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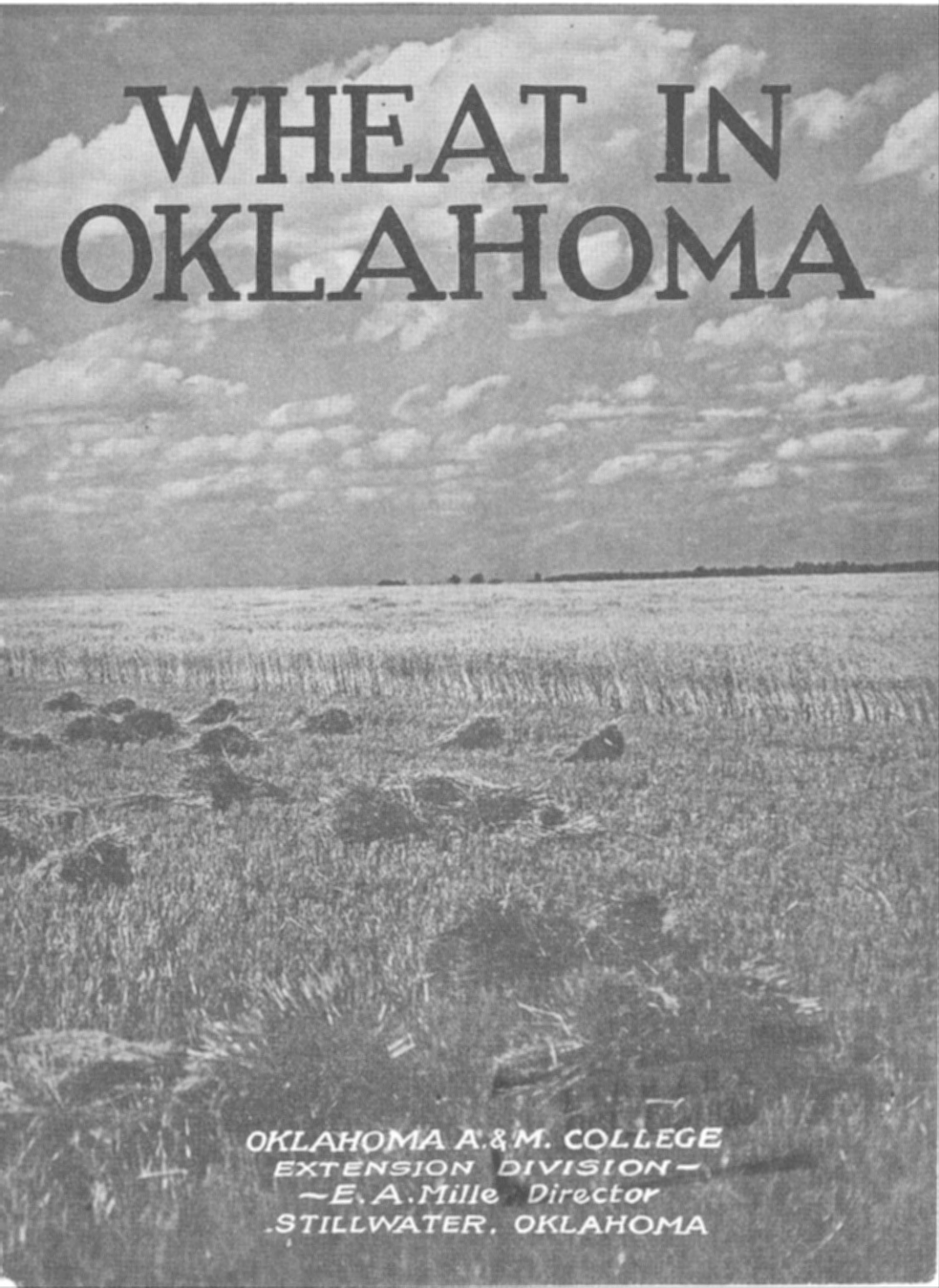
WHEAT IN OKLAHOMA



OKLAHOMA A. & M. COLLEGE
EXTENSION DIVISION—
—E. A. Mille Director
STILLWATER, OKLAHOMA

ON THE COVER PAGE

The picture on the cover page of this bulletin is a harvest scene on the government farm at the Chilocco Indian school, in Kay county.

WHEAT IN OKLAHOMA*

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The wheat section of Oklahoma is in the southern and southwestern part of the hard winter wheat area of the United States. A comparatively small amount of this crop is produced south and east of Oklahoma, while a relatively large acreage is grown in the Texas Panhandle. Because of climatic conditions and the importance of the cotton and corn crops little wheat is grown in the southeastern part of the state while in the northeastern counties only the soft winter wheats are grown. The hard wheats which are by far the most important are grown primarily in the north central and western parts of the state. In these sections it is the most important cash crop grown and the farmer is to a large extent dependent on it for his ready cash income.

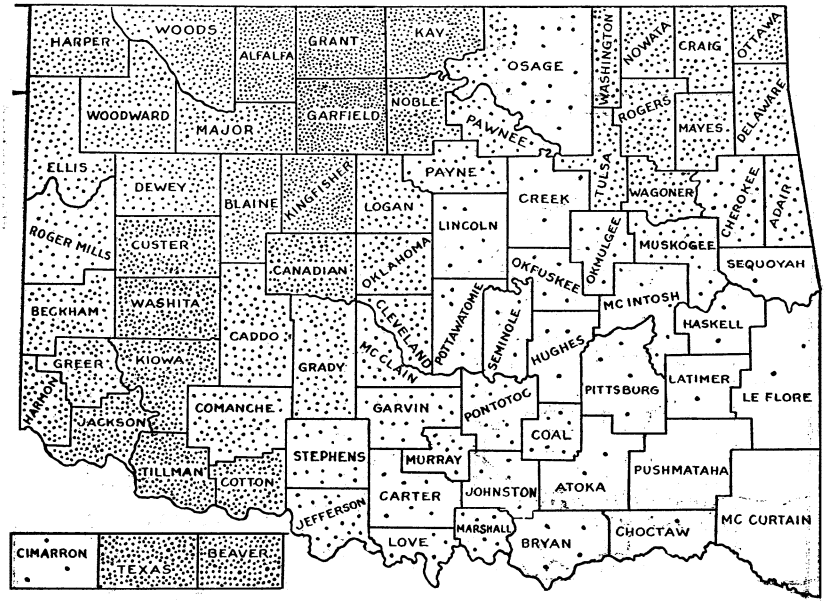

Figure 1 Wheat Map of Oklahoma.

