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Summary of

Soil and Water Conservation and Management Research

at the

RED PLAINS CONSERVATION EXPERIMENT STATION

Guthrie, Oklahoma
1954

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DIVISION OF AGRICULTURE

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FIELD DAY GUIDE
For 1954
And Summary of
Soil and Water Conservation and Management Research

RED PLAINS CONSERVATION EXPERIMENT STATION
Guthrie, Oklahoma

By Harley A. Daniel, Harry M. Elwell, and Maurice B. Cox*

Methods of controlling erosion, conserving moisture, and bringing eroded and unused land into production in the Red Plains area have been studied since 1929 at the Red Plains Conservation Experiment Station.

Research under way on the 350-acre Red Plains Station is aimed at developing means of controlling erosion and of conserving moisture and increasing plant growth. In general, the soils on this station are shallow, sloping, highly erodible, and low in organic matter and plant nutrients.

The Station is now entering a third phase of its work, the research program having been thoroughly revised in 1952-53. In the first decade, 1930-40, emphasis was chiefly on the mechanical phases of erosion control and on the measurement of losses due to water runoff. Since 1940, emphasis has been on the reclaiming of eroded land and the use of vegetative cover as a means of reducing erosion losses. Now emphasis is being placed on:

1. Integration of erosion control and fertility restoration into a complete farm program, through cropping systems and other management practices.

2. Pasture development and management on eroded and brush land.

STOP NO. 1 Grass and Legumes for Revegetation

These plots are designed to determine growth characteristics and maintenance of a protective soil cover of plants in small plots. Several hundred different plantings of grasses and legumes have been made on this station. Some of the most

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promising introduced plants are Caucasian bluestem, KR bluestem, weeping lovegrass, birdsfoot trefoil, and Arlington sericea lespedeza.

STOP NO. 2 New Herbicide CMU for Brush Control

Herbicides for brush control are currently being tested on this station as they become available. This location of dead brush is an example of results being obtained. CMU, 3-(p-chlorophenyl)-1, 1-dimethylurea, was applied on oak brush during the spring and summer of 1951, 1952, and 1953. Different amounts of this material were applied on and in the soil at various distances from the base of the plant in the form of dry powder, water solutions, and pellets. The concentration of the powder was 80 percent and that of the pellets only 25 percent.

Best results were obtained with 80 percent powder in water solutions. On sandy type soils, 7.5 pounds per acre in 60 gallons of water has produced very satisfactory results on dense stands of oaks. However, on clay soil it appears that rates up to 15 pounds per acre will be necessary to obtain a good kill. It was most effective when placed on the soil in the zone occupied by the greatest amount of feeder roots.

An adjacent area of persimmon was also treated. About one-third more CMU was required to obtain effective control. CMU is normally toxic to all plants, but established native grasses have survived and are making normal forage and seed production where rates of 15 pounds or less were applied.

STOP NO. 3 Experiments to Fit Land Capabilities and Use

The soils on this station were recently classified according to their capabilities and the experiments are designed to fit each capability class. The purpose of classifying soils, and the basis on which they are classified, will be explained with the aid of a soils map of the station farm.

STOP NO. 4 Waterway Design and Management

Heavy rainstorms can result in surplus water which must run off. Such floods can destroy farm lands by their erosive power. Control of run-off waters, therefore, is essential for proper land use. Grassed waterways are usually satisfactory for this purpose.

Sod grasses offer greatest protection, but bunch grasses can be used if the slope of the channel is not too steep or the soil too sandy. Bermuda is one of the best grasses for protecting waterways in Oklahoma.

The size of the waterway depends on many factors, such as the area of land

drained, the slope, and the kind of grass planted. Each must be planned for its individual location.

The shape may be flat-bottomed, V-shaped, or rounded. Each has certain advantages. In any case, the cross-section should be broad to keep the flow depths shallow. This slows down the water and thus reduces the erosive force.

When the waterway is planted, make every effort to get an early and dense stand of grass. After the grass is established, the waterway will still need care. Mowing promotes the growth of a more dense stand and controls weeds. It also helps to prevent silting.

