IMPLEMENTATION OF ROADSIDE EROSION CONTROL RESEARCH RESULTS

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IMPLEMENTATION OF ROADSIDE EROSION CONTROL RESEARCH RESULTS

FINAL REPORT

By

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in cooperation with

The Oklahoma Department of Transportation

and

The Federal Highway Administration

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* In order that the information in this publication may be more useful, it was sometimes necessary to use tradenames of products, rather than complicated chemical identifications. As a result it is unavoidable in some cases that similar products which are on the market under other tradenames may not be cited. No endorsement of named products is intended, nor is criticism implied of similar products which are not mentioned.

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16. ABSTRACT Large scale areas were established to demonstrate implementation of research findings. These included: (1) johnsongrass control, (2) willow control, (3) bindweed control, (4) broadleaf weed control, (5) sandbur control, (6) seeding Plains bluestem, and (7) planting ground covers other than grass. As a result, the use of herbicides for roadside maintenance has increased dramatically in the period 1976 to 1981. In 1976, approximately 300 acres were treated with herbicides. By 1980, the total exceeded 109,000 acres. Meanwhile mowing has been reduced substantially, from 229,729 acres in 1976 to 157,912 acres in 1980. Cost savings have been especially significant. Mowing costs have continued to rise each year to $11.56 per acre in 1980, while chemical costs have decreased the past three years to $7.65 per acre in 1980, a savings of almost $4.00 per acre. The selective control of johnsongrass along Oklahoma highways can be achieved with applications of MSMA (monosodium methanearsonate), or DSMA (disodium methanearsonate). Willows less than 4 to 5 inches in diameter, can effectively be controlled during the dormant season (February-March) by a basal bark treatment of 2,4-D low volatile ester in diesel oil (ratio 1:25). Two annual applications, for 2 to 3 years, made with 1 quart of 2,4-D low volatile ester (4 lb ai/gal) in water at 40 gpa, can eliminate 75% or more of the perennial bindweed from our roadsides. The preemergence application of Aatrex 4L, or Aatrex 80W, has provided 95 to 100% broadleaf control, and most annual grasses. Sandburs can be effectively eradicated with 2 to 3 annual applications of DSMA. The lack of precipitation during the year of establishment, resulted in very little success with Plains bluestem and Japanese honeysuckle, in producing erosion resistant ground cover.

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SUMMARY

In 1976, the "Implementation of Roadside Erosion Control Research Results" program was initiated as a cooperative project agreement between Oklahoma State University and the Oklahoma Department of Transportation (ODOT). The objectives of this project were to develop, implement, and refine research findings that are currently available, to reduce maintenance activities to a minimum level on Oklahoma highway rights-of-way.

The areas of research implementation included the following activities in which large scale demonstration areas were designated and selected: (1) johnsongrass control, (2) willow control, (3) bindweed control, (4) broadleaf weed control, (5) sandbur control, (6) seeding plains bluestem, and (7) planting ground covers other than grasses.

As a result of this Implementation Project, the use of herbicides on highway roadsides in Oklahoma by ODOT has increased dramatically during the past five years. In 1976, approximately 300 acres were treated with herbicides. By 1980, the total exceeded 109,000 acres. Meanwhile, mowing has been reduced substantially, from 229,729 acres in 1976 to 157,912 acres in 1980. Cost savings have been especially significant! Mowing costs have continued to rise each year to $11.56 per acre in 1980, while chemical control costs have decreased the past three years to $7.65 per acre in 1980, a savings of almost $4.00 per acre. ODOT has projected the acreage to be treated with herbicides for fiscal year 1981 will exceed 115,000 acres.

The following information deals with each of the seven respective activities as mentioned earlier, in summarizing the results and information obtained from these large-scale demonstrations.

1. The selective control of johnsongrass along Oklahoma highway rights-of-way can be achieved with applications of MSMA (monosodium methanearsonate) or DSMA (disodium methanearsonate). A liquid formulation of MSMA (6.0 lbs. ai/gal) and applied at the rate of one-half gallon per acre in 40 gallons of water, or DSMA applied as a liquid formulation (3.6 lbs. ai/gal) applied at the rate of one gallon per acre in 40 gallons of water, were used in the large scale demonstration areas. Treatments were begun in early spring when the johnsongrass plants reached a height of 8 to 12 inches and were actively growing. Best results were usually obtained if the first application was made using MSMA, when the air temperature was between 70^{o} and 80^{o}F and the sun shining brightly. Two or three repeat applications were usually made at 2 to 3 week intervals with DSMA, when the air temperature was above 80^{o}F and the sun shining brightly, while the plants are actively growing. Two or three applications for each of 2 or 3 years have been necessary to control 95-100 percent of the johnsongrass plants in each demonstration area.

2. Willows can be selectively controlled in areas which remain wet for prolonged periods of time, such as drainage ways and ditches. Results substantiated by large-scale demonstration areas have shown that willows, less than 4 to 5 inches in diameter can effectively be controlled during the dormant season (February-March) by a basal bark treatment, using 2,4-D low volatile ester (4 lbs. ai/gal) applied at the rate of 8 gallons mixed with 200 gallons of diesel fuel (ratio 1:25). Basal treatments are used to spray the bark around the base of the tree. This is done by completely wetting the bark approximately one foot above the soil surface until runoff of the spray to the groundline is noticeable.

Johnsongrass should be treated when 8 to 12 inches tall and actively growing (top photo) for best results with the organic arsonate herbicides DSMA or MSMA. Botton photo shows same area a few days after treatment.

This photo depicts an ongoing problem which confronts ODOT. Willows which clog drainage ways and ditches will begin to collect debris, become unsightly and impede water flow.

