it is very important to see that the combinations of the feeds are such that they will furnish the different materials in the proper proportion to the animals, in order to make the waste as little as possible. The above comparative prices put on corn and cottonseed meal might be said by some to be theory but numerous experiments at the Experiment Stations have demonstrated that they have this approximate value when fed in the proper mixtures, amounts and manner.

The Experiment Station will figure out rations for those that cannot, if they will write and state what kind of feeds they have and the market price and the kind of animals they want to feed it to, and the approximate weight and age of animals.

The following table will aid in determining the best and cheapest feeds to use and combine.

Market price and digestible nutrients per 100 lbs. of the following feeds:	Price per 100 lbs.	Protein, lbs. per 100	Carbohydrates and Fat Equivalents	Total Digestible Nutrients
Wheat Straw	$ .15	.4	37.2	37.6
Cotton Seed Hulls	.15	.3	36.9	37.2
Alfalfa	.60	11.	42.3	53.3
Oat Straw	.25	1.2	40.4	41.6
Prairie Hay	.40	3.5	45.	48.5
Corn Stover	.30	1.7	34.	35.7
Cotton Seed Meal	1.25	37.2	44.4	81.6
Cotton Seed	.70	12.5	68.9	81.4
Oats	1.25	9.2	56.8	66.
Bran	1.15	12.2	45.3	57.5
Wheat	1.00	10.2	73.	83.2
Kafir Corn, whole	1.08	4.7	32.6	37.3
Kafir Meal	1.12	5.8	56.5	62.3
Corn	1.08	7.9	76.4	84.3

Bear in mind that the total amount of digestible nutrients in a feed goes as much toward determining the value of a feed as the amount of protein it contains.

The above feeds must be in the normal condition to contain the given amount of digestible nutrients. For instance, if corn stover or prairie hay were cut at the wrong time or allowed to get wet or are otherwise handled improperly, they might not contain more than half of the amount given above.

The following is given as answers in part to the many inquiries received by the Experiment Station about feeding cotton seed and cotton seed meal.

Steers give the best returns when properly fed on cotton seed or cottonseed meal.

The following results were obtained at this Station during the winter of 1899-1900. The results are for four lots of steers containing five steers in a lot, and for 35 days.

The daily gain per steer was 2.6, 3.2, 2.45, and 2.99 lbs, respectively.

Grain eaten per pound gain was 8.02, 6.54, 8.73, and 7.01 lbs.

The grain for the first and third figures was Kafir meal 18 parts cotton seed 4 parts, cotton seed meal 2 parts. In the second and fourth corn meal took the place of Kafir meal.

To realize the value of this showing, the fact must be known that the 35 days were the last of a feeding period of 147 days, and that in the first 112 days of the period the steers had made good gains. Where cotton seed or cotton seed meal are mixed with corn, Kafir corn or wheat, steers made most excellent gains and this is the most economical way to feed it. Roughly, from four to six pounds of the meal mixed with 16 to 18 pounds of ground corn, Kafir corn or wheat will make a good daily ration for a 1000 pound steer if he has good roughage.

Near the oil mill it is quite a practice to feed no other grain but cotton seed meal mixed with the hulls in the proportion of one of the former to three or four of the latter. Experiment Station trials go to show that much better gains can be made for the amount of grain consumed when corn chop or some other like feed is a part of the ration. Even at the present price of corn and wheat it will pay well to buy wheat or corn to mix with cotton seed meal for steers.

Steers can be partially fattened exclusively on cotton seed, but they will not eat enough of it per day (about 13 lbs) to enable them to make the best gains.

The Texas Experiment Station considers 33 1-3 pounds of cotton

seed worth about as much as 28 pounds of corn for steers and dairy cows. This makes cotton seed quite valuable this year. Cattle want to be brought onto a feed containing cottonseed very gradually.

Cotton seed and cotton seed meal are most excellent feeds to feed with other grains for dairy cows. Not more than 3 to 4 pounds of the meal should be fed per day. When fed in small quantities, 3 or 4 pounds per day, cotton seed meal may be fed indefinitely to steers and cows without injury to them, but if fed in large quantities, they may go blind in about 90 days. At this Station rough yearling steers have been fed the whole winter on a ration of 4 pounds cotton seed meal and 2 pounds of corn and what roughage they would eat, and with good results.