STOP NO. 5 Legumes and Weeping Lovegrass on Eroded Land

The comparative value of vetch, biennial sweet clover, and Arlington sericea lespedeza in weeping lovegrass are being calculated by comparing the densith of the vegetative soil cover, the amount of runoff from watersheds in the pastures, and animal gains in three pastures of about 12 acres each, located on severely eroded Class VII land. Each pasture was fertilized with 300 pounds of superphosphate (0-20-0) per acre in the spring of 1953 and planted to weeping lovegrass in 48-inch rows on the contour. Legumes were seeded between the rows of weeping lovegrass. Vetch was seeded in Pasture 4, sweet clover in Pasture 5, and sericea lespedeza in Pasture 6. The soil between the rows of the grass will be cultivated sufficiently in Pastures 4 and 5 in subsequent years to aid in the establishment of the legumes. The grasses and legumes on each pasture made a very good growth. However, the fences enclosing each pasture have not been erected and runoff measuring equipment has just been installed. The plans are to have this study in full operation beginning with 1955.

STOP NO. 6 New Mechanical Methods of Brush Control

In this area, a dense stand of oak brush was undercut in July, 1952, with a large sweep mounted on a heavy tread-type tractor. The brush has been left on the ground and observations will be made concerning the number of sprouts and the amount of decay that has taken place since the brush was cut.

Machines in operation will include undercutter sweeps, a tree cutter and a root rake mounted on crawler-type tractors, and a stubble plow for use where the land is to be put into cultivation. The undercutter handles small brush up to 3 or 4 inches in diameter and cuts about one acre an hour. The tree cutter cuts trees up to 10 inches in diameter level with the ground, and covers approximately two acres per hour. The root rake is used for piling the brush. The stubble plow is for use where the land is to be put into cultivation. It cultivates the soil to a depth of 6 to 12 inches.

STOP NO. 7 Maintenance of Terraced Land

Terraced land on the Red Plains Station has been plowed by backfurrowing to the terrace ridge and leaving dead furrows in the intervals between terraces, using conventional moldboard plows. The soil has been moved away from the intervals and onto the terrace ridges.

The absence of top soil can be noticed by the accumulation of runoff water in the dead furrows instead of terrace channels and by poor-growing crops along this line.

Terraced land on the Wheatland Conservation Experiment Station at Cherokee was plowed with a two-way plow. With it, all furrow slices were thrown in the same direction and the laying out of lands was not necessary. Lowering of the terrace interval did not develop. No dead furrows or backfurrows were left in the intervals. Terraces and channels were maintained and there has been no apparent change or lowering of the surface soil in interval areas.

STOP NO. 8 Weeping Lovegrass for Waterways

This channel was seeded to weeping lovegrass in the spring of 1948 at double the rate ordinarily used for planting pasture. By August, after it was seeded in the spring, a satisfactory cover was produced. This grass has been most satisfactory for an establishment of cover on severely eroded land. This channel has been mowed four or five times during each growing season. In this way, the growth is kept down and permits trash and other material to flow down the channel. Mowing also stimulates stooling and thereby provides a more protective cover.

STOP NO. 9

Cropping Systems and Management for Productive Land Use

This is a study of the effect of a rotation in which sod-like winter cover crops and legumes predominate on fertilized, terraced, and contour-cultivated land, using the minimum amount of sowed summer crops and harvesting forage with livestock. This rotation is being compared with a rotation including chiefly clean-tilled crops harvested for grain or forage.

The experimental rotation is designed especially for Class IV land. It consists of winter oats, biennial sweet clover, sudan, vetch, and sudan, with an application of 500 pounds of rock phosphate per acre at intervals of three years.

The oats were seeded in wide rows during the fall and overseeded with sweet clover the following spring, at which time the phosphate was applied. After the oats were harvested, the clover was grazed in the fall of the first year and the spring of

the second. Then the land was one-way disked and sudan was drilled. The sudan was harvested with cattle during the summer and vetch and wheat seeded in the stubble mulch tilled land in the fall. The rate of seeding was about one-fourth of that normally used for wheat and three-fourths of the amount used for vetch, when each is planted alone. The vetch and wheat were grazed in the fall and harvested in the spring with cattle. After the vetch and wheat, the land was one-way disked and seeded to sudan. The sudan was harvested with cattle and the land stubble mulch tilled and seeded to oats in the fall.