*(Material in this bulletin is taken largely from experiment station manuscript on wheat about to be published.)

It is desired that recognition shall be made of the assistance rendered by Mr. H. M. Bainer of the Southwestern Wheat Improvement Association most of the cuts contained herein being furnished by him.

SOILS FOR WHEAT

While wheat will grow on a wide range of soils, sandy lands are not well adapted to the production of a good yield or quality of wheat. These soils are usually too light, and are frequently lacking in one or more of the necessary plant food elements. The physical condition of a sandy soil also is adverse to the production of a good crop. Clay soils, while harder to work, are better for growing wheat than sandy soils. The best conditions as regards the soil are usually found in the sandy loams, the silt loams, or the clay loam soils of the prairie region in the great plains area of the United States and Canada.

CLIMATE

Climatic conditions in Oklahoma are so varied that it is impossible to grow hard wheat in all parts of the state. With an altitude of about 500 feet and a rainfall of 45 inches in the southeastern part to an altitude of almost 5000 and a rainfall of scarecly 20 inches in the northwestern part it is impossible to grow wheat of good quality in all sections of the state. The variations in climate are too great with such extremes. Wheat farming is found to be most profitable in the northern and western parts of the state where good yields of high quality of wheat are possible.

HARD WHEAT IN OKLAHOMA

The dividing line between the hard and soft wheat areas in Oklahoma is not fixed but moves to the east and south or to the north and west according to the season.

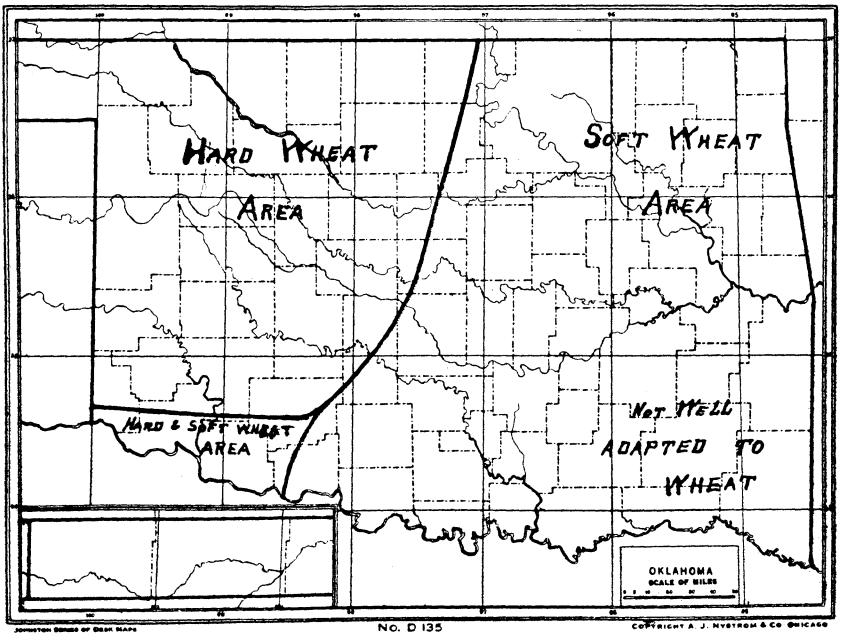

Figure 2 Wheat map of Oklahoma showing the hard wheat and soft wheat areas.

Its position is usually about the 32-inch rainfall line. During seasons of much rainfall this line may move far to the west and north as in 1919 when an excessive amount of rainfall over the state and particularly in the western part was adverse to the production of a good hard wheat. During such seasons a yellow berry wheat develops, causing a starchy kernel which is of poorer quality than the dark hard red kernel. This condition exists so regularly east of this line that only soft wheats can be recommended to be grown. During seasons of light rainfall, especially when the wheat is heading and the kernel developing, a much better quality of wheat is produced. As these conditions are common in the northern and western parts of the state hard wheat of the best quality can be grown in those sections.

PROFITABLE PRODUCTION OF WHEAT

The largest profits in wheat production are usually secured where high yields are obtained. The cost of covering the ground, in preparing the seedbed, sowing, har-

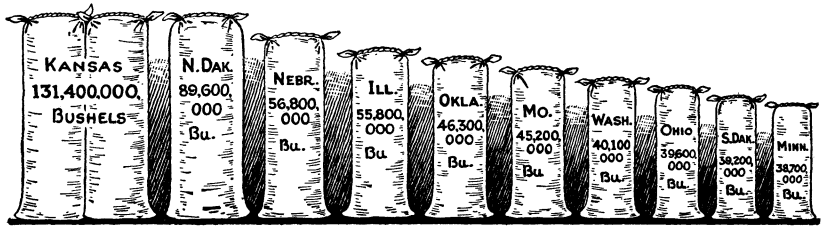

Figure 3. The ten leading wheat producing states of the United States. Average production for the five-year period 1918 to 1922 inclusive.

vesting and threshing the crop is about the same for a poor yield as for a good one. The labor and materials expended in producing a crop should be so used as will give the best results. The cost of preparing the seedbed is about the same whether it is prepared early or late, yet the results secured from increased yields in preparing the seedbed early are so great as almost to make the difference between a loss or a good substantial profit. Yields may also be increased through maintaining or increasing the fertility of the soil. The judicious use of fertilizers together with a proper rotation of crops will add much to the maintenance of high yields. The use of good seed and care in handling the crop after harvest will also add to the profits in growing wheat. With proper management the yields of good quality wheat can be increased much above 12.4 bushels per acre which is the average for Oklahoma.

SOIL FERTILITY

No soil can withstand continuous cropping and maintain high production. Good yields may be secured for a few years but they are bound to decrease sooner or later. In order to keep up good production the fertility taken from the soil must be replaced in some way. Where wheat is the main crop or where any other exhaustive cropping system is used and the fertility is not replaced it ultimately becomes necessary to add fertilizers in some form in order to maintain the yields.

PLANT FOOD

Of all the plant food elements nitrogen, phosphorus and potassium are the ones

most often lacking. However, potassium is usually found in sufficient quantities in most of the soils in Oklahoma that its addition as a fertilizer is not so urgent. Nitrogen and phosphorus are, on the other hand, quite frequently lacking and any means by which their amount or availablility in the soil may be maintained or increased will aid in holding up the yield of wheat.

Nitrogen. While it is a very important food element and is much needed by practically all soils, nitrogen should be supplied to soils through growing such crops as alfalfa, sweet clover, cowpeas, or any other adapted legume. When any of these crops are grown on the farm in a rotation with other crops the nitrogen supply of the soil is maintained if not increased, especially if some of the legume crops is returned to the soil. Nitrogen is taken from the soil air, used by the legumes as a food and if the plant is returned to the soil the nitrogen supply is consequently increased. The nitrogen supply in the soil then is a problem which should be solved through using a proper cropping system including a legume and a proper management of the crops and their residues.