Some deaths have resulted from feeding cottonseed meal to calves, but others have had good results.

It is generally conceded that cotton seed or cotton seed meal should not be fed to swine as many of them so fed die after three or four weeks feeding on it.

But before letting swine want for the proper ration, it is well to consider the proposition of feeding them some cotton seed meal. In the experience of the feeder with a large number of experiments, cotton seed meal mixed with corn or Kafir corn has given the best of gains, but there has been some loss from hogs dying. But we think that the risk of loss is so small with our method of feeding it that all hogs on the Station farm will have cotton seed meal as a part of their ration this winter. The ration should consist of about 1-5 cotton seed meal and 4-5 corn, wheat or Kafir chop. This should not be undertaken unless the risk of losing a hog or two can be taken, and the proper methods are followed. In our judgment, the feed and cost that will be saved will over balance any hogs that we may lose.

Horses have been fed cotton seed and cotton seed meal in small quantities mixed with other grains with the best of results. Such a mixture would be the superior to a single grain as corn and this winter would lessen the cost of feed very much.

In all feeding, stock should be put on a grain gradually, and changes must be made very gradually, and care must be taken not to feed too much. (October, 1901.)

WHEAT MEAL, BRAN, AND SHORTS.

The feeder is frequently in doubt as to which is the cheapest, wheat meal, bran, or shorts when purchasing feed for cattle and hogs.

If wheat meal costs $20 per ton, is it cheaper than bran at $15 or shorts at $16 per ton? Other considerations aside from arithmetic enter into the answer to this sort of questions. In the first place, the material sold as bran varies from the hulls of wheat to a mixture of the entire refuse from flour manufacture known as 'millrun.' And material sold as shorts is often mixed with bran in varying amounts. As used here, bran means material produced as a by-product of milling from which shorts have been separated. It should be flakey, light and bulky, and of the color of the wheat hull. Shorts on the other hand, should be fine, grayish in color, and free from all except small particles of the wheat hull.

The value of a feed, as a rule, is estimated on the basis of the amount of protein, carbohydrates and fat, and the total nutrients which it contains. These words are too often meaningless and will be better understood if protein is thought of as that part of a feed that makes growth; 'muscle-makers' is sometimes used to explain this term. Carbohydrates and fat are the fat formers; they also serve to keep up the heat of the animal body. By total nutrients is meant the sum of the compounds or substances in a feed that contribute to the nutrition of animals. Another term, nutritive ratio, is used to designate the proportion between the protein and other compounds in a feed. It is obtained by dividing the number of pounds of protein in 100 lbs. of a feed into the number of pounds of carbohydrates and fat.

The following table shows the composition of wheat meal, bran, and shorts expressed in the above terms.

FEEDS	Pounds in 100 Pounds			Nutritive Ratio
	Protein	Carbohydrates and Fat	Total Nutrients	
Wheat Meal	10.2	73.0	83.2	1:7.2
Wheat Bran	12.2	45.3	57.5	1:3.7
Wheat Shorts	12.2	58.5	70.7	1:4.8

If the total amount of nutrients determined the value of a feed, it would be a simple matter to decide which is the cheapest. On the basis of total nutrients, if wheat meal costs $20 per ton, wheat bran should cost $13.80 per ton and shorts $16.87. But the requirements of the animal to which the feed is to be fed must also be considered. The nutritive ratio of the ration fed to hogs and cattle may vary within reasonably wide limits. As a rule, however, the grain ration should have a nutritive ration from 1:5 to 1:6.5. The feeder who keeps within

these limits, while he may depart from theoretical standards, will do better than if he feeds without system and without figuring.

It will be seen from the table that wheat varies on one side of the standard and bran and shorts vary on the other. Thus it appears that a mixture of wheat meal with either bran or shorts would be cheaper than any one of them alone; even though the cost be greater.

For example, if wheat meal costs $20 per ton and shorts $16 per ton, a mixture of equal parts of each will cost $18 per ton. This mixture would contain in each 100 lbs. 11.2 lbs. protein and 65.7 carbohydrates and fat making 76.9 lbs. total nutrients, and would have a nutritive ratio of 1:5.9 which would be better to feed than either wheat meal or shorts alone. When wheat meal is fed alone, there is an excess of carbohydrates and fat. In shorts there is an excess of protein. In the mixture, these are balanced, giving what is called a balanced ration.