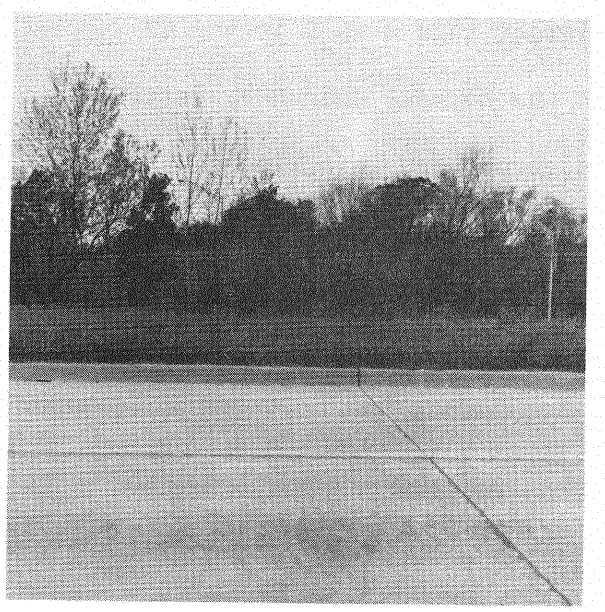
Further results have shown willows larger than 4 to 5 inches in diameter can be effectively controlled in the dormant season by basal injection. This involves using a tree injector, and injecting 2,4-D in the concentrated form, without the addition of diesel fuel as a carrier. One milliliter of herbicide is injected per injection, with injections being spaced three inches apart around the base of the tree.

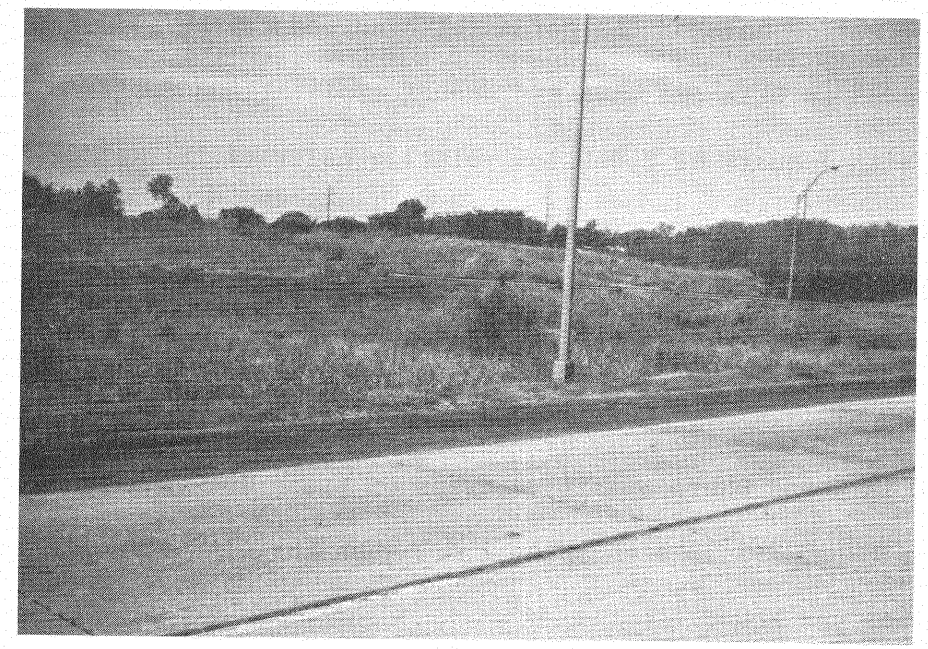
The control of willows using the two methods described above in the demonstration areas across Oklahoma has been very successful, ranging usually from 95 to 100 percent control.

3. Results from large-scale demonstration areas have shown that 75 percent or more of the perennial bindweed can be eliminated from roadsides in Oklahoma when two annual applications for 2 to 3 years are made with 1 quart of 2,4-D low volatile ester (4 lbs. ai/gal) in 40 gallons of water per acre per treatment. The best control is obtained when the bindweed is in the late bud or early bloom stage, usually mid-May through August, while the plant is in a vigorous growing condition.

Caution should be exercised when using phenoxy herbicides such as 2,4-D in areas where sensitive crops or trees are growing to avoid drift. It would be advisable to spray 2,4-D when the wind velocity is less than 10 miles per hour.

4. Results from a large-scale demonstration area have shown that 95 to 98 percent of the broadleaf weeds along roadsides in Oklahoma can be eliminated with one annual treatment of 2,4-D amine (4 lbs. ai/gal) at the rate of one quart in 40 gallons of water per acre, per treatment. Broadleaf weeds can be treated anytime May through July while they are actively growing.





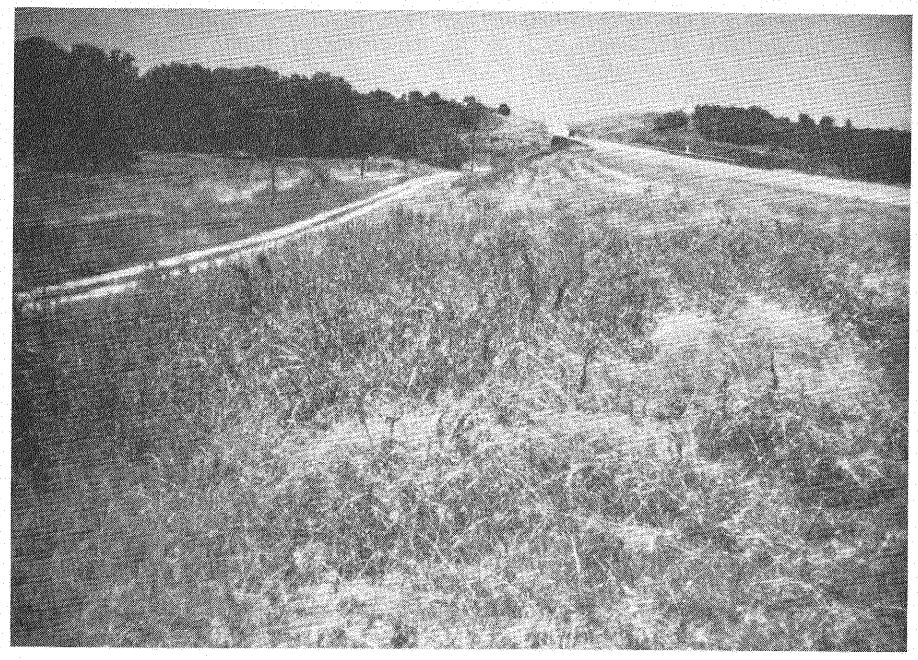
A willow control demonstration area located in Division 3 in Shawnee on US-177, at the Farrell Avenue exit (upper left photo). These willows were treated with a basal-bark treatment using 2,4-D and diesel fuel as a carrier and applied with a handgun in 1976 (upper right photo). The same area is shown 4 years later in 1980 after removal of dead willows (bottom photo).