Phosphorus. The phosphorus supply in the soil is not so plentiful as in the case of potassium nor is there a supply to replenish it so near at hand as in the case of nitrogen. Therefore, the maintenance of phosphorus in a soil is a greater problem for the farmer than that of any other plant food element. As all plants use this element as a food and its supply in the soil is more or less limited, the maintenance of the productivity of the soil depends much on the return of the crops harvested or their equivalent as fertilizers.

ORGANIC MATTER

Besides the application of barnyard manure or crop residues to the soils as fertilizers there is much benefit derived from them due to their effect on the physical condition of the soil. Soils need organic matter to make them mellow and improve their tilth. A soil containing organic matter can be kept in a good state of cultivation much easier than one lacking in this substance. Organic matter binds loose sandy soils and helps to keep them from blowing, while on clay soil organic matter makes the soil more friable. By so doing aeration of the soil is also accomplished which aids bacterial activity and hence makes more plant food available. Organic matter also aids in the retention of moisture in sandy soils and permits a clay soil to absorb more of the rainfall due to making them more porous and open. Because of the many benefits derived from the application of organic matter to a soil its use should be much more common in Oklahoma than it is now.

Great care should be exercised in the use of organic matter or fertilizers in Oklahoma. This is because of the lack of rainfall particularly in the western portion or wheat section of the state. Farmers sometimes experience detrimental results through the use of straw or barnyard manure. These must be applied judiciously if they are to increase production. In the eastern part of the state where the rainfall is 40 to 45 inches each year better results can be obtained than in the western part where the rainfall is much less.

COMMERCIAL FERTILIZERS

Commercial fertilizers are not recommended for the western portion of Oklahoma but in the northeastern part of the state where there is considerable acreage

of wheat and where the rainfall permits, light applications of phosphates have given profitable results with small grains. The fertilizer is applied at the time of seeding with a combination fertilizer and grain drill and at the rate of about 100 to 125 pounds per acre. A high grade acid phosphate is used.

STRAW

Straw removed by a crop should be returned to the soil. This can be accomplished by disking it into the ground or applying it as a top dressing in late fall. Experience has shown that light applications of about one ton to the acre are sufficient. Returning the straw in this manner does not only return some plant food taken from the soil but also adds to the organic content of it. This is essential to improve the physical condition of the soil, which aids in providing more moisture, makes more plant food available and gives a seed bed in which the plants can better establish a root system.

BARNYARD MANURE

Increased wheat yields can be obtained through the judicious use of barnyard manure. An experiment conducted at the Oklahoma Station since 1898 shows that beneficial results can be secured, at least in this section of the state. Two one-half acre plots were used in this experiment. To one plot 10 to 12 tons of barnyard manure were applied early and plowed under, or if not plowed under it was disked into the plowed ground a month or so before seeding. If conditions would not permit of applying it then, the manure was applied as a top dressing in the fall after the wheat was up. When manure is used it should be applied evenly. The following is the result of 24 years on these two one-half acre plots that have been in wheat continuously since 1893.

TABLE I

	Average yield per acre
Manured	21.97 bu.
Unmanured	13.05 bu.
In favor of the manured plot	8.92 bu.

Barnyard manure is here shown to increase the acre yield almost 9 bushels and more than 9 bushels above the average acre yield for the state (12.4 bu.) Since the manure is applied only every four years the ten tons added have increased the yield 9 bushels per acre for a period of four years. At one dollar per bushel the 36 bushels of wheat would bring a return of over $3.50 for each ton of manure applied. It might be added also that at no time during the twenty-four years of this experiment has the unmanured plot yielded as much as the manured plot. Furthermore, the first and second years following the application of the manure the effect on the yield of wheat has been greater than the third and fourth year after its application. The manured plot always has a higher percentage of moisture in its soil than has the unmanured plot except at harvest time when the percentage in each is about the same, though sometimes in the surface of the manured plot it is less. This is due to the larger crop on the manured plot using more moisture than the crop on the unmanured plot. In the subsoil however, the manured plot always contains a higher percentage of moisture.

While barnyard manure is more effective in central and eastern Oklahoma, beneficial results can no doubt be secured in the western part of the state if light applications of well rotted manure are judiciously used. Light but frequent applications are better than heavier applications less frequently applied.

DIVERSIFICATION

It has been proven through experience as well as by experiments that a one crop system of farming is not a success especially if it is continued very long. It is necessary to diversify, producing feed crops as well as cash crops and through a proper handling of the former by feeding them to livestock a safe system of farming is established. Under such conditions the fertility of the soil is more easily maintained and the labor is well distributed throughout the year. In a diversified system of farming a good rotation of crops is possible which further enhances production. Experiments at the Oklahoma Experiment Station prove conclusively that small grains in a rotation yield from 3 to 7 bushels more per acre than when grown continuously on the same land.

ROTATIONS

All rotations should include a row crop, a small grain crop and a legume. So far as possible they should come in this order. The row crop may be one of the following crops: corn, grain sorghums, sweet sorghum, broom corn, or cotton. The prime object of the row crop is to give the soil plenty of cultivation and to kill weeds as well as to produce a cash crop or to produce feed. In sections where cotton is grown with wheat it is considered best to follow the sorghum crop with cotton which is to the best interest of the physical condition of the soil as well as to increased production of the crop following. As a rule small grains should follow a row crop if possible. In the western part of Oklahoma where wheat, sorghums and cotton are used in a cropping system this rule does not hold unless wheat is sown on the cotton or sorghum land without first plowing it. If a spring crop such as oats or barley is used to follow cotton or a sorghum crop then wheat can be put into the rotation readily. Another system that may be used is to permit the sorghum land to be summer tilled in preparation for the wheat crop the next fall.