Each set of conditions requires different management and in this season of high priced feeds, the feeder must use pencil and paper wisely if he is to come out on the right side. The Experiment Station will calculate rations for Oklahoma feeders who desire it. The letter of inquiry should state the prices of different feeds, the character of roughness on hand, and the kind, age, and weight of the animals in order that the most economical ration may be suggested. The above remarks concerning wheat meal, bran, and shorts show how difficult it is to arrive at an exact decision when comparing the cost of feeds and how necessary it is to study feeds and their composition in order to feed to best advantage. (November, 1901.)

FALL PLANTING OF TREES.

Young trees that are bought from the nursery should be planted in the fall. Over ninety-five per cent of the nursery trees are dug in the fall and exposed to the sun and wind all winter without sufficient moisture to keep the trees in perfect condition. These trees should be delivered in the fall and set out in the orchard before January. The sooner the trees are set in the orchard after being dug the better. The trees should be well planted and the moist soil pressed firmly about the roots. The top of the trees gives off moisture in the winter through the bark, and the roots must be well packed in moist soil to supply this moisture; a condition which seldom exists when the trees are in temporary quarters. If the trees are set in the fall, the soil settles around the roots in the winter and will be full of moisture and the trees are ready to start into full and rapid growth in the spring. November and December are usually the best months for transplanting trees and shrubs.

Trees set in the spring will usually grow and do well but the results are not so uniformly satisfactory. The trees are seldom in as good condition for spring setting as for fall. (October, 1901).

PLANT TREES AND CARE FOR THEM.

Governor Ferguson of Oklahoma prefaced his arbor day proclamation with the following appreciation of the beauty and utility of trees:

"In all ages men have loved trees. The beauty of their foliage, their grateful shade in the heats of summer, and the protection of their encompassing branches from the blasts of winter, led primitive men to build their homes in the forests. Trees made it possible for men to pursue the trackless ways of the seas, and from their trunks, were carved the very sinews of civilization. Year after year, the blossoming of trees gladdens the hearts of men with the promise of renewed life. To plant trees is to assist nature in perpetuating one of her most priceless gifts to humanity."

Arbor day is fixed by legislative enactment and Friday, March 14, has been so designated in 1902; a time when trees may be planted with every promise of success.

Trees add much to the comfort, beauty, and value of the home, whether it be in the city or in the country. The value of shade trees about the house is appreciated almost every day from May until October, and no effort to increase the number of trees is wasted. A grove, if well cared for, increases the value and productivity of the farm. The greatest benefit is realized when the grove is placed so that it will form a wind-break on the south and west sides of the orchards and on the north side of the barns and feed lots. This location need not interfere with the grove's producing a constant supply of posts and fire-wood.

There are many trees that, if given proper attention, grow rapidly in Oklahoma. Some of these may be taken from the native forest and all may be obtained from nurseries at a reasonable price and in first-class condition for transplanting. Nursery-grown trees usually grow better when transplanted than those taken from the native forest. The small forest trees are usually sprouts from old stumps and cannot be taken out with a good root system for transplanting. Trees in a native timber are accustomed to shade and they suffer when exposed to the direct heat of the sun and to the wind.

The soil in which trees are to be planted should be given as thorough preparation as for any other crop. It should be plowed to a depth of at least eight inches and firmed down by repeated harrowings. Where

trees are to be planted for shade the holes should be dug large and deep, three feet each way is not too large, and filled in with surface soil to the depth at which the trees are to be set. This work should be done as long as possible before the time for planting the trees, and if now, the soil that is filled into the holes should be saturated with water before setting the trees. Trees that do not have good roots should not be set where they will be exposed to the direct force of the wind. When transplanting, set the roots at about the same depth as that at which they grew naturally, and press the soil firmly about the roots. This is a very important point and frequently neglected.

Trees should be pruned when set. The broken and crushed roots should be cut back to sound wood; they usually are cut short enough in digging. The tops should be cut back so as to properly balance them with the roots; one year old trees may be cut back to the ground, two year old trees should have about half of last year's growth removed, and older trees should be pruned quite severely. No set of rules can be followed in all cases and individual judgment must determine what is to be done with each tree.