Another herbicide Aatrex 4L or Aatrex 80W (atrazine-80% wettable powder) is currently being used quite extensively along Oklahoma roadsides, with which excellent results (95 to 100 percent control) have been obtained for the preemergence control of many broadleaf weeds and also most annual grasses, applied at 2.5 pounds (2.0 lbs. active ingredient), or Aatrex 4L at 2 quarts (2.0 lbs. active ingredient) applied in 40 gallons of water per acre, per treatment, per year. Usually, Aatrex is applied in February or March to control early germinating species such as sweet clover.

5. Results from large-scale demonstration areas have shown sandburs can be effectively controlled with DSMA liquid (3.6 lbs. ai/gal) when applied at the rate of 1 gallon per acre in 40 gallons of water per treatment. A repeat application was usually needed approximately 3 weeks after the initial treatment for complete control. Retreatments were necessary the following year to control sandburs that had germinated. Since that time until the final evaluation was made in 1980, no sandbur plants have been found growing in the demonstration areas.

6. Results from seeding plains bluestem in designated demonstration areas have shown very little success in establishment. From final evaluations made in 1980, approximately 30 percent of the original stand remains on a backslope in Division 4; 1 percent survival of plains bluestem plants in Division 6 north of Seiling; and no plains bluestem plant survival in the demonstration area located north of Boise City in Division 6. The poor results may be largely attributed to severe environmental conditions due to lack of precipitation during the year of establishment.

7. Results from the activity of planting honeysuckle on backslopes in Divisions 5 and 3 has been unsuccessful. Final evaluations made in October 1980 revealed that no honeysuckle plants had survived in Division 5



A weed infested area in Division 4, west of Cushing, on SH-33 before weed control treatments (top photo). Bottom photo shows the same area one year later after being treated with atrazine, 2,4-D and DSMA to control the unwanted weeds.

and only approximately 5 percent of the original planting of honeysuckle had survived in Division 3. This may be largely attributed to the severe environmental conditions, due to lack of precipitation after initial planting and/or due to weed competition.

Results from the one and only multiflora rose demonstration area, located west of Clinton, have shown that since the time of planting, the rose population has steadily declined until 10 to 15 percent of the original planting remained on the backslope in 1980. Although Texoka buffalograss which was hand-seeded on the backslope at the same time the roses were planted, has become the climax vegetation and has stabilized the backslope.

INTRODUCTION

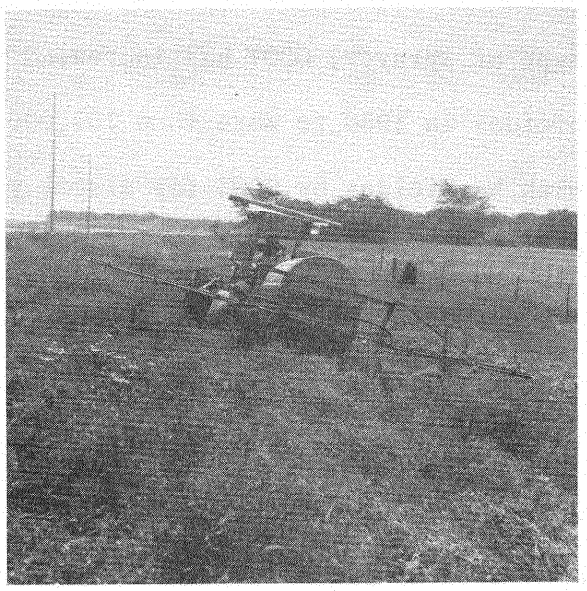
The origin of chemical weed control (using herbicides) along Oklahoma roadsides had its beginning in the early 1960's. In 1963, the Oklahoma Agricultural Experiment Station entered into an agreement for a period of 5 years with the Oklahoma Department of Transporation (ODOT). The objectives of this project were (1) to investigate and evaluate methods for the satisfactory and economical prevention and control of soil erosion on newly constructed highways, (2) the maintenance of ground covers on areas where turf failure has resulted in frequent and extensive repairs, and (3) the control of weeds on various highway areas. Two, 1-year project extensions followed the original agreement. In 1970 and 1976, two, 5-year cooperative projects were initiated, respectively.