A legume crop should be included in every rotation. Alfalfa, sweet clover, and

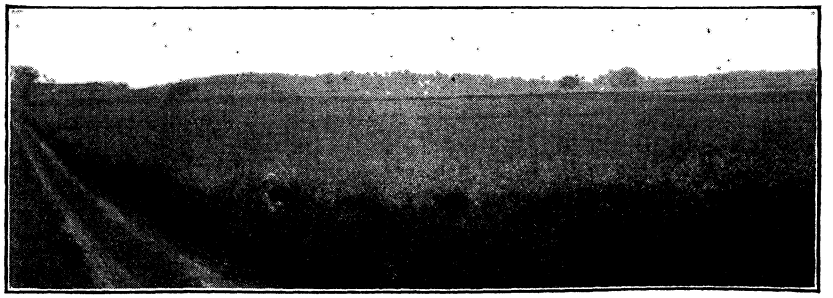

Figure 4 Sweet clover grown for green manure. Land is greatly benefited by the use of a legume in the rotation.

cowpeas are about the only legumes that can be used in the western part of the state. Alfalfa necessitates a period of six to ten years on the same land after it is once established before it should be plowed up to bring into the rotation and therefore does not work well in a rotation system. If conditions permit, however, alfalfa should be grown and the land plowed up every six or eight years and used for other crops for the same length of time if possible.

Sweet clover, being a biennial, can be sown in the fall and a full crop secured the second season after which the land can be plowed and used for other crops. If sown in the winter or spring two seasons' growth can be secured necessitating an extra season to mature the crop. Where it is a success this crop should be more commonly grown. (Write for the Extension Bulletin on this crop).

The cowpea is an annual crop adapted to most sections of the state. Where the rainfall permits or during seasons of sufficient moisture cowpeas can be used as a catch crop, though as a rule in the western part of the state catch crops cannot be depended on. In the northeastern part of the state it is possible to use cowpeas as a catch crop, and thereby simplify the inclusion of a legume in the rotation. Soy beans have been successfully grown in this part of the state but they cannot be recommended in the western part of Oklahoma. The legume crop should follow the small grains if possible and precede the row crop. There are sections in the state where it is necessary to vary this arrangement due to the crops grown or the peculiarity of soil or climatic conditions, but whatever the order in which the crops are grown a legume should be included and a rotation of three or four years is considered better than one necessitating a longer period of time to complete it.

PREPARING THE SEEDBED

In preparing the seedbed for wheat the plowing should be done as early as possible. Experiments conducted to determine the proper date for plowing at the Oklahoma Station show that land plowed in July for wheat almost invariably shows higher yields than when plowed in August or September. Likewise the plowing in August showed better yields than when the plowing was done in September except in instances where timely rains in the fall made conditions ideal no matter when the land was plowed. However, such conditions are exceptional and cannot be depended on.

TABLE II

Showing Time of Plowing for Wheat.

Time of Plowing	5-Year Average	
	Bu. per Acre	Tons Straw
Early—July 15	27.10	1.39
Medium—August 15	24.20	1.19
Late—September 15	22.00	1.15

(Oklahoma Bulletin 65).

Early plowing of the soil in preparing for wheat is necessary to good yields in Oklahoma. If plowing cannot be done early disking at least should be done.

In the spring of 1922 a questionnaire was sent out to county agents who were asked to visit wheat farmers and find out when they had prepared their land for

wheat, also to learn when the wheat was seeded and to get the yields per acre after thereshing. From 72 reports secured the following summary is given:

TABLE III

Average yield per acre of land plowed in July	19.15 bu.
Average yield per acre of land plowed in August	14.07 bu.
Average yield per acre of land plowed in September	2.00 bu.
Average yield per acre of land plowed in October	7.00 bu.
Average yield per acre of land drilled in kafir stubble	4.00 bu.

The average yields per acre of lands plowed as late as September and October as well as those secured from fields where the wheat was drilled in on kafir stubble are only estimates and in many other such cases the wheat was abandoned, plowed up and put into spring crops. From the above figures it will be seen that land plowed early provides a safe means of insuring higher yields. When plowing cannot be done due to lack of time listing should be practiced. Especially is this true where blow soils occur. Listing requires less time to cover the ground than in the case of plowing. The ridges should be worked down as early as possible. If plowing or listing

Figure 5. Disking a stubble field immediately after the binder. The disk kills weeds, conserves moisture and makes it easier to plow at the convenient time.

is not done disking the land is helpful to increase yields. By working the land early in the season moisture is conserved and weeds are kept down. As moisture is such an important factor in crop production in Oklahoma any means employed to conserve it will increase production. A good stand of wheat in the fall often means a good crop the following season. Failure to get a stand in the fall is frequently due to lack of moisture. Any factor which influences a stand in the fall will go far towards determining the results at harvest.

The importance of early plowing may be summed up as follows:

The land usually plows better and easier in June or July than later.

Early plowing prevents the growth and spread of weeds.

Early plowing permits more of the rainfall to get into the soil.

Early plowing together with a little subsequent care prevents loss of moisture which comes about through evaporation or the growth of weeds.

Early plowing necessitates less labor to get the seed bed ready at seeding time.

Early plowing provides a partial summer fallow which liberates plant food.

Early plowing provides a firm seedbed at seeding time.

Early plowing puts the soil in the best physical condition to receive the seed in the fall.

Because early plowing and the subsequent tillage provide an ideal seed bed, there will be a greater uniformity in the germination of the seed. Comparatively the plants will make a better and healthier growth with which to go into the winter.

BLOW SOILS

Practices recommended in preparing ordinary soils for sowing wheat cannot be used on blow soils. Early plowing and later working of the field means failure in such cases. To prevent soils from blowing, stubble or trash on the surface should not

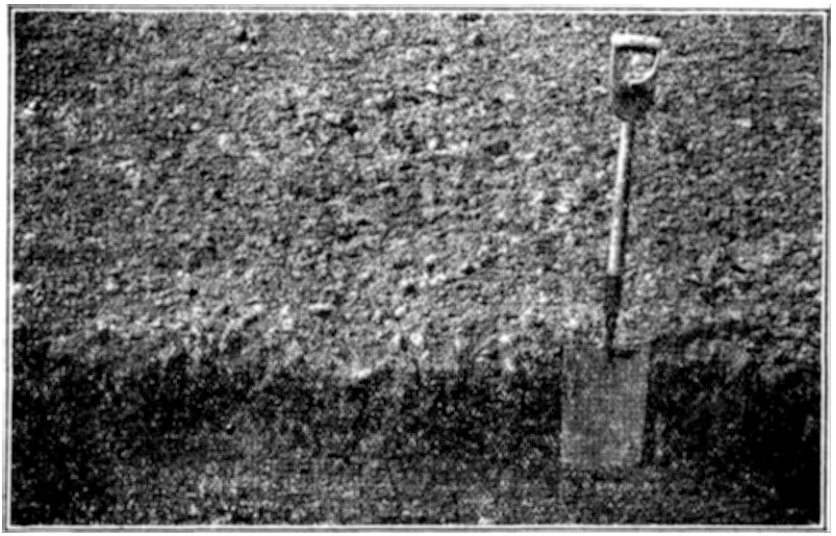

Figure 6 Ideal seed bed for wheat. The cloddy surface reduces blowing, and the compact subsurface will hold moisture.

be plowed under. Disking the ground leaving the surface rough in the stubble will aid in keeping the soil from blowing. Listing the ground crosswise of the direction of the wind is another means that may be employed. Leaving the surface rough or giving little preparation to the land just before seeding where row crops are grown is also used with success. The addition of organic matter such as straw or any other vegetative growth will lessen the effect of high winds. It should be disked in, in order to hold it in place. Even after decay it tends to tighten or bind loose soils. The control of blowing soils in the central and western parts of Oklahoma is always a difficult problem for the wheat farmer. For further information on blow soils write for Extension Circular No. 8.