In 1952, the vetch produced 32 pounds of beef per acre and the sweet clover, 53 pounds. The sweet clover and sudan grass planted in 1952 failed due to the severe drought. Vetch and wheat was substituted for the sweet clover. It produced an average of 65 pounds of beef per acre. During previous seasons, sweet clover produced an average of 55 pounds of beef per acre. The cattle were removed from these studies early and good seed crops were produced.

The cattle now on pasture will be removed about the first of June. They were wintered on native grass and prairie hay with small amounts of cottonseed cake.

STOP NO. 10

Crop Rotation and Plant Cover for Soil and Water Conservation

The effect of a rotation of cotton, wheat, and sweet clover has been studied at this location during the past 24 years and compared to continous cotton. The reduction of soil and water losses, along with the difference in yield of cotton, has been as follows:

	(Percentages)						
	1930-34	1935-39*	1940-44	1945-49	1950-53	1930-52	1953
Reduction in soil loss	76.8	80.1	80.3	70.5	70.2	73.4	44.1
Reduction in water loss	19.9	17.9	47.6	37.8	33.2	33.8	30.5
Gain or loss in cotton yields**	-9.5	-5.9	58.5	200.0	109.6	47.2	123.2

*Beginning in 1940, all plots have received superphosphate at the rate of 250 pounds per acre every third year. The fertilizer was applied to the sweet clover in the rotation.

**Seed cotton.

This experiment was started in 1929 on virgin soil broken from native grass

sod. Although the yield of seed cotton was lower in the rotation during the first and second five-year periods, it increased materially in succeeding years.

The effect of various kinds of plant covers on annual runoff and soil losses from 1930 to 1953 has been as follows:

Plant Cover	Soil Loss (tons per acre)	Runoff Water (percent)
Continous Cotton	21.85	12.4
Rotation		
Cotton	14.58	9.7
Wheat	2.41	10.8
Sweet Clover	0.42	4.1
Bermuda Grass	0.04	1.4
Bare Hard Fallow	16.79	25.3
Continuous Cotton on Eroded Soil (10 inches top soil removed)	30.54	29.6

These results show that thick growing vegetation is very effective for conserving both soil and water.

STOP NO. 11

Pasture Development and Fertilization of Native Grass on Eroded Class VII Land

This study is designed to determine the value of fertilizer in native grass pastures on eroded Class VII land. The effectiveness will be calculated by comparing the density of the soil cover, the amount of runoff water from watersheds in the pastures, and animal gains. There are two pastures in this study. They contain a mixed stand of native grass, but the amount of production is low due to poor soil conditions. The fertilized pasture received an application of 300 pounds of superphosphate (0-20-0) in 1952, using a distributor which splits the sod and places the fertilizer about 4 inches deep in furrows 30 inches apart. The plan is to repeat this application at 3-year intervals, making an annual rate of 100 pounds of superphosphate per acre. Nitrogen fertilizer is applied on the soil surface annually in the last week of May at a rate equivalent to 33 pounds of actual nitrogen per acre.

Overseeding tests will be tried on the establishment and maintenance of

legumes in the fertilized pasture. Both native and introduced species that seem to be adapted will be tried. The method of seeding will be row-planting on the contour.

Arlington sericea lespedeza planted in the native grass sod maintained a stand and produced a good growth, but all other legumes failed.

The results of the grazing tests are as follows:

Pasture No.	Treatment	Grazing Season	Acres per Animal	Animal Gain--Lbs. Per Head For Season[1]	Per Day	Per Acre	Vegetation Consumed Percent[2]	Hay Pounds per Acre[3]
2	Fertilized[4]	1952	3.75	316	2.61	85	20.8	1,362
		1953	3.75	276	2.12	75	23.6	1,905
		Average	3.75	296	2.36	80	22.2	1,633
3	Unfertilized	1952	5.00	285	2.36	57	20.6	1,180
		1953	5.00	240	1.85	48	20.7	1,217
		Average	5.00	262	2.10	52	20.6	1,198

1/ Grazing period in 1952 was May 1 to August 29 (121 days). In 1953, it started April 24 and ended August 31 (130 days).