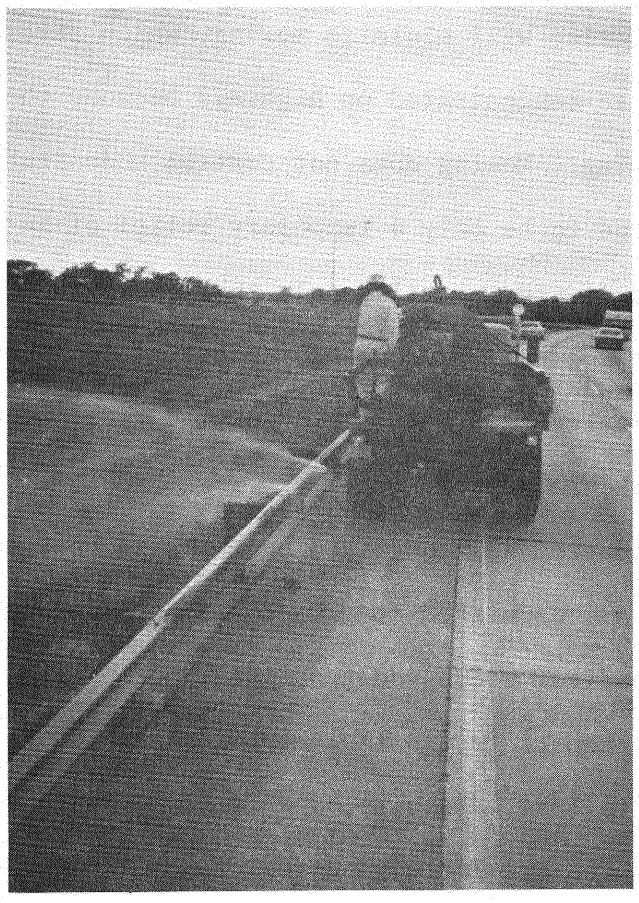
From the inception of these cooperative projects, the common objectives have been the development of satisfactory and economical means of roadside erosion control, and the eradication of undesirable plants on roadside areas, with a minimum hazard to the applicators and the environment.

In 1976, the "Implementation of Roadside Erosion Control Research Results" program was initiated as a cooperative project agreement between Oklahoma State University and ODOT. The objectives of this project were to develop, implement, and refine research findings that are currently available, to reduce maintenance activities to a minimum level on Oklahoma highway rights-of-way.

The areas of research implementation included the following activities in which demonstration areas were designated: (1) johnsongrass control, (2) willow and/or other woody species control, (3) bindweed control, (4) broadleaf weed control, (5) sandbur control, (6) seeding plains bluestem, and (7) planting ground covers other than grasses.

As a result of this Implementation Project, the use of herbicides on highway roadsides in Oklahoma by ODOT has increased dramatically during the past five years. In 1976, approximately 300 acres were treated with herbicides using a 300 gallon sprayer, pulled by a tractor traveling at speeds of 3 to 4 miles per hour in the designated demonstration areas. Even though the results obtained using herbicides were satisfactory, the program wasn't economical because of inefficient equipment. As a consequence, ODOT began to use and are currently using in their herbicide program, for all activities except sandbur and most brush control, 2 to 2½ ton dump trucks, equipped with 1000 to 1500 gallons, skid-mounted, spray tanks. The system has a 2 inch or larger centrifugal pump which can deliver 20-25 gallons of spray material per minute, through a Spraying Systems off-center 300 nozzle tip, and produce sufficient by-pass agitation for the system. This type of arrangement allows the truck to be driven on the surfaced shoulder of the road at speeds of 10 to 15 miles per hour (depending on calibration), while spraying the adjacent area to a width of 20 to 28 feet.





A typical 300 gallon tractor drawn sprayer initially used in spraying the johnsongrass control demonstration areas (top photo). A much more effective means of spraying these demonstration areas was to use a truck equipped with a skid-mounted 1000 to 1500 gallong tank with an off-center nozzle (bottom photo).

Using this type of sprayer, ODOT has increased the number of acres treated with herbicides in 1980 to more than 109,000 acres. The projected acreage treated with herbicides by ODOT for fiscal year 1981 will exceed 115,000 acres. Meanwhile, mowing has been reduced substantially, from 229,729 acres in 1976, to 157,912 acres in 1980. Cost savings have been especially significant. Mowing costs have continued to rise each year to $11.56 per acre in 1980, while chemical control costs have decreased the past three years to $7.65 per acre in 1980, a savings of almost $4.00 per acre when compared to mowing.

Chemical weed control is expected to continue to economically benefit ODOT. This practice will minimize mowing, which saves fuel and money; more work will be concentrated on highways because there is less time being spent mowing. Mowing does not control undesirable weed species and is considered to be only a temporary relief of an eyesore. After an extended period of time, cutting only the top parts of native grasses can eventually cause damage, because of inadequate replenishment of the root system. This weakens and reduces the native grass population and allows weeds to overtake an area.

Chemical control has long-term benefits in that bermudagrass and native grasses are permitted to grow by eliminating the competition from undesirable broadleaf weeds and grasses.

This final report covers implementation of activities during the period of 1976 to 1981. Results of this project are compiled in annual Interim Reports and are included here.

1977

Interim Report

Project No. 76-04-3

Implementation of Roadside Erosion Control Research Results

by

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Johnsongrass (Sorghum halepense L.) is a perennial plant that spreads by seeds and underground stems (rhizomes) and appears to grow best on porous, fertile, low land. Within a few years after johnsongrass becomes established, the soil may become heavily infested with seeds and rhizomes. Its ability to produce large quantities of seed and rhizomes makes it a difficult plant to bring under control within the first year with spray applications of selective herbicides.

Johnsongrass control demonstration areas were initiated in all eight highway divisions in 1976. The organic arsonate herbicide, disodium methanearsonate (DSMA), was used in a liquid formulation (3.6 lbs active ingredient/gal.) and applied at the rate of one gallon per acre in 40 gallons of water per treatment in all demonstration areas.

In Division I, the johnsongrass control demonstration area is located on the "Nat Irish" freeway starting at the intersection of Madison Street and continuing south to the Davis Field Airport road. It is approximately 5 miles in length and 10 feet wide adjacent to the shoulders on both sides of the highway. The demonstration area was treated three times with the treatment dates being May 7, 1976, June 1, 1976, and June 30, 1976. In August, an evaluation of the demonstration area was made, which showed approximately 80-85 percent of the johnsongrass was eliminated.

The johnsongrass control demonstration area in Division 2 is located on S. H. 78 starting at Yuba and extending south approximately 4 miles to the Texas state line. Four spray applications were made on an area approximately 20 feet wide adjacent to the shoulder with the treatment dates being April 21, 1976, May 10, 1976, June 1, 1976 and June 30, 1976. In August, an evaluation of the demonstration area was made which showed

approximately 85-90 percent of the johnsongrass was eliminated.