TIME OF SEEDING WHEAT

The time for seeding wheat in Oklahoma varies with seasons and different local conditions. Some seasons best results are obtained by sowing relatively early while

in other years later seeding is best. An experiment to determine the proper time to sow wheat was conducted at the Oklahoma Agricultural Experiment Station from 1900 to 1904 and showed results as follows:

TABLE IV

Time of Seeding	Average Yield per Acre*
September 10 to 20	24.3
October 10 to 20	27.5
November 10 to 20	13.9

*(Oklahoma Station Bulletin 65)

If the crop is to be pastured, early seeding is necessary and if moisture conditions permit, the value of the fall and winter pasture will offset a decrease in yields. Early seeding under favorable conditions permits the plants to establish a good root system, make a vigorous growth and be in a healthy condition to start the winter. Under such circumstances little winter injury takes place and the crop is ready to start off well in the spring. Later seeding gives less pasture and as the plants are smaller and weaker more winter killing takes place. There are disadvantages, however, in early seeding. The Hessian fly may do much damage to a crop in the spring if it is permitted to get into a field in the fall. Little or no trouble is experienced if the wheat is sown late. Wheat sown early may use up all the available moisture in early fall. If this is the case the plants will be very weak and not able to stand the winter well. This may cause a decrease in yields. In general seeding the latter part of September or the first part of October has given best results at Stillwater. In the northwestern part of the state where the altitude is higher, earlier seeding is necessary while in the southwestern part of the state seeding may take place later than at the Station here. On account of the Hessian fly, wheat in north central and northeastern Oklahoma should be sown not earlier that the second week in October. If the "fly" is not present earlier seeding no doubt can be practiced.

DEPTH TO SEED WHEAT

It is not necessary to sow wheat deeper than one to two inches if moisture conditions are favorable. During dry falls or in the western part of the state it is well to sow deeper. If the seed is sown shallow light rains will sprout it after which drouths even though short will kill it. By sowing deeper only heavier rains will sprout it and the moisture will be sufficient to keep it growing through temporary drouths.

As practically all the wheat in Oklahoma is sown with a drill the depth of seeding can be easily regulated.

RATE OF SEEDING

The rate of seeding wheat in Oklahoma varies with the locality and climate and also with the condition of the seedbed and time of seeding. In the eastern part of the state higher rates are used than in western Oklahoma. Late seeding usually requires heavier rates of seeding for best results. In the eastern part of the state rates of five to seven pecks are used while in the central part four to five pecks give best results. Two to three pecks usually give as good yields as higher rates in western Oklahoma.

VOLUNTEER WHEAT

While some good reports are made where volunteer wheat has succeeded yet it is not dependable. Good yields in such instances are exceptions and not the rule. Such a crop requires too much moisture and is too favorable for the ravages of the Hessian fly. Particularly in the central and eastern parts of Oklahoma volunteer wheat should be plowed up early.

WHEAT SMUTS

There are two smuts of wheat, namely the loose smut and the stinking smut or bunt. The latter is much more common in Oklahoma and is readily distinguished from the former. When wheat is affected by the loose smut the whole head becomes black immediately after heading. With stinking smut the head is apparently normal but on threshing or rubbing the head, smut balls instead of wheat grains will be found.

TREATMENT FOR STINKING SMUT

To treat seed wheat for this disease, the formalin method is very effective. Use one pint of 40 percent formalin to 30 gallons of water. This amount should be sufficient to treat about 60 bushels. The seed should be fanned before treating if possible, after which the sprinkling or emersion method may be used.

In sprinkling the formalin over the seed, make sure that all the seeds are thoroughly moist. Stir the pile of seed by shoveling it over a few times, applying more of the solution each time. After leaving the seed in a covered pile for a few hours, the seed should be dried. This can be easily accomplished if the seed is spread out where there is a good circulation of air or if it is placed in the warm sun. By stirring it occasionally with a shovel, it will not take long to have the seed sufficiently dry so that it will readily pass through a grain drill. If the seed is to be stored before seeding, it should be placed in bins or sacks that have been treated with the formalin solution. Before putting the seed in the grain drill, the seed box should be thoroughly washed or sprinkled with the solution. This is to disinfect all surfaces with which the seed comes in contact that may have smut spores clinging to them.

THE HOT WATER TREATMENT FOR LOOSE SMUT

At least two tubs, hot water and an accurate thermometer are necessary. The grain (about one-half bushel or less) is placed in a sack (a gunny sack or sack of loosely woven material). The sack with the grain is then immersed in water, the temperature of which should be about 70 degrees Fahrenheit. After soaking for three or four hours (if water is cold soak four to six hours) the sack containing the grain should be placed in one of the tubs of water the temperature of which should be about 105 or 110 degrees Fahrenheit. It should be left in this tub only a minute or two, moving the sack up and down once or twice so as to have the water of uniform temperature. It is then placed in the other tub containing water at 129 degrees Fahrenheit and left for ten minutes.

The grain should then be removed and dipped in cold water to bring the temperature down. It is very necessary that the water in the second tub should not be warmer than 131 degrees Fahrenheit and not cooler than 124 degrees Fahrenheit. Experiments have shown that if the water is hotter, then the grain will be killed and will not germinate. If the water is cooler the smut spores will not be killed. There-

fore. the necessity of an accurate thermometer and the following of the directions carefully. After this treatment the seed should be spread out where it can dry. When sown after treatment allowance should be made for a thicker rate as some of the seeds may be killed by the treatment, and too the seeds are larger, having been soaked in water.