2/ Calculated from the difference in amount of hay clipped from six protected areas and the same number of locations on grazed land in each pasture at the end of the grazing season.

3/ Yields from three meadows maintained in each pasture.

4/ In 1952, 300 pounds of superphosphate (0-20-0) were applied in furrows about 4 inches deep and 30 inches apart, using a distributor which split the sod. This treatment is to be repeated every third year to provide an average of 100 pounds of 20 percent superphosphate annually. Nitrogen fertilizer, providing 33 pounds of actual nitrogen, is applied on the surface annually during the latter part of May.

During 1952 and 1953, animal gain in the fertilized pasture was more than 1.5 times that in the unfertilized, and the yield of hay 1.36 times more.

In a similar comparison made prior to 1952, the 7-year average animal gain on the fertilized pasture was exactly the same as the 1952-53 average in this test--80 pounds per acre. On the unfertilized pasture the 7-year average was 42 pounds per acre.

The cattle grazing on the fertilized pasture carried considerably more finish

at the end of the growing season than those on the unfertilized. There was also a decided improvement of the grass stands and the quality of the plants on the treated pasture.

Flumes and runoff measuring equipment are being installed as rapidly as possible in the different pastures on the station. Consequently, runoff data for all individual pastures are not available. However, previous data from watersheds show that runoff water from good grassland was 90 percent less than from cultivated, terraced land, and that good vegetative cover also protected the soil from erosion. Some of the more badly eroded soils were so poor, however, that a good grass cover could not be produced without the use of fertilizer.

STOP NO. 12 Gully Control and Grassland Improvement

This study is designed to determine specialized practices necessary to develop plant cover for gully control. In regrassing gullied land, special treatment may be necessary, according to previous findings at this station. The first step will be to reduce further erosion and stabilize the seedbed. In some areas, it may be necessary to divert the runoff water from the original channels by diversion terraces above the heads of the gullies. Another step is the installation of vegetative barriers of brush and crop residues, along with plowing and grading down the gully banks. Then the seedbed is ready for fertilizer and lime, as needed, and the planting of legumes. Following the establishment of legumes, grasses may be seeded by the seed-hay method. Where this procedure has been followed, the density of the vegetation in the treated gullies was three times more than in the untreated gullies.

At other locations on the station, studies are being made on rock outcrop of soft sandstone. There was no noticeable erosion on the rock outcrop areas treated with mulches of weeping lovegrass hay and cotton burrs. On the areas receiving superphosphate and nitrogen in addition to these mulches, some weeds and annual grasses grew during the summer of 1953. Brush alone has not provided sufficient protection to prevent erosion during the disintegration of the rocks due to weathering.

Three slick spots of exposed subsoil were selected for reclamation study. The areas were treated with 2,000 pounds of gypsum and 500 pounds of rock phosphate per acre and were seeded to sweet clover in the spring of 1953. Due to the drought, poor stands of clover were obtained; but better surface soil structure was observed and increased stands of grass seemed to be appearing on the plots treated with the gypsum.

Terraces, however, are of no benefit when tight, eroded Class VII land is put to grass. Actually they increase water runoff, according to a 12-year test on this station. An unterraced field lost only half as much water and made three times as much hay and pasture as an adjoining terraced plot with the same slope and soil

type. An excellent stand of native bluestem grass came in the intervals between terraces, but growth on the ridges was poor, probably due to lack of moisture.

For nine years before the land was put to native grass in 1939, the areas had been in a rotation of cowpeas and cotton. During that period of cultivation, terraces reduced runoff 40 percent. They continued to cut water loss while the grass was being established. However, runoff from the terraced and unterraced grass was about the same by the fourth year; and by the fifth season the terraced land was losing the most water. These results are given in Oklahoma Agricultural Experiment Station Bulletin B-373.

STOP NO. 13

Beef Production from Fertilized Native Grass Following Brush Control

This study on the fertilization of native grasses is located on virgin land from which the brush (chiefly scrub oak) was cleared in 1935 and a good stand of native grass developed from plants intermingled in the brush. It was established in about three years. This particular pasture received an application of 300 pounds of superphosphate (0-20-0) in 1952, using a distributor which splits the sod and places the fertilizer about 4 inches deep in furrows 30 inches apart. The plan is to repeat this application at three-year intervals, making an annual average of 100 pounds of superphosphate per acre. Nitrogen fertilizer is applied on the soil surface annually in the last week of May, at a rate equivalent to 33 pounds of actual nitrogen per acre.