In Division 3, the johnsongrass control demonstration area is located on U. S. Highway 77, starting south of Paoli, 0.8 miles south of Owl Creek and extending south for approximately 3.6 miles. The control measures were applied to an area approximately 48 feet wide on the east side, extending from the highway shoulder to a telephone line which is the border between the railroad right-of-way and the highway. Three spray applications were made with the treatment dates being May 17, 1976, June 10, 1976, and September 21, 1976. In August an evaluation of the demonstration area was made which showed approximately 50 percent of the johnsongrass was eliminated. This area at the time of the evaluation had been treated with only two applications, with the third treatment being applied after the evaluation.

The johnsongrass control demonstration area in Division 4 is located on I-35 from the Mulhall exit south to Beaver creek on both sides of the mainline. This area excludes the backslopes with only the flatter areas being treated to the right-of-way fence. Three spray applications were made with the treatment dates being May 17, 1976, June 2, 1976, and June 28, 1976. In August an evaluation was made which showed approximately 65 to 70 percent of the johnsongrass was eliminated.

In Division 5, the johnsongrass control demonstration area is located on I-40, east of Clinton at Bethel road extending east on the north side of the mainline approximately one and three-quarters miles extending from the highway shoulder to the right-of-way fence. Three spray applications were made with the treatment dates being June 16, 1976, July 13, 1976, and August 16, 1976. In August an evaluation of the demonstration area was made prior to the third treatment date. Approximately 75 to 80 percent of the johnsongrass had been eliminated with the first two treatments.

The johnsongrass control demonstration area in Division 6 is located

on S. H. 3 northwest of Seiling, beginning at Bent creek and extending northwest approximately three-quarters of a mile on the north side of the highway. Three spray applications were made with the treatment dates being June 16, 1976, July 7, 1976, and July 28, 1976. In August, an evaluation of the demonstration area was made which showed approximately 95 percent of the johnsongrass was eliminated.

In Division 7, the johnsongrass control area is located on S. H. 53 starting approximately 10.7 miles east of Comanche and extending 17 miles east. These areas total approximately 4.1 miles of creek bottoms that are being treated. Three spray applications were made with the treatment dates being April 29, 1976, May 18, 1976, and June 7, 1976. In August an evaluation of the demonstration areas was made which showed approximately 85 to 90 percent of the johnsongrass had been eliminated.

The johnsongrass control demonstration area in Division 8 is located in part of the division yard and on I-244 at 129 E. Avenue exit in Tulsa, extending east three-quarters of a mile on the south side of the highway. Four spray applications were made with the treatment dates being May 3, 1976, May 28, 1976, June 25, 1976, and August 17, 1976. In August, an evaluation of the demonstration area was made prior to fourth treatment date. Approximately 40 to 50 percent of the johnsongrass had been eliminated with the first three treatments.

In 1977, prior to July 1 all eight Divisions had begun retreatments of the same johnsongrass control demonstration areas that were initiated in 1976 and are continuing at this time.

WILLOW AND OTHER WOODY SPECIES CONTROL

Willows (Salix spp.) and other woody species such as cottonwood (Populus spp.) are becoming more of a problem in Oklahoma along the highway right-of-way. They have a tendency to invade areas near water and in areas which remain wet for prolonged periods of time. When willows and other woody species become established in drainage ways and ditches, they begin to impede water flow and start collecting debris. This becomes very unsightly and may restrict sight distance in some areas.

Willows less than 2 inches in diameter can be effectively controlled in the dormant season by a basal treatment using 2,4-D, low volatile ester (4 lbs. active ingredient per gallon) at the rate of 8 gallons mixed with 200 gallons of diesel fuel. Basal treatments are used to spray the bark at the base of the tree. This is done by completely wetting the bark approximately one foot above the soil surface until runoff of the chemical to the groundline is noticeable.

Willows and other woody species less than two inches in diameter can be effectively controlled in the dormant season with basal applications using a mixture of 4 gallons of 2,4-D low volatile ester (4 lbs. active ingredient per gallon) and 4 gallons of 2,4,5-T low volatile ester (4 lbs. active ingredient per gallon) mixed with 200 gallons of diesel fuel.

Four divisions participated in the willow control or willow and other woody species control activities in 1976. The control achieved was quite successful in 1976, for the most part, in that only one area needed to be retreated in 1977. In 1977, these same four divisions set up new demonstration areas for willow control and/or willow and other woody species control.

In 1976, the willow and other woody species control demonstration areas in Division I were located on S. H. 16, 4.7 miles west and 7 miles west of the Taft Road intersection west of Muskogee. These areas total approximately ¼ acre in area and were treated on March 12, 1976. In August an evaluation of the demonstration areas was made which showed approximately 80-85 percent of the willows

and other woody species were controlled.

On March 17, 1977, the demonstration area 4.7 miles west of Muskogee was retreated. Two new demonstration areas for willow and other woody species were initiated on March 18, 1977. One area is located on S. H. 2, ¼ mile north of I-40, on both sides of the highway, consisting of approximately 3/4 acres in area. The other demonstration area is located on U. S. 266, 1½ miles west of S. H. 2 on both sides of the highway at Bennett Creek, consisting of approximately 1 acre in area. An evaluation of the control of willows and other woody species of these demonstration areas has not been made prior to July 1, 1977.

In 1976, the willow and other woody species control demonstration area in Division 3 was located on U. S. 177 in Shawnee at the Farrell Avenue Interchange. This area was treated on March 17, 1976. In August, an evaluation of the demonstration area was made which showed approximately 90-95 percent of the willows and other woody species were controlled.