In planting for a grove, the trees may be set three or four feet apart in rows seven or eight feet apart each way, or in check rows four or five feet apart each way. The first method will admit of cultivation for a longer time than the second and thinning will not be necessary for a longer time. Trees one year old are suitable for grove planting and may be set in furrows plowed for the purpose after the soil has been put in good condition. In every case the trees should be set thicker than they are expected to stand when grown. It is easy to remove a tree.

Trees set in isolated positions are especially exposed to the hot sun and attacks of borers. In such places, the trunks of trees that are taken from the native forests should be protected during the summer by standing a board on the southwest side of the tree.

The trees most generally planted have been elm, soft maple, catalpa, black locust, and box elder. The elm grows slowly at first and is attacked by borers, but it is the best shade tree in the list and should be included in every planting for shade. The soft maple is easily broken by the wind and suffers from drouth and the attacks of borers, but it grows rapidly from the start and makes a pretty tree. The limbs of the catalpa are easily broken by the winds, but it grows rapidly, makes a fair shade, and is valuable timber for posts.

The black locust is not generally regarded as a first class shade tree and its tendency to sprout from the roots makes it somewhat objec-

tionable on lawns. But it is the fastest grower in the list, will stand more neglect than the others, and the wood is very durable for posts. The box elder is a moderate grower and is not adapted to poor, upland soil, though it does well in favored location. The ash, and sycamore are good trees, but are not adapted to as wide a range of soils as the others.

While the present season does not afford the best of conditions for planting trees, success may be had by all who make an earnest effort. The holes should be well watered when the trees are set and if there is a shortage of rainfall up to the time that growth starts more water should be supplied. After the growth has started and the soil is once filled with moisture, it is then a matter of cultivation. The soil at all times within at least three feet, and better ten feet, of the trees should be kept loose on top and free from grass and weeds. If there are fifty trees or less they should be hoed after every rain; it can be done in an hour. Where the trees are in rows, cultivation with horse tools is cheaper and as effective. Dirt should not be piled up around the base of the trees so as to run water away from them. It is better to have a basin-shaped depression to catch the water that falls and let it soak in.

The planting of trees is commendable and cannot be too strongly urged upon any one who owns even ten square feet of land. But the planting is the least part of the operation. The daily, weekly, and monthly care which is given the tree during the first ten years after transplanting determines whether or not the tree will continue growing. None but those who love trees can succeed in growing them in Oklahoma but nowhere else is care and attention more abundantly repaid. (March, 1902).

CULTIVATE THE TREES.

Many of the trees that were planted for shade and fruit this spring are already dead. Many more will die before the summer is past. The chief cause for this loss has been and will be neglect. Assuming that the trees have been planted properly and that they were of sorts adapted to Oklahoma conditions, at least ninety-five per cent of those planted should live and thrive. Orchardists as a rule give their trees every needed attention and lose but few trees. The most notable example of intermittent enthusiasm may be seen along the streets of towns and cities. When spring comes, nearly every one plants trees as a matter of course or to get rid of some tree agent. Too often when the planting is done, no further attention is given. After planting, the dirt is often piled up in a nice mound about the base of the trees possibly with the notion that this will hold the tree in place. The result is that what rain falls is drained

away from the roots of the trees instead of toward them. In stead there should be a slight depression about the trees so as to get a little excess of water if possible and let it soak in. Cultivation throughout the summer should be given if trees are wanted. The growth of the trees will be better if all the space between them is cultivated after every rain. This is hardly desirable about the house and the next best thing is to cultivate a space about the trees. The soil should be hoed and kept loose for a space of from three to five feet about the trees, the larger the cultivated space, the better. It isn't a hard matter to grow trees if one will give them a little attention right along and will think of them as a crop that should be cultivated if good growth is expected. A treeless town is always cheerless to the stranger, while streets bordered with thrifty trees are attractive and are appreciated by all. Cultivate the trees every time it rains and sometimes between times. (May, 1902).

LOCO INVESTIGATIONS.

The Experiment Station has under way some experiments and studies concerning the "loco weed." This well known weed is fairly well distributed over the western half of our territory and is a source of considerable loss to the stockmen of the region mentioned. Probably all cattlemen are familiar with the symptoms exhibited by the so-called "locoed" cattle but as yet the exact nature of the poison contained in the loco has not been determined—the fact is that many doubt the existence of any specific poison in the loco plant. Investigations regarding this poisonous principle and the general nature of locoism are now being conducted by the veterinarian of the Station and it is hoped this work will yield some positive results regarding this subject.