Animal gains are measured by grazing good yearling white face steers during the summer growing season. The steers averaged about 535 pounds when they went on the pastures during these two seasons. The grazing season was 121 days in 1952 and 130 days in 1953. The results are given in the following table:

Pasture No.	Treatment	Grazing Season	Acres per Animal	Animal Gain--Lbs. Per Head For Season[1]	Per Head Per Day	Per Acre	Vegetation Consumed Percent[2]	Hay Pounds per Acre[3]
8	Fertilized[4]	1952	2.50	334	2.76	134	20.4	2,222
		1953	2.30	304	2.34	132	20.9	2,885
		Average	2.40	319	2.55	133	20.6	2,553
9	Unfertilized	1952	3.33	321	2.65	96	28.1	1,822
		1953	3.33	242	1.86	73	19.8	2,081
		Average	3.33	281	2.25	84	23.9	1,951

For footnotes for this table, see next page.

On this virgin soil from which brush had been removed, the per acre gain without fertilizer was greater than on the eroded soil where fertilizer was applied--84 pounds as compared to 80 pounds. When this virgin land was fertilized, the gains were increased by almost 60 percent--from 84 to 133 pounds.

In 1953, good fall rains occurred; and, after the grazing season, the grass produced seed. An average of 78 pounds per acre of native grass seed was harvested from the fertilized pastures and only 42 pounds from the unfertilized. This is an increase of about 85 percent. Based on the price received from the cattle and the seed, the gross income in 1953 from the fertilized pasture was $42.96 per acre, compared to $23.34 from the unfertilized one.

In earlier work, eroded land was compared with land formerly in brush. Both carried stands of native grasses and neither was fertilized. The average seasonal gain per acre during a 10-year period was 40 pounds on the eroded land and 70 pounds on the virgin land.

STOP NO. 14

Performance of a KR Bluestem - Lovegrass Mixture When Fertilized

This work with a mixture of KR bluestem (Andropogon ischaemum) and weeping lovegrass (Eragrostis curvula) is located on 12 acres of formerly cultivated badly eroded and gullied Class VII land. In 1947, these gully banks were graded down, leveled, and treated with 200 pounds of superphosphate per acre. Then sweet clover was planted, and an excellent crop was produced in 1947 and 1948. In the spring of 1949, the entire area was plowed. Superphosphate (0-20-0) at 300 pounds per acre and nitrogen at 33 pounds of actual nitrogen per acre were applied, and the land seeded to KR bluestem. The seed proved to be contaminated with weeping lovegrass, however, and as a result the final stand was about one-third lovegrass. Beginning in 1950, this pasture was grazed annually during the growing season. It

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Footnotes for table on preceding page.

1/ Grazing period in 1952 was May 1 to August 29 (121 days). In 1953, it started April 24 and ended August 31 (130 days).

2/ Calculated from the difference in amount of hay clipped from six protected areas and the same number of locations on grazed land in each pasture at the end of the grazing season.

3/ Yields from three meadows maintained in each pasture.

4/ In 1952, 300 pounds of superphosphate (0-20-0) were applied in furrows about 4 inches deep and 30 inches apart, using a distributor which split the sod. This treatment is to be repeated every third year to provide an average of 100 pounds of 20 percent superphosphate annually. Nitrogen fertilizer, providing 33 pounds of actual nitrogen, is applied on the surface annually during the latter part of May.

was fertilized with 33 pounds of nitrogen per acre in 1950, 200 pounds of 16-20-0 in 1951, 150 pounds in 1952, and 300 pounds in 1953. The results are as follows:

(Pounds)

	Average Weight per Steer		Animal Gain		
			Per Head		
	At start of season	At end of season	For Season*	Per Day	Per Acre
1950	634	846	212	2.60	88
1951	506	732	226	2.13	94
1952	556	866	310	2.56	155
1953	605	812	207	1.82	103
Average	575	814	239	2.28	110

*Stocking rate, 2 acres per animal.