In 1977, two new willow and other woody species control demonstration areas in Division 3 were initiated. One demonstration area is located in Ada on North Broadway near the Fairgrounds. The area is approximately ½ acre in size. The second area is located west of Ada on S. H. 19.2 miles west of S. H. 13 on the south side of the highway. This area is approximately ½ acre in size. An evaluation of the control of willows and other woody species of these demonstration areas has not been made prior to July 1, 1977.

In 1976, the willow and other woody species control demonstration area in Division 7 was located on S. H. 37,7.5 miles west of S. H. 81 near Buggy Creek. The area consisting of approximately 1 acre was located on the north side of the highway and extended west for approximately ½ mile. Treatment of the demonstration area was March 18, 1976. In August, an evaluation of the demonstration area was made which showed approximately 95-98 percent of the willows and other woody species were controlled.

In 1977, Division 7 initiated new willow and other woody species control

demonstration areas on U. S. 81 starting south of Chickasha at the junction of S. H. 19 and continuing south approximately 25 miles to the Stephens County line south of Rush Springs. All willows and other woody species were treated in this area along waterways and in low areas which would total approximately 4 acres in size. An evaluation of these areas has not been made prior to July 1, 1977.

In 1976, the willow control demonstration areas in Division 8 were located in Tulsa on the I-244 Crosstown Expressway at Mingo Creek between the two mainlines, on I-244 at the junction of U. S. 75, and on I-44 east of Union Street. Treatment of these areas was begun on March 1, 1976. In August, an evaluation of the demonstration area was made which showed approximately 90-95 percent of the willows were controlled.

On March 1, 1977, three new demonstration areas for willow control were initiated in Tulsa. The first area is located U. S. 64 (Broken Arrow Expressway), ¼ mile northwest of 161st East Avenue Exit. Another area is located on U. S. 64 on the westbound side at the on-ramp at Lynn Lane. The third area is located on U. S. 75 on the east side between 141st and 151st streets. These new demonstration areas have not been evaluated prior to July 1, 1977.

BINDWEED CONTROL

Over one-half million acres of land in western Oklahoma are infested with bindweed (Convolvulus arvensis L.). Bindweed is a perennial plant that has a very extensive root system containing stored food materials which can support the plant for long periods of time. In deep fertile soils, roots have been traced down beyond 25 feet. A young seedling has the ability to develop a deep tap root in about 11 weeks. Within a single season one plant may spread up to 10 feet in diameter. The bindweeds' prolific seed producing ability, its lateral root system with buds which send up new plants, and its fleshy roots in which it stores reserve food supplies, makes it a very difficult plant to control.

Bindweed can be effectively controlled with one quart of 2,4-D low volatile ester (4 lbs. active ingredient per gallon) in 40 gallons of water per acre per treatment. The best control is obtained when treatments are applied when the bindweed is in the late bud or early bloom stage while the plant is in a vigorous growing condition.

Two divisions participated in the bindweed control activity in 1976. The demonstration areas in both divisions were treated twice in 1976 and the treatment of these areas are still continuing in 1977.

In Division 5, the bindweed control demonstration area is located east of Clinton on I-40, 10.7 miles east of S. H. 183. The area is in the center median between the two mainlines consisting of a 16 foot strip on the south side of the median continuing east for approximately 1.2 miles. The demonstration area was treated twice with the treatment dates being May 19, 1976 and July 13, 1976. In August, an evaluation of the demonstration area was made which showed approximately 60-70 percent of the bindweed had been eliminated.

In Division 6, the bindweed control demonstration area is located on U. S. 64 east of Buffalo for 15 miles in length continuing east to the Cimarron River, including all the right-of-way. The demonstration area was treated twice on the north side of U. S. 64 and only once on the south side with treatment dates being June 20, 1976 for both sides and July 8, 1976 the second treatment date for the north side. In August, an evaluation of the demonstration area was made which showed approximately 70-80 percent of the bindweed was controlled.

BROADLEAF WEED CONTROL

Broadleaf weeds detract from the overall beauty of our highways and compete with the desirable plants for space and nutrients. Not only are they an eyesore, but necessitate the need for having to mow the highway rights-of-way.

Most broadleaf weeds can be effectively controlled with one annual treatment of Dacamine (4 lbs. active ingredient per gallon) or 2,4-D amine (4 lbs active

ingredient per gallon) at the rate of 1 quart in 40 gallons of water per acre per treatment. Broadleaf weeds can be treated anytime May through July while they are actively growing. Retreatments the second and third years may be necessary for complete control.

In 1976, Division 1 was the only division participating in the broadleaf weed control activity. The demonstration area (the same area for johnsongrass control) is located south of Muskogee on the "Nat Irish" Freeway starting at Madison Street and continuing approximately 5 miles south to the Davis Field Airport Road treating a 10 foot strip adjacent to the shoulder on both sides of the highway. The demonstration area was treated once in 1976 with the treatment date being June 25, 1976. In August, an evaluation of the demonstration area was made which showed approximately 90 percent of the broadleaf weeds were controlled. On June 9, 1977, the area was retreated for broadleaf weeds.

SANDBUR CONTROL

Sandbur (Cenchrus pauciflorus) is an annual grass that produces numerous spiny burs which virtually renders an area unusable by man or animal. This weed not only detracts from the overall beauty of an area, but it may inflict physical pain if brought into contact with a person.

Sandburs can be effectively controlled with disodium methanearsonate (DSMA) liquid (3.6 lbs. active ingredient per gallon) at the rate of 1 gallon per acre in 40 gallons of water per acre treatment. A repeat application approximately 3 weeks after the initial application may be needed for complete control. Retreatments may be necessary the second and third years to control sandburs that have germinated from seed.

In 1976, one division participated in the sandbur control activity. The demonstration areas were treated twice in 1976 and treatments are still continuing in 1977.

The sandbur control demonstration areas in Division 4 are located at the rest areas on both sides of the mainline on I-35 south of Guthrie at the 150 mile marker. The treatment was applied to all of the area that has foot traffic. The demonstration areas were treated twice with the treatment dates being June 3, 1976 and June 21, 1976. In August, an evaluation of the demonstration area was made which showed that approximately 95-100 percent of the sandburs had been controlled. Treatment of the areas are continuing in 1977.

