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Summary of

Soil and Water Conservation and Management Research

at the

RED PLAINS CONSERVATION EXPERIMENT STATION

Guthrie, Oklahoma

1953

OKLAHOMA AGRICULTURAL EXPERIMENT STATION
Oklahoma A. & M. College, Stillwater
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in cooperation with

UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Plant Industry, Soils,
and Agricultural Engineering

FIELD DAY GUIDE
For 1953
And Summary of
Soil and Water Conservation and Management Research

RED PLAINS CONSERVATION EXPERIMENT STATION
Guthrie, Oklahoma

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, Guthrie, Oklahoma. This Station is conducted cooperatively by the Oklahoma Agricultural Experiment Station and the Soils Research Division of the Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture.

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

The Red Plains Station is now entering a third phase of its work, and the research program was thoroughly revised in 1951-52. In the first decade, 1930-1940, emphasis was chiefly on the mechanical phasases 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 Basal-Bark Treatment for Brush Control

Basal-bark treatment consists of completely wetting the bark around the lower part of each tree to the point of runoff. Knapsack sprayers, fire fighters and powered orchard-type sprayers were used for this purpose. The spray materials were applied in bands 20 to 30 inches wide around the lower part of saplings and smaller trees, and in axe incisions on trees larger than five inches in diameter. Summer applications were not as effective as winter treatments made from December 15 to March 15. The low-volatile ester of 2, 4, 5-T, applied in concentrations of 8 pounds of acid in 100 gallons of diesel oil, was the most satisfactory and produced a high degree of kill. In some places, however, more than one treatment was required to eliminate the brush. More information may be obtained from Oklahoma Agricultural Experiment Station Mimeographed Circular M-240.

CMU and Other Non-Selective Herbicides. Two non-selective herbicides, CMU (3-P-Chlorophenyl 1, 1-dimethylurea) and "Ammate" (ammonium sulfamate) were tried. CMU was applied on oak brush during the spring and summer the past two years. Application of this material to the soil around the base of each shrub was very effective. An effective rate of application was 15 pounds of CMU in 60 gallons of water per acre.

Where "Ammate" was applied in axe incisions around small oak trees of 10 inches or less in diameter, during late summer, good results were obtained. Crystals, as well as a solution of 5 pounds of this material per gallon of water, were effective.

STOP NO. 2 Plowing To Maintain Terraced Land

Terraced land in 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 this soil moved away from the interval and on to the terrace ridge.

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 where the two-way plow was used. No dead furrows or backfurrows were left in the intervals. Terraces and channels were maintained and there was no apparent change or lowering of the surface soil in interval areas.

STOP NO. 3 Grass and Legumes for Soil Conservation and Improvements

Several hundred different plantings of grasses and legumes have been made on this Station. Some of the most promising introduced plants are Caucasian Bluestem, KR Bluestem, Weeping Lovegrass, Birdsfoot Trefoil Clover, and Arlington variety of Lespedeza sericea.

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 such runoff 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 on the kind of grass planted. Each must be planned for its individual location.

The shape can 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 Bees on Vetch

Less than one colony of honey bees was used per acre, which was not enough to properly cover the entire field; therefore data were obtained from areas within 50 to 100 yards from the hives. A cage which kept out all insects, including the honey bees, enclosed one small plot. Nearby, a plot of similar size and stand was measured off but left open to insects. Four such comparisons were established. Average results in 1952 were as follows:

	Caged	Uncaged
Hay yields (pounds per acre)	1,921	2,594
Seed yields (Pounds per acre)	75	422

In 1951, the seed yield inside the cages was 133 pounds per acre, and outside it was 436 pounds.

STOP NO. 6 Experiments Designed to Fit Land Capabilities and Use

The soils on this Station recently were 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. 7 Weeping Lovegrass and Reclamation of Eroded Land

Weeping lovegrass has been planted on this part of the Station in a water channel, and in row and broadcast seeding. It has proved satisfactory for quick establishment of cover on eroded land. Under natural conditions on an adjacent plot left to reseed itself, the native grasses have re-established themselves very slowly.