It has produced an average of 110 pounds of beef per acre during this 4-year period. The highest production was 155 pounds per acre in 1952. Through this type of pasture improvement, together with proper management, much of the shallow, poor eroded, unused land can be converted into useful pasture and protected from erosion.

STOP NO. 15

Management of Native Grass Pasture Following Brush Control

Investigations in pasture development and management are being studied on this station. They are opening new possibilities for greater production and protection on about 10 million acres of unused brush land in Oklahoma. Much of this land is being only partially used and producing practically nothing. But before it can be protected and used, the brush must be removed and the sprouts controlled. Pastures on this type of land are often misused with the land cover and production destroyed and thereby runoff and erosion losses increased. The study at this particular location was started in 1947. Several plots were sprayed with different herbicides and results compared to the untreated areas. The yield of grass in 1949 was 2,836 pounds per acre from the sprayed plots. The yield in 1950 was equal to that on virgin meadows and 5 times more than that on the adjacent brush land.

Where selective herbicides were properly used, the leaves, twigs, and stems of sprayed brush accumulated in a mulch on the soil. There was an average of 7,593 pounds per acre of this litter two years after treatment. It conserves water and makes conditions favorable for the immediate growth of native grass

intermingled in the brush. Measurements made during an 8-year period on this station show that 45 percent less water ran off annually from good grass on treated land than from an adjacent area of brush land.

The success of the pasture will depend largely upon its management after the brush is removed. The soils covered with scrubby oak are usually shallow and highly erodible. It is, therefore, important that a continuous protective cover be maintained on this land. In order to do this, burning must be prevented.

In earlier tests on this station, annual fall burning during an 8-year period decreased the yield of native grass about 53 percent and increased soil losses 12 times and runoff losses 31 times. In addition, annual burning destroyed valuable nitrogen and organic matter and is no longer recommended for insect control.

The erodibility and fertility levels of the soils are important. Their ability to produce palatable plants can often be determined by the kind of grass intermingled in the brush. On better sites, big bluestem, little bluestem, Indiangrass, switchgrass, purple top, and sand lovegrass are usually in the undisturbed oak brush. But, due to the competition of the brush, these grasses are small, spindling, and greatly depressed in growth. The average yield of grass on fully cleared virgin land was 5 times that found on land 90 percent shaded.

Full grass production will be obtained more rapidly, and erosion more completely controlled, if clearing is limited to areas having only light or medium brush cover. The original grass cover is more dense on gently sloping soil where shade from woody vegetation is less. Under such conditions, a complete land cover is usually established in one or two years. There is also less likelihood of erosion starting between the time of clearing and the time the grass becomes well established. Therefore, through proper site selection and good management, the use of selective herbicides is the safest way of changing worthless brush land into valuable grass land.

STOP NO. 16 New Herbicide for Brush Control

The new, low volatile 2(2, 4, 5-trichlorophenoxy) propionic ester was used in foliage sprays on dense stands of brush and trees. Hardwood species of the post oak and blackjack type were treated. Various applications were made on a large number of plots with both airplane and ground sprayers in 1951, 1952, and 1953 at this station and at four other locations in the state. They were applied in the spring when the plants reached full leaf size and later in the summer when they were in a semi-dormant condition because of dry weather. In the airplane treatments, the quantity of acid used varied from 0.8 to 2 pounds per acre. Each of the quantities were mixed in an emulsion of 4 gallons of water and 1 gallon of diesel oil. The amount of material used in the ground equipment also varied. In some tests, the new chemical was applied at the rate of 3 pounds of the acid in 100 gallons of water. While in others, 1.5 pounds of this material and the same quantity of low volatile

2, 4-D ester were used together in the same amount of water. These tests were compared to adjacent treatments with equal quantities of propylene glycol butyl ether 2, 4, 5-T ester.

The action of the new chemical was not noticeable for ten to twelve days. After this time, a gradual browning of the leaves developed and many of them remained on the plants until forced to drop by ice or sleet several months later.