SEEDING PLAINS BLUESTEM

Plains bluestem (Bothriochloa ischaemum var. ischaemum) is a new variety of an introduced group of grasses commonly known as old world bluestem. It is a distant relative of our native bluestem grasses and belongs to the same group as El Kan, King Ranch and Caucasian bluestem varieties.

Plains is a perennial, warm-season bunch grass combining the attributes of good productivity, aggressiveness, persistance and drought tolerance. It is well suited for use both as a pasture and a soil conservation grass in Oklahoma and should be particularly adaptable for seeding in the western one-half of the state.

During the site preparation, a good seedbed can be prepared on a backslope by using either a chisel or a disk to leave the soil in a roughened condition. This permits better air and water movement into the soil, leading to better plant growth, than the usual smooth, compacted backslope which generally is prepared.

Seeding of adapted grasses in a well prepared seedbed and mulched with a non-competitive mulch will permit the establishment of an erosion resistant ground cover in most areas.

Plains bluestem can be successfully established on highway rights-of-way at the rate of 5 lbs. pure live seed per acre anytime April through June. Plains can be seeded using a seed drill or a hydroseeder with 500 gallons of water per

acre. A good mulch should be applied at the rate of one ton per acre immediately after the area has been seeded.

Three divisions participated in the plains bluestem seeding activity in 1976.

In Division 4, the plains bluestem seeding demonstration area is located on S. H. 51, ¼ mile west of I-35 on a north-facing backslope. The area was seeded on June 21, 1976 and mulched on June 21-22, 1976. The demonstration area is approximately 2 acres in size. In August an evaluation of the demonstration area was made which showed that the slope was stabilized by the straw mulch and the plains bluestem plants' height ranged from emergence to 1½ inches.

In 1976, Division 6 initiated two plains bluestem demonstration areas. The first area is located on U. S. 287 starting 1 mile north of Boise City and extending north for 5 miles. This area was divided up into three equal areas each approximately 1.7 miles in length by 8 feet wide on both sides of the highway which was seeded and mulched on April 4, 1976. The southern 1/3 of the demonstration area was seeded to plains bluestem at the rate of 2 lbs pure live seed per acre; the middle 1/3 area was seeded with a mixture of buffalograss (Buchloe dactyloides) 4 lbs pure live seed per acre, sideoats grama (Bouteloua curtipendula) 3 lbs pure live seed per acre, blue grama (Bouteloua gracilis) 2 lbs pure live seed per acre, and plains bluestem at 1 lb pure live seed per acre. The northern 1/3 of the area was seeded to buffalograss at the rate of 20 lbs pure live seed per acre. In August an evaluation of the demonstration area was made in which it was decided to wait until 1977 to be able to make a better evaluation of the demonstration area.

The second plains bluestem seeding demonstration area is located on U. S. 281 approximately 2 miles north of Seiling starting at the Canadian river bridge and continuing north for approximately 3/4 mile. This area was seeded and mulched on March 30, 1976. In August, an evaluation of the demonstration was made which

showed the slopes still stabilized by the straw mulch with the plains bluestem plants ranging from 2 to 6 inches in height.

In Division 8, the plains bluestem demonstration area is located in Tulsa on the Cherokee Expressway approximately ½ mile north of I-244 starting on the east side of the highway and continuing north for approximately 1200 feet which includes a west-facing backslope and an east-facing fill slope. The area was seeded on June 22, 1976 and mulched on June 24, 1976. In August an evaluation of the area was made which showed the slope still being stabilized by the straw mulch with the plains bluestem height ranging from ½ to 8 inches.

PLANTING MULTIFLORA ROSES

Multiflora rose (Rosa multiflora L.) is an Asiatic plant that has been used in this country as an ornamental. More recently it has been used for soil erosion control. In the spring it has masses of white blossoms. In the fall and winter its red fruits add color to the landscape.

On the best soils multiflora rose reaches a height of 10 feet, and about the same width. Its growth is somewhat umbrella like; canes shoot up 4 to 6 feet or more, then begin to droop, with the slender ends of the side canes hanging toward the ground.

Multiflora roses are best adapted to the eastern-half of Oklahoma. This is essentially from I-35 eastward. In western Oklahoma they will grow from I-35 to a line approximately north and south along the west side of Dewey, Custer, and Washita counties. In this area careful site selection and the best cultural treatments are required to overcome climatic hazards.

Multiflora rose grows best on moderately heavy or medium-textured soils. For maximum success use only healthy plants with stem diameters of 1/8 to 1/4 inch with well branched roots 6 to 9 inches long. Plant tops should be cut off prior to planting, leaving 3 to 4 inches above the root collar. Plants should be fertilized and mulched. The best planting season for multiflora rose is December 1 to

March 1.

In 1976, only one Division participated in planting multiflora roses. In Division 5, the multiflora rose planting demonstration area is located on I-40 west of Clinton at the Parkersburg Road, on the south facing backslope on the off-ramp for westbound traffic.700 multiflora roses were planted on February 23, 1976, on the backslope consisting of approximately 6000 square feet in area and was also hand-seeded with buffalograss. The backslope had been benched prior to planting with benches each 3 feet in width. The roses were planted on 3 foot centers and were watered immediately after planting. On March 12, 1976, the roses were mulched with straw and then fertilized with a complete fertilizer (6-24-24) at the rate of 2 lbs/rod or approximately 300 lbs per acre.

After planting multiflora roses, a portion of the backslope on the east end remained unplanted due to a shortage of plants. It was decided to plant the remainder of the slope to honeysuckle (Lonicera spp.). On December 2, 1976 the remainder of the slope was planted to honeysuckle on 18 inch centers, fertilized, and watered.