INSECT PESTS

Hessian Fly. By referring to figure 7. showing the life history of the Hessian fly. it will be seen that two main broods of Hessian flies occur annually. one in the spring and the other in the fall. The spring brood emerges and reinfests the wheat fields where the insect passed the winter. The fall brood of adults emerge from wheat

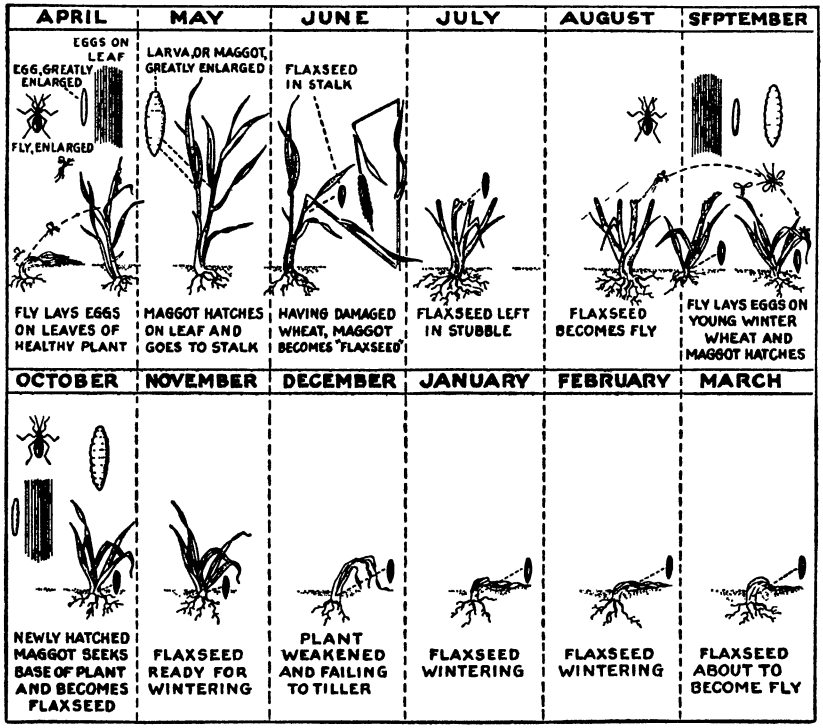

Figure 7. The life history of the Hessian fly. Note what it is doing each month. (Courtesy U. S. Department of Agriculture)

stubble and volunteer grain and infest the fall sown grain. The Hessian fly attacks wheat, rye and barley.

Destroy the "flax seed" while in the wheat stubble by deep summer plowing. disking and harrowing. Prevent the growth of volunteer wheat. rye and barley. Prepare a good firm seedbed for late sown wheat.

Green Bug. So long as the green bug infestation is confined to small spots in wheat and oat field, we have been able to kill from ninety to ninety-nine percent of them by the use of nicotine dust. This is made by mixing ten pounds of hydrate lime with one-half pound of nicotine sulphate or "Black Leaf 40." The nicotine sulphate and the lime should be thoroughly mixed to a very fine powder free from lumps. The nicotine sulphate is added to the dry lime and then the mixture is sifted through a wire screen. When properly prepared, the resulting mixture is a dry powder and it has been given the name "nicotine dust".

In comparing the results of burning with the dust treatment in two fields near Orlando, the dust is evidently very much superior.

The nicotine dust should be applied with some type of machine adapted to distributing dust. In our experiments and demonstrations, we have employed the Springfield duster, the saddle gun duster and two-horse machine that are recommended for dusting cotton.

This dust must come in contact with the green bug. The nicotine dust must be applied during the initial stages of infestation, when the green bugs are confined to small spots. A thin film of the dust over the surface of the ground and plants proves very effective. The more green bugs one can cause to fall to the ground the better.

The nicotine dust should be applied during a dry, warm, still day.

By dusting the initial infested spots, it will not be necessary to treat all the wheat field. When the infestation becomes very general, at least forty pounds of the dust will be necessary to an acre. This is rather expensive.

Other recommendations are rotation of crops, burning as for boll weevil and chinch bugs and to permit no volunteer food plants to grow through the summer.

Persons desiring more information about nicotine dust as a green bug control, should address the Oklahoma Agricultural Experiment Station, Department of Entomology, Stillwater, Oklahoma.

The Chinch Bug. An abundance of chinch bugs in a community is largely due to a certain kind of farm practices.

Spring wheat, oats, corn, winter wheat, rye, barley, broom corn, sorghum, kafir, milo, feterita, millet, and other grasses are attacked by this pest.

Where does the chinch bug spend the winter? Approximately ninety percent hibernate along fences, road sides, hedges and creeks and in bunch grass. They seek shelter and the majority of them find appropriate and congenial environment in bunch grass along creeks and in pastures and grass land.

How can chinch bugs be destroyed in the fall of the year? By burning over grass land, bunch grass, creek banks, woodlots, fence rows, road sides and right-of-ways. Any and all places where chinch bugs can find shelter should be burned.

When should burning be done? Any time between the first killing frost and the tenth of December when the cover is dry and on a calm day. Burning while in hibernation will kill many chinch bugs and others will perish from exposure.

Will burning destroy beneficial insects? A few might be burned but this is no good reason for not destroying the chinch bug.

Just before harvest or before the chinch bugs leave the wheat fields, plow a furrow between the wheat field and corn or other crops subject to attack. The side of the furrow next to the corn field should be as steep as possible and at least eight

inches deep. The bottom of the furrow should be dragged frequently to keep it dusty. Chinch bugs collecting in the furrow can be killed by the drag. The heat will kill them in dry, hot weather. This furrow method is not very effective in rainy weather.

PREVENTION AND CONTROL OF STORED GRAIN INSECTS

Grain should never be stored in a bin before the bin is thoroughly cleaned. Dust, old grain and husks over the floors, corners and cracks are usually infested with weevils and will always serve to infest the new crop from the field.

Absolutely weevil proof granaries have been found very practical and economical on farms where large quantities of grain are harvested and stored.

Treatment in Granary Fumigation. Perhaps the best and simplest and most inexpensive remedy for weevils infesting grain in storage is the carbon bisulphide treatment. The liquid readily catches fire and therefore should be handled with care.

Application. Use about five pounds to each 1000 cubic foot of grain. Place a shallow pan on top of the grain and place the carbon bisulphide in it. The liquid evaporates rapidly and the gas given off is heavier than air and will therefore sink downward toward the bottom of the grain.

This application should be made when the temperature is 70° or higher. Treatment with carbon bisulphide cannot be depended upon when the temperature is below 70°.

The bin, crib or container in which the grain is placed for fumigation should be as near air tight as possible. If holes, cracks or the doors permit the escape of the fumes, the treatment will not be effective.

It is sometimes desirable to treat smaller quantities of seed. One pound of carbon bisulphide to 100 bushels of seed is the correct formula or in smaller quantities use three ounces carbon bisulphide to five bushels of seed.