The new herbicide was superior to that of a comparable 2, 4, 5-T ester in the airplane tests. A higher percentage of the post oak was affected by the single treatments than were the blackjacks. On five acres sprayed twice, 73 percent of all the oaks were defoliated the second year, and there are no signs of these plants producing sprouts. About the same percentage of defoliation occurred on red bud, elm and chittum trees. Nearly a 100 percent kill was obtained on sumac, but there was no effect on chickasaw plums. There was a 90 to 95 percent defoliation of all the oaks at the end of the second year as a result of two annual sprayings with ground machines. The mixtures of the chemical with 2, 4-D, applied under similar conditions, produced about the same degree of defoliation. Applications made during the semi-dormant summer period produced very poor results.

Annual production of native grass hay was increased 14 times or from 156 pounds per acre on the untreated brush to 2,185 pounds per acre on the airplane plots that received two annual applications of 2 pounds per acre. Control of broadleaved weeds on this area was very good.

STOP NO. 17

Effectiveness of Herbicides on Oak Brush and Sprouts

Ester formulations of selective herbicides have generally given the best control of brush. It appears unlikely that any one method can be developed to operate satisfactorily under all conditions and types of brush. Before deciding the method to use on a given area, a survey should be made to determine the size and different kinds of species present. The various species and plants are not equally affected by chemicals.

This area was cleared during 1948 with portable saws. It was divided into 11 plots, each of which were 60 feet wide and 460 feet long. During 1949, 1950, and 1951, the sprouts on two-thirds of each plot were removed with a brush beater. The portions of each plot that were treated included a 20-foot strip along each side, leaving a 20-foot section in the center that was untreated. In 1951, a strip 100 feet wide across each of these plots, including the different stages of growth, was sprayed with a low volatile ester formulation of 2, 4-D and 2, 4, 5-T. A similar area was also sprayed in 1952 and 1953. These plots were sprayed with a hydraulic sprayer until the foliage was wet with a solution containing 3 pounds of acid to 100 gallons of water. Although a careful evaluation of results has not been made, young sprouts from

stumps were difficult to kill. This was particularly true of sprouts that were not well established on the old roots of the original plants. The best results have been obtained on the sprouts that were over 2 years old.

The effectiveness of some of the new formulations of low volatile ester herbicides are as follows:

Kind of Chemical Applied*	Pounds of Acid in 100 Gallons of water	Percent of Brush Remaining October, 1953
Untreated (Check)	-	100.0
2,4-D	2	14.6
"	3	12.1
"	4	12.7
2,4- D - 2,4,5-T	2	13.5
"	3	7.6
"	4	9.8
2,4,5-T	2	10.5
"	3	6.7
"	4	9.2

*There was originally an average of 17,274 trees and shrubs per acre of the post oak-blackjack type of brush. Application made May, 1951, on 4-year old oak sprouts.

These results were obtained on adjacent areas where the native oak brush was crushed and broken with a heavy brush cutter in May, 1947. The regrowth, when sprayed in May, 1951, with selective herbicides in low-volatile esters, was quite dense and ranged in height up to 10 feet. In this particular study, very effective control was obtained from only one application.

STOP NO. 18 Root-Cutting of Oak Brush

This area of dense oak was undercut on July 26, 1952, with a large sweep mounted on a crawler-type tractor. A rolling coulter 48 inches in diameter was mounted in front of each of the two supporting beams. The depth of cut varied from about 12 to 14 inches. This machine covered about 1.25 acres per hour. The treatment caused a high percentage of kill of both the brush and native grasses. The soil was very dry, however, and severe drought conditions have existed since that time. The brush was left on the soil for surface protection.

One-half of this area was crushed in January, 1953, with a Marden brush cutter operated by a crawler-type tractor. It was crushed at the rate of about 2.5 to 3 acres an hour. This area was seeded to sweet clover in the spring and a good stand and growth was obtained.

STOP NO. 19 Aerial Applications of Herbicides

Large scale airplane spraying investigations were started in Oklahoma in 1952. Four areas were selected in locations of productive land on which the brush was suppressing the growth of grass. One site is near Alex, and others near Bristow and northeast of Pawhuska. In addition, tests were made at this Station and on a cooperator's ranch in the Oklahoma County Soil Conservation District. A progress report on this work is given in Okla. Agri. Exp. Sta. Mimeographed Circular M-258, "Tests of Aerial Applications of Herbicides on Post Oak and Blackjack Brush in Oklahoma; Progress Report, 1952-1953."