For some time stockmen have known that the loco plant was more common some years than others but no very definite reason has as yet been given for this phenomenon. It has been suggested that the loco weed during certain years is largely destroyed by insects that make their apearance during certain years in abundance. Some preliminary field work seemed to make this explanation quite reasonable and the botanist and entomologist of the Station has commenced a thorough study of the insects known to infest the loco. Some interesting facts have already developed along this line but some time must elapse before the final announcement of the results of the work can be made.

The final object of the work is to offer the stockmen some relief from the great losses they are now suffering and the Experiment Station therefore desires to secure the hearty co-operation of all persons inter-

ested in the extermination of the loco weed from the ranges. It is especially desired that all persons interested in the subject send in full statements regarding the possible connection of the loco eating habit and rather the common occurrence of abortion among cattle. The losses from this source among stockmen are very great and many seem inclined to think that the abortion is caused by the eating of the loco plant. In fact it is not uncommon to have other evil effects connected with the eating of loco. All these questions will receive attention during the investigations.

It is particularly desired that specimens of the loco plant and all the insects found upon the plant be sent to the Station for examination and study. These specimens may be sent by mail enclosed in a pasteboard box of proper size. Such assistance as that mentioned will do much to hasten on the work along this line now commenced. (August, 1901).

PROTECTION AGAINST PLANT-DISEASES AND INSECTS.

Plant diseases and insects are doing so much damage to the orchards and gardens in Oklahoma that it has become necessary to protect the plants by some artificial means. The method of destroying the diseased and wormy fruit and foliage is of great value if persistently carried out. This cannot be done in so thorough a manner, however, as to destroy all the diseases and insects present, and a few left over and those that will come from neighboring farms will produce a dangerous number next year. The cheapest and most practical method of protecting plants from diseases and insects is spraying. The ideal method is to spray thoroughly and then destroy all diseased fruit, leaves and trash about the orchard and garden. Either method is good when used alone and the value of each is greatly increased when used together.

Spraying solutions are divided into two general classes. Those designed to prevent the attacks of fungus diseases are called fungicides and those designed to destroy or prevent the attacks of insects are called insecticides.

Fungicides protect the plants by preventing the fungus diseases from gaining a foothold on the plants. The solutions are composed of materials that destroy the germinating spores where it comes in contact with them. The copper and sulfur compounds are the most effective materials used in these solutions. Most of the fungus diseases of plants that can be prevented by spraying reproduce by means of two kinds of spores. One kind of spore is produced in the spring and summer

and germinates soon after maturity. If the spore finds lodgment on tender growing parts of the plant and a favorable amount of heat and moisture is present germination and growth immediately follow. If these spores do not soon germinate they lose their vitality. This process of germination, growth and fruiting goes on during the spring and summer. Late in the season another kind of spore is produced, which is capable of passing through the winter and germinating the following spring. The germinating spores send the roots directly into the tissue of the plant, unless it is a surface growing fungus, in which case the roots spread over the surface of the plant. If the plants are covered with a good fungicide when the spores germinate the spores will be killed.

There are two general classes of insecticides. The first class of mixtures contains some poisonous substance that kills the insects when it is eaten with the foliage or fruit on which it has lodged. Paris green, London purple, and white hellebore are the poisonous materials most commonly used in these mixtures. These mixtures are effectual in destroying only those insects that eat the foliage or fruit of the plants, and are harmless to the insects that suck the juice of the plant.

The other class of insecticides kills the insect by coming in contact with the body. Kerosene emulsion, whale oil soap, and pyrethrum powder are the most common materials used in these mixtures. Mixtures of this class are used chiefly to destroy those insects that suck the juice of the plant and cannot be destroyed with poisons. The poisonous insecticides may be mixed with fungicides and applied all in one spraying, but other insecticides must be applied separately.

The fungicides and insecticides, if properly prepared and applied, have no effect upon the plants. If the mixtures are not correctly prepared and applied they do not form the desired protection to the plants and may damage the foliage and fruit. There is never enough poison on the well sprayed fruits and plants to alter their value for food. Most fruits are pared before eating and all sediment of the spraying material removed. In the case of fruits that are not pared before eating, as grapes, a person would have to eat from 350 to 500 pounds to get a small dose of poison. It will always injure the sale of such fruits, however, if there are any signs of a spraying material on them when placed on the market.