Information about other methods of controlling insects in stored grain can be obtained by writing the Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma.

White Grubs. White grubs have been doing considerable damage to wheat for the last few years. The growing of row crops such as grain sorghum should serve as a good control.

Plow deep immediately after harvest allowing no vegetation to grow on the land until wheat is sown. Wire worms will also be largely controlled by the same methods as white grubs.

PASTURING WHEAT

While wheat is much used for fall and winter pasture such a practice should be handled with care. Experiments at the Oklahoma Agricultural Experiment Station have shown that pasturing lowers the yield. However, the decrease in yield when pastured judiciously has never been so great but that the value of the pasture has offset it. Early pasturing or too heavy pasturing will greatly reduce the yield as will also pasturing when the soil is wet or pasturing too late in the spring. Later pasturing than the last of March or the first of April is not recommended.

VARIETIES OF WHEAT

Only winter wheats are grown in Oklahoma. No spring wheats are a success. They have frequently been tried where winter wheats failed to make a stand in the fall but in practically all cases the yields have been low and the quality of the wheat very poor. Of the winter wheats both the hard and soft varieties are grown. The soft wheats are primarily confined to eastern and southwestern sections and the hard varieties to the north central and western sections of the state, the latter making up about 75 percent of the total producion.

Of the hard wheats the Turkey variety is by far the most commonly grown. It was introduced into the United States from Russia about fifty years ago. It has always been the leading variety in Oklahoma, its production being about 60 percent of the total wheat grown. It is one of the best hard winter wheats, producing a strong flour of excellent quality for bread making purposes.

The Kharkof, another introduction of Turkey wheat, is grown to some extent in Oklahoma. It was introduced into the United States about 23 years ago from a more northern section than that from which Turkey wheat was secured and is therefore considered more winter hardy than the latter. In other respects it is identical with Turkey.

Kanred is a selection of the Turkey wheat which was made at the Kansas Agricultural Experiment Station in 1906. It is more winter hardy and a few days earlier than Turkey. It is also much more resistant to rust and has proven to be a higher yielding strain than the Turkey. It is now quite widely grown in Oklahoma.

The Blackhull variety has been grown but about two years in Oklahoma. While it yields about the same as Kanred there is yet some doubt as to the quality of its flour. The above varieties are grown principally in north central and western Oklahoma.

Fulcaster is the most popular of the soft wheats in Oklahoma. This variety together with Mediterranean, Harvest Queen, and Fultz make up about three-fourths of the soft wheats and 20 to 25 percent of the total wheat production in the state. Their production is confined largely to the northeastern and southwestern sections of Oklahoma. The Fultz and Harvest Queen are beardless varieties. All the other varieties mentioned above are bearded.

SEED

To produce good wheat of high quality pure seed is necessary. A great deal of effort has been made in recent years to improve the wheat in Oklahoma through growing of better seed. Unlike corn, cotton or the sorghums, wheat cannot well be improved through selection by the farmer as the expense incurred and the time required are too great for this crop. The seed must be kept pure by care in handling so that mixing with other varieties or other seeds does not take place. The adulteration of pure seed usually comes about in threshing or the maturing of volunteer wheat especially when the variety is changed on the farm. Impure seed reduces the quality and the price per bushel on the market. The presence of even a small percentage of rye in wheat lowers its grade and consequently its price on the market. As rye heads out in the field earlier and is taller than wheat it can be readily distinguished and should be removed by pulling up the plants and taking them from the field. Oats,

weed seeds, straw, chaff and dirt should be removed with a fanning mill. As there is extra expense involved in keeping wheat seed pure no one should hesitate to pay a reasonable amount above market price to secure pure seed.

HARVESTING AND THRESHING

Wheat should be harvested as soon as it is ripe. This should be done to avoid loss due to weathering, shattering and krinkling. Because of the large acreage and the shortage of help it is sometimes necessary to start harvesting the crop early in order to finish before it is over ripe. While this is a better practice than to allow it to get entirely ripe before beginning to harvest and thus run the risk of shattering, krinkling, hail and weathering, yet it should not be cut so green that the kernel will not properly fill out, and have a good natural color and luster.

While harvesting wheat with a header in western Oklahoma usually gives good results, losses from this method are mainly due to cutting too green. A little excess moisture in the kernel and straw at heading time causes the grain to mold or heat in the stack. If heading is done at the proper time and well stacked the quality of the wheat should be good.

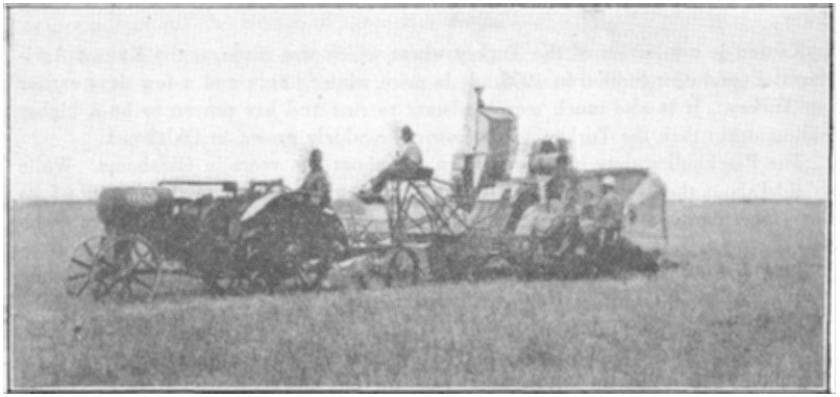

Figure 8. Harvesting wheat with a combine.

The harvester-thresher or combine is coming to be more common than heretofore. The wheats of the southwest are not as well adapted to this method of harvesting as are the club wheats of the Pacific northwest. Neither is the climate in this section of the United States as favorable as it is in Eastern Washington and Oregon and Northwestern Idaho. Our hard wheats do not have stiff enough straw. They krinkle and shatter much when fully ripe. Cutting and threshing immediately necessitates the placing of the grain in storage where the liability of damage is great due to molding or heating. Such damage can be largely prevented by sacking the grain that is not ripe or that contains too much moisture and stacking the sacks under cover. Good ventilation is thus provided which permits the drying of the grain before any damage results. Bins in which wheat is stored should be well ventilated. In order that grain may be properly aerated the bins should have ventilating spouts running through them, either from top to bottom or from side to side. Much care must be

exercised in using a combine that too much grain will not be lost in the field or its quality lowered in the bin.