This particular channel was seeded in 1948. The rate of seeding was double that ordinarily used for planting pastures. By August, after it was seeded in the spring, a satisfactory cover was produced.

Data from various watersheds on this Station show that runoff water from good grassland was 89 per cent less than from cultivated, terraced land. The amount of runoff water from different kinds of plant cover was as follows:

Kind of Cover and Treatment of Land*	Percent of Runoff**
Cultivated, terraced	14.9
Eroded, regrassed	12.9
Native virgin woods	2.2
Native virgin grass	1.6

* Located on rolling, mainly shallow land. The eroded-regrassed and the native virgin grass areas were grazed annually during the growing seasons. The native woods plot was not utilized.

** Average of eleven years, 1942-1952, for all areas.

This good vegetative cover also protected the soil from erosion. Some of the more badly eroded soils are so poor, however, that a good grassy cover cannot be produced without the use of fertilizer.

STOP NO. 8 Sod-Like Cropping Systems and Management

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, and phosphate applied the following spring. After the oats had been harvested, the clover was harvested with cattle 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 grazed 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. 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. 9 Foliage Sprays of Ammate for Brush Control

Non-Selective Herbicides and Other Materials. The non-selective herbicide "Ammate" (ammonium sulfamate) has been effective on hardwood species. This area occupies about five acres and was sprayed with "Ammate" during the growing season of 1951 and retreated in 1952. The study is designed to compare the use of the air-blast machine with that of the hydraulic sprayer on rather heavy, dense oak brush. Present results indicate that the air-blast machine has produced as effective kills of this oak brush as the hydraulic sprayer, with only one-third to one-half the quantities of Ammate and water.

At another location the rate of application, using a hydraulic sprayer, was 3/4 to 1 pound per gallon of water. This material is safer than the selective herbicides for use along roadsides, fence rows, orchards, etc., adjacent to sensitive crops. It is also effective during a longer period of the growing season. The effect of Ammate in foliage sprays on oak brush at this Station is as follows:

Date and Treatment		Percent of Brush Remaining October 1952
Sprayed	Retreated	
Untreated		100.0
May 1945	Sept. 1945	3.0
Sept. 1945	May 1946	6.0
May 1946	July 1946	5.8
July 1946	May 1947	5.6
May 1947	May 1948	3.7

There was originally an average of 10,396 trees and shrubs per acre of the post-oak-blackjack type of brush. The chemical was applied on plots one-fourth acre in size at the rate of one pound per gallon of water.

STOP NO. 10 Weeping Lovegrass and Vetch

Solid stands of weeping lovegrass provide excellent protection for the soil against runoff and erosion and this study is designed to determine its value in row plantings with vetch. The experiment was started in 1952. The rows of grass are spaced 42 and 84 inches apart. The weeping lovegrass developed a good stand, while the vetch planted between the rows made a poor growth. These plots were mowed three times for hay in 1952. The plot with the rows spaced 84 inches apart produced 2833 pounds of hay per acre and that with rows 42 inches apart, 3111 pounds. The season was abnormally dry, so runoff was low on both plots.

STOP NO. 11 Effect of Crop Rotation and Plant Cover on Runoff and Soil Losses

The effect of a rotation of cotton, wheat and sweet clover has been studied at this location during the past 23 years and compared to continuous cotton. The reduction of soil and water losses, and difference in yield of cotton has been as follows:

(Percentages)

	1930-34	1935-39*	1940-44	1945-49	1950-52	1930-52
Reduction in soil loss	76.8	80.1	80.3	70.5	74.5	73.7
Reduction in water loss	19.9	17.9	47.6	37.8	30.2	34.0
Gain or loss in cotton yields**	-9.5	-5.9	58.5	200.0	89.7	39.1

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

** Seed cotton.

per acre and the unfertilized 39 pounds.

STOP NO. 13 Gully Control and Grassland Studies

In regrassing gullied land, special treatment may be necessary, according to 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, and 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 establishement 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. Legumes condition the soil for the growth of grass. Sweet clover, during periods of fall and spring grazing, produced about 50 pounds of beef per acre, and then 200 pounds of seed per acre. Vetch is also being used to improve soils for grass culture.