There are several kinds of spray pumps on the market that can be purchased for eight to twelve dollars that will do all the work on the average farm. The best form of pump for the ordinary farm orchard is a compact strong barrel pump. It should have a good sized air

chamber and be capable of throwing a good quantity of water with great force. The working parts should be made of brass and if all parts of the pump that come in contact with the liquid are of brass the life of the pump will be greatly increased. Agitator attachments can be purchased as part of the pump or as separate machines. These attachments are very convenient but are not necessary; the agitation of the liquid may be done with a board, by hand.

The pumps should be supplied with about fifteen or twenty feet of one-half or three-quarter inch rubber hose for each nozzle attached. A good length of hose will save a great deal of time and trouble about reaching all parts of the trees and vines.

The nozzle should make a fine spray and be able to throw it several feet. There are two well defined groups of nozzles now in use. The first group forms the spray by forcing the liquid against an obstruction at the outlet of the nozzle. These nozzles throw a fan-shaped spray and most of them can be adjusted to throw a very fine spray or as coarse a spray as may be desired, or even a solid stream. These nozzles are easily opened and cleaned of any clogging material that may lodge in them, by adjusting them to throw a solid stream. This form of nozzle is best adapted for general use.

The second group of nozzles gives the liquid a strong rotary motion just before it leaves the nozzle. This causes the liquid to form a funnel shaped spray. These nozzles form a very fine spray and for applying liquids that are not liable to clog are a very good form.

The spraying must be well done if it is to be of any value. Slipshod work will never pay. It is just so much time and material used and still the plants are not protected. The liquid must be applied in the form of a very fine mist or spray. If the liquid is thrown on the plants in large drops it collects and runs off, but if thrown on in a fine mist the foliage and fruit can be wet on all sides and but little liquid reach the ground. The liquid must be applied from every direction so that all parts of the foliage and young shoots will be wet. If the top of the tree is very dense the nozzle should be held in the center and the spray thrown in every direction. The work cannot be done in a hard wind. The side of the plant next to the wind will be washed and the opposite side show little signs of the spray. The greater the power applied to the pump the better the form of spray thrown by the nozzle.

Spraying is a preventive and not a remedy. There are a few fungus diseases that can be destroyed by spraying but they can also be prevented by the same operation. The damage done by a disease

or insect can be repaired only by the plant itself, and such work as can be done to protect it from further damage is about all that can be done for it. The spraying should be done early and the protection made complete before the disease and insects appear. The first spraying should be done in the orchard, vineyard, and berry patches just before the growth starts in the spring. The second application should be made ten days or two weeks after the first and the third about two weeks after the second. If the orchard or vines are badly infested a fourth application should be made about two weeks after the third. If an application is followed immediately by a hard rain the application should be repeated as soon as possible. If this plan is followed and the work well done with properly prepared mixtures there will seldom be any need of further attention in this direction during the season. The solutions used in these sprayings should be a combined fungicide and insecticide, preferably Bordeaux mixture and Paris green. If the directions are followed they will meet the requirements for preventing about ninety per cent of the common fungus diseases and insects pests. There have been a great many spraying calendars published giving long lists of diseases and insects with specific directions for preventing each one. A careful examination of these calendars shows that a large majority of the treatments recommended are covered by those given above.

The Bordeaux and Paris green mixture is prepared as follows: Dissolve 4 pounds of copper sulfate (blue vitriol) in 2 or 3 gallons of water by placing the sulfate in a sack and suspending in the top of a jar or tub of water. Do not put this in tin or iron vessels as it will rapidly dissolve them. Before mixing dilute this to about 20 gallons. Slake 4 pounds of fresh lime by adding a small amount of water and after slaking is finished add about 20 gallons of water. Stir the lime and water thoroughly and strain before mixing. Pour these two solutions into the barrel or tank at the same time and stir vigorously while mixing. This may be diluted to 50 gallons and is the Bordeaux mixture. Make about one-fourth of a pound of Paris green into a thick paste with water and add it to the Bordeaux mixture and stir thoroughly and the mixture is ready for use.

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