Considerable wheat in Oklahoma is threshed from the shock. This method may be necessary where the acreage is large and the labor scarce, but wherever possible the wheat should be stacked as there are many advantages in so doing. In the first place one cannot always secure the services of a threshing machine as soon as his wheat is ready to thresh from the shock. In waiting for the thresher bad weather will certainly damage the quality of the wheat. In the second place, if the wheat is stacked the land can be plowed, listed, or disked immediately if it is to be put to wheat again in the fall. In the third place, wheat that goes through a sweat in the stack is improved in color and quality. Further, wheat threshed from the stack seldom gives trouble in storage, whether in the bin on the farm, in elevators, cars or in terminals. Again, if in the stack wheat can be threshed wherever convenient, although it should be permitted to go through the sweating process before threshing. This usually takes about three weeks from the time it is stacked.

QUALITY IN WHEAT

Farmers usually look to high yielding variety, a plump kernel and a high weight per bushel as a good wheat. Millers and bakers consider quality and quantity of protein as the factors that largely determine the quality of wheat. While a plump kernel and high weight per bushel of a good milling variety is desirable the percentage of protein and its quality should also be high. Wheats of high weight per bushel produce the most flour when milled. Wheats that yield a strong flour make the best bread. Hard wheats produce a better flour for bread making purposes than do the soft wheats, the latter are usually low in percentage and quality. The quantity of protein in wheat varies from three to five percent. It may go as low as eight percent and as high as fifteen percent and even more. A protein content of twelve percent is necessary to make good bread. For this reason high and low protein wheats are usually blended to make a uniform flour with a standard percentage of protein. The hard wheats of Oklahoma generally meet with this standard though some seasons conditions may be such as to make the average low. Even in the same season the protein content may vary or be low in certain localities and high in others.

The factors that affect the protein content of wheat most are climate, soil and variety. Of these three climate is the most important. In the western portion of Oklahoma where the rainfall is limited a high protein wheat develops while in the eastern portion of the state wheat of low protein content develops.

A soil rich in nitrogen produces wheat with a high percentage of protein. The prairie soils of western Oklahoma as a rule are higher in nitrogen than the more humid, eastern parts of the state. Sandy soils are known as poor wheat soils. This is partially due to the fact that they are poor in nitrogen.

Hard wheats contain a higher percentage of protein than the soft wheats. A hard wheat grown in a humid section or on sandy soil or any soil poor in nitrogen develops a starchy kernel low in protein It is because of these reasons that hard wheat cannot be recommended for eastern Oklahoma. Even though a hard wheat is used as seed if it is sown on poor wheat soil in a humid section or in a year of abundant rainfall, a poor quality of grain develops. However, some of the factors that affect the quality in wheat can be modified by the farmer, at least to some extent. A good rotation of

crops including a legume, the use of manure and straw, early preparation of the seedbed, the use of good seed of an adapted variety, free from mixtures and the proper care of wheat at harvest and after threshing, all tend to produce wheat of better quality.

HARD RED WINTER WHEAT*

This class shall include all varieties of hard red winter wheat, and may include not more than 10 per centum of other wheat or wheats. This class shall be divided into three subclasses as follows:

Subclass (a) Dark Hard Winter

This subclass shall include wheat of the class Hard Red Winter, consisting of 80 per centum or more of dark, hard, and vitreous kernels.

Subclass (b) Hard Winter

This subclass shall include wheat of the class Hard Red Winter, consisting of less than 80 per centum and more than 25 per centum of dark, hard and vitreous kernels.

Subclass (c) Yellow Hard Winter

This subclass shall include wheat of the class Hard Red Winter, consisting of not more than 25 per centum of dark, hard, and vitreous kernels.

Grade requirements for: (a) Dark Hard Winter, (b) Hard Winter, (c) Yellow Hard Winter.

Grade No.	Minimum test weight per bushel, Lbs.	Maximum Limits of—						
		Moisture, percent	Damaged Kernels		Foreign Material other than Dockage		Wheats of Other Classes	
			Total, percent	Heat damage, percent	Total, percent	Matter other than cereal grains, percent	Total, percent	Common White, White Club, and Durum, singly or combined, percent
1	60	13.5	2	0.1	1	0.5	5	2
2	58	14.0	4	0.2	2	1.0	10	5
3	56	14.5	7	0.5	3	2.0	10	10
4	54	15.5	10	1.0	5	3.0	10	10
5	51	15.5	15	3.0	7	5.0	10	10

Sample Grade shall be wheat of the subclass Dark Hard Winter, or Hard Winter, or Yellow Hard Winter, respectively, which does not come within the requirements of any of the grades from No. 1 to No. 5, inclusive, or which has any commercially objectionable foreign odor except of smut, garlic, or wild onions, or is very sour, or is heating, hot, infested with live weevils or other insects injurious to stored grain, or is otherwise of distinctly low quality, or contains small inseparable stones or cinders.

*(From the United States Bureau of Markets—Wheat Standards).

(1) The wheat in grade No. 1 shall be bright.
(2) The wheat in grades Nos. 1 to 4, inclusive, shall be cool and sweet.
(3) The wheat in grade No. 5 shall be cool, but may be musty or slightly sour.

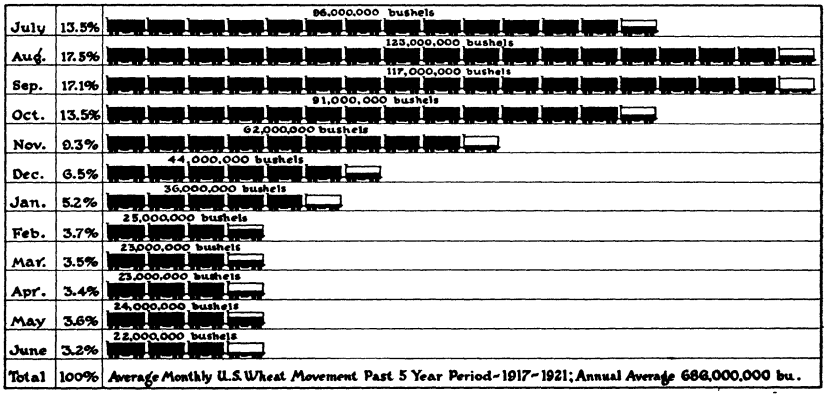

Figure 9. Over 61 percent of the wheat crop of the United States is marketed during July, August, September and October. Each carload represents 1 percent of the crop.

The last legislature created a new Department of State Grain Inspection in connection with the offices of the State Board of Agriculture, Capitol Building, Oklahoma City. E. H. Linzee is the Grain Inspector in charge of this department. His services are for the grain trade. Write him for information on storing, grading and marketing grain.