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. 14 Grass and Beef Production Following Brush Control and Fertilization

Brush control investigations on hardwoods, oaks and related species were started on this Station in 1935. Where selective herbicides have been properly used and fires prevented, the soil is protected with an adequate cover by mulches of the dead brush. Where bruch control was applied to land suitable for clearing, a complete land cover and full grass production of native grass has been obtained in about three years.

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 1952 have been as follows:

Plant Cover	Soil Loss (Tons per acre)	Runoff Water (Percent)
Continuous Cotton	22.62	12.6
Rotation		
Cotton	15.04	9.9
Wheat	2.40	10.8
Sweet Clover	0.42	4.2
Bermuda Grass	0.04	1.4
Bare Hard Fallow	17.45	25.7
Continuous Cotton on Froded Soil (10 inches top soil removed)	31.31	29.7

STOP NO. 12 Pasture Development and Fertilization on Native Grass on Eroded Class VII Land

This study is designed to determine the value of fertilizer on native grass and different legumes on eroded Class VII land. Superphosphate was applied in the spring of 1952 at the rate of 300 pounds per acre in rows with a "Pasture Dream" fertilizer distributor, as various areas of Birdsfoot Trefoil clover, lespedeza sericea and sweet clover were seeded in the native grass. The phosphate treatment will be repeated at three-year intervals. Thirty-three pounds per acre of nitrogen was applied in early May and will be repeated annually.

Good stands of the legumes were produced, but it appears that the drought killed most of the young plants of birdsfoot trefoil and sweet clover. The Arlington strain of lespedeza sericea made a fair growth.

This fertilized native grass on Class VII land produced 85 pounds of animal gain per acre during the grazing season of 1952, compared to 57 pounds on the adjacent pasture of the same kind of grass and land. During a five-year period of summer grazing, fertilized pastures at other locations on this Station produced an average of 80 pounds of beef

During an eight-year period, 45% less water ran off annually from good grass on cleared land than from an adjacent area of brush land.

These native grasses were highly nutritious and have made valuable pasture. Grazing studies have been made during the growing seasons of the last nine years under controlled conditions. The beef production from eroded and brush land on the Red Plains Conservation Experiment Station at Guthrie, Oklahoma has been as follows:

Kind of Pasturage and Land	Kind of Fertilizer (Lbs. per acre each year)	Pounds Animal Gain or Beef per acre	
		1952	Average
Native grass on eroded land	None	57	41*
Native grass on eroded land	Equivalent of 100 lbs. superphosphate 100 lbs. ammonium nitrate	85	--**
KR Bluestem mixed with Weeping lovegrass on eroded land	250 lbs. of 16-20-0	155	113***
Native grass virgin land cleared mechanically 1935-1943	None	96	69*
Native grass virgin land treated with chemicals 1946-1947	None	104	72***
Native grass virgin land cleared mechanically 1935-1943	Equivalent of 100 lbs. superphosphate 100 lbs. ammonium nitrate	134	--

* Nine-year average.

** Same amount of fertilizer on a similar pasture on the Station produced an average of 79 pounds of beef per acre during a 5-year period.

*** Three-year average.

Cattle were in the experimental pastures from about May 1 to the latter part of August each year. These investigations were conducted on both eroded and formerly brush land. The highest cattle gains were obtained in 1952 from the cleared brush land pastures.

During 1952, fertilization was made a part of this experiment. Fertilizer greatly increased beef and grass production. The results were more outstanding on the eroded land. The pastures on virgin land, formerly in brush, produced approximately 1.7 times as much beef as these on eroded land. The one that was treated with chemicals produced slightly more beef than that cleared mechanically.

STOP NO. 15 KR Bluestem and Weeping Lovegrass Pasture on Eroded Land

In the spring of 1949, KR Bluestem (Andropogon ischaemum) was seeded on about 12 acres of formerly abandoned eroded land on this Station. About one and one-third acres of the area was badly gullied land. In 1947, these gullies had been plowed and 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 and 300 pounds of superphosphate and 100 pounds of ammonium nitrate per acre was applied to all the land except a few check plots. Before the KR Bluestem was seeded, a nurse crop of oats was planted in 16-inch rows to protect the soil from erosion while the grass was becoming established. However, the seed was contaminated with weeping lovegrass and it occupied about one-third of this area.

During May and June 1949, there was 21.64 inches of high intensity rainfall. Although there were several critical storms, the oats protected the land from severe erosion, and allowed the grass to produce an excellent stand. The yield of oats was as follows:

Treatment	Yield Per Acre	
	Grain (Bushels)	Straw (Pounds)
Fertilized*	40.5	1852
Fertilized gully area, and two years sweet clover **	44.0	2248
Check	4.0	151

* Superphosphate, 300 pounds per acre, and ammonium nitrate, 100 pounds per acre, applied in spring of 1949.

** Gullies in this area were plowed, bulldozed and leveled. Then in the spring of 1947 they were seeded to sweet clover, and 200 pounds per per acre of superphosphate added.

This area was fertilized at a rate per acre of 100 pounds of ammonium nitrate in 1950 and 200 pounds of 16-20-0 in 1951 and 150 pounds in 1952. This pasture has been grazed during the summer growing season of 1950 to date. It has produced an average of 113 pounds of beef per acre. The highest production was 155 pounds per acre in 1952.

STOP NO. 16 Brush Control for Pasture Development

Brush control investigations involving hardwood species of the post-oak and blackjack type were started on the Red Plains Conservation Experiment Station in 1935, and chemicals were introduced into these studies in 1945. Since then new formulations of chemicals have been tested as they became available.

Foliage sprays of these and other chemicals have been applied on the oak types of brush with motor-driven sprayers, air-blast machines and the airplane. The most effective and satisfactory time to spray was when plants had reached full leaf size, while photosynthesis was active. Best results have been obtained with selective herbicides when the soil moisture was adequate for ideal growing conditions, humidity fairly high, and there was a uniform air temperature of 60 to 80 degrees Fahrenheit with little or no wind.

Under humid conditions, spray solutions of water have been satisfactory for selective herbicides and "Ammate". But when dry or more arid conditions were encountered, the addition of 10 gallons of diesel oil to each 100 gallons of spray solution of selective herbicides has increased the kill. The effectiveness of water solutions of "Ammate" was also improved by the addition of a spreader-sticker material recommended by the manufacturer.

When mixed species of hardwoods were sprayed, some plants were resistant to the herbicides. Retreatments were therefore necessary. Better results were sometimes obtained when the follow-up treatments were made with a different chemical from the one originally used.

Sprouts from stumps were difficult to kill with 2, 4-D or 2, 4, 5-T foliage sprays. This was particularly true for sprouts that were not well established on the old roots of the original plants. Ammate foliage sprays were usually more effective in treating young sprouts. However, it was generally advisable to let the sprouts grow for more than two years before attempting to treat them.

Earlier Tests of Selective Herbicides. Although the results from the earlier tests were often erratic and required more retreatments, the older formulations of 2, 4-D and 2, 4, 5-T have killed oak brush when applied in large volume applications on fully leafed brush. These plots were sprayed with a hydraulic sprayer until the foliage was wet, using two pounds of acid in 100 gallons of water. Effective control of this oak brush was obtained from several of these treatments. The effect of selective herbicides in foliage sprays on oak brush has been as follows:

Kind of Chemical	Date and Treatment *		Percent of Brush Remaining October 1952
	Sprayed	Retreated	
**			
Untreated (Check)	= --	--	100.0
Salts of 2,4-D			
Sodium	April 1946	May 1947	34.2
Ammonium	July 1946	"	26.1
"	May 1947	May 1948	5.5
Amines 2,4-D			
Triethanol	April 1946	May 1947	77.5
"	May 1946	"	25.6
Esters of 2,4-D			
Ethyl	June 1945	May 1947	8.4
"	April 1946	"	26.8
Butyl	"	"	38.6
"	May 1947	May 1948	7.7
Isopropyl	"	"	7.7
"	July 1947	"	3.0
"	May 1947	"	9.5
Esters of 2,4,5-T			
Isopropyl	May 1947	May 1948	1.4

*Plots were each one-fourth acre in size.

** There was originally an average of 10,396 trees and shrubs per acre of the post-oak-blackjack type of brush.

Low-Volatile Ester Selective Herbicides. The effectiveness of some of the new formulations of the low-volatile ester herbicides in foliage sprays on oak brush has been as follows:

Kind of Chemical Applied*	Pounds of Acid in 100 gallons of water	Percent of Brush Remaining October 1952
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

* May 1951 on four-year old oak sprouts.

** There was originally an average of 17,274 trees and shrubs per acre of the post-oak-blackjack type of brush.

The native oak brush on this area was crushed and broken down with a Marden brush cutter 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 cnntrols were obtained from only one application.

STOP NO. 17 Chemicals and Methods of Applying Them for Brush Control

The ester formulations of selective herbicides such as 2,4-D and 2,4,5-T have generally given the best control of brush. The new formulations applied recently include esters of butoxy ethanol, and the combination of propylene glycol butyl ether and alkyl-glycol. These low-volatile esters appeared to be more effective than the older types of the isopropyl, buytl, ethyl esters and also sodium and ammonium salts and smine formulations. Another new chemical was the non-selective herbicide CMU (3-P-chlorophenyl 1, 1-dimethylurea). Some recent results with Ammate (ammonium sulfamate) are also reported in Oklahoma Agricultural Experiment Stations Mimeographed Circular M-240. These materials can be obtained from chemical companies and are usually available at feed and seed stores.

The chemicals were applied in foliage sprays, basal-bark and stump treatments. These methods have all given satisfactory results when used on brush within the limits for which each is best suited. 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. Therefore, a list of susceptibility of various species to herbicides will be helpful. This information can be obtained from Oklahoma Agricultural Experiment Station Mimeographed Circulars M-240 and M-242, the North Central Weed Control Research reports, and from chemical companies.

STOP NO. 18 Root-Cutting of Oak Brush

This area of dense oak was undercut on July 25, 1952 with a large sweep mounted on a D-7 Caterpillar 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 and 1/4 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 D-6 Caterpillar tractor. It was crushed at the rate of about 2.5 to 3 acres an hour.

STOP NO. 19 Brush Plots Sprayed With An Airplane

Most of the airplane spraying on the post-oak-blackjack type of brush in Oklahoma, Kansas and Missouri has been studied. Generally the powerful, slow-flying airplanes delivering a coarse spray have produced the best coverage. The quantity of acid to produce satisfactory control of the dense stands of the taller trees has not been definitely determined.

Some promising results on oak were obtained by using 4 pounds per acre of low-volatile esters containing equal parts of 2,4-D and 2,4,5-T, in diesel oil. Best results were obtained where 2 pounds of this material was applied the first year and additional annual treatments of 1 pound per acre the second and third years after the first treatment. The same quantity of 2,4,5-T alone was also effective and appears to be better adapted for use on the oak type of brush.

In earlier tests diesel oil was most commonly used for airplane spraying. Some tests made in June, 1952, however, with water-oil emulsions at a rate of 4 parts of water to one of oil, and this appears to be about as effective as the oil treatments.

Airplane spraying during the winter months was not effective on hardwood species. Several tests were made during the winter of 1949 and 1950. The rate of application of 2,4-D and 2,4,5-T ranged

from 1 1/2 to 3 pounds per acre in diesel oil in quantities of 5 to 15 gallons.

Large-scale field trial studies with airplane applications on oak brush were started in June, 1952 at four locations in Oklahoma. These investigations were made cooperatively by Production Marketing Administration, Soil Conservation Service and Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture, Aerial Applicator's Association, Oklahoma Agricultural Experiment Station, and ranchers. Two of these tests were located in Osage County, one in Creek County and the other in Grady County. Evaluations of these studies will be made at a later date.