In the spring of 1977, it was noticed that many of the honeysuckle plants had not survived the winter either due to the extremely cold weather or a lack of moisture through the winter months or both. On May 12, 1977, the area was replanted with honeysuckle. In August 1976, an evaluation of the multiflora rose demonstration area was made which showed that approximately 90-95 percent of the plants were still alive. An evaluation of the honeysuckle planting has not been made prior to July 1, 1977.

I-40 SPECIAL PROJECT

In January 1977, a special project in Division 4 on I-40 in Oklahoma City was initiated. The purpose of this project was to initiate a total land management program in this demonstration area and compare the maintenance costs to a like area in size that is maintained by the Department of Transportation

in their normal operating maintenance practices. At the end of approximately 5 years, a comparison of the costs will be made to determine the economic feasibility of a total management program.

The demonstration area is located in Oklahoma City on I-40 starting at the North Canadian River Bridge on I-35 and extending east 6.37 miles to and including the Douglas Boulevard Interchange. Maintenance practices initiated in the program include johnsongrass control, broadleaf weed control, complete plant suppression under guardrails and around signposts and delineators, elm control, and bermudagrass fertilization.

Activities that have been completed in 1977 include broadleaf weed control (pre-emergence), complete plant suppression under guardrails,along curbs, and around signposts and delineators, and elm control.

Treatment of the johnsongrass is still continuing, however, the bermudagrass fertilization activity has not been initiated.

An evaluation of the demonstration area has not been made prior to July 1, 1977.

1978

Interim Report

IMPLEMENTATION OF ROADSIDE EROSION CONTROL RESEARCH RESULTS

by

Wayne W. Huffine

Lonnie M. Cargill

JOHNSONGRASS CONTROL

Johnsongrass (Sorghum halepense L.) has become one of the most serious and major weed problems along the highway rights-of-way in Oklahoma. Johnsongrass is a highly competitive perennial grass that has adapted to a wide variety of soils. It robs desirable plant species of nutrients, moisture, light, and space. Within a few years after johnsongrass becomes established, the soil may become heavily infested with seeds and rhizomes. Its ability to produce large quantities of seed and rhizomes makes it a difficult plant to control within the first year with spray applications of selective herbicides.

Johnsongrass control demonstration areas were initiated in all eight highway divisions in 1976. These same demonstration areas were retreated in 1977. (See 1977 Interim Report for treatment dates and locations). It was observed in 1976, after the initial treatment using DSMA during the cool springtime temperatures, that very little burn or control was obtained. As a result, it was decided to use the organic arsonate herbicide, MSMA (Monosodium methanearsonate) for the first treatment in 1977 in all of the johnsongrass control demonstration areas. MSMA, 6.0 lbs ai/gal was used at the rate of one-half gallon per acre in 40 gallons of water. MSMA exhibited better control at air temperatures of 70^{o} - 80^{o} F than when using DSMA. After the initial application using MSMA, retreatments using DSMA were applied in 1977 in the demonstration areas.

In Division I, the johnsongrass control demonstration area is located on the "Nat Irish" freeway at the south edge of Muskogee. The demonstration area was treated three times during 1977, with the treatment dates being May 11, June 8, and August 16. In August, an evaluation of the demonstration area was made, estimating 85-90 per cent of the johnsongrass being eliminated.

The johnsongrass control demonstration area in Division 2 is located on S.H. 78 starting at Yuba and extending south approximately 4 miles to the Texas state line. This area was treated four times during 1977 with the treatment dates being April 25, May 19, June 13, and July 12. In August, an evaluation of the demonstration area was made, estimating 90-95 percent of the johnsongrass being eliminated.

The johnsongrass control demonstration area in Division 3 is located on U.S. Highway 77 between Pauls Valley and Paoli, on the east side of the highway. Four spray applications were made in 1977, with the treatment dates being April 28, June 2, July 6, and September 1. In October, an evaluation of the demonstration area was made, estimating 90-95 percent of the johnsongrass being eliminated.

The johnsongrass control demonstration area in Division 4 is located on Interstate 35 starting south of the Mulhall Exit and continuing south to Beaver creek. Four spray applications were made in 1977 with the treatment dates being June 8, August 8, September 7, and October 3. In October, an evaluation of the demonstration area was made, estimating 90-95 percent of the johnsongrass being eliminated.

In Division 5, the johnsongrass control demonstration area is located on Interstate 40 east of Clinton, beginning at Bethel Road and continuing east to the Bridgeport Road on the north side of the highway. Three spray applications were made in 1977, with the treatment dates being June 13, July 22, and August 18. In October, an evaluation of the demonstration area was made, estimating 85 percent of the johnsongrass being eliminated.

The johnsongrass control demonstration area in Division 6 is located on S.H. 3 northwest of Seiling, beginning at Bent Creek and extending northwest approximately three-quarters of a mile on the north side of the highway. Two

spray applications were made in 1977 with the treatment dates being June 14 and July 11. An evaluation of the area was not made until the spring of 1978 at which time it was estimated that 95-98 percent of the johnsongrass had been eliminated.

In Division 7, the johnsongrass control demonstration area is located on S.H. 53, starting approximately 10.7 miles east of Comanche and extending 17 miles east. The areas treated being only creek bottoms, covered approximately 4 miles. Three spray applications were made in 1977 with the treatment dates being April 26, May 20, and June 20. In October, an evaluation of the demonstration area was made, estimating 95-98 percent of the johnsongrass being eliminated.

The johnsongrass control demonstration area in Division 8 is located on Interstate 244 in Tulsa, at the 129th E. Avenue exit on the south side of the highway. Five spray applications were made (lost the effectiveness of one treatment due to rain) in 1977 with the treatment dates being May 3, May 26, June 30, September 2, and September 27. In October, an evaluation of the demonstration area was made, estimating 90 percent of the johnsongrass being eliminated.

In 1978, prior to July 1, all eight Divisions had begun retreatments of these same johnsongrass control demonstration areas and are continuing at this time. It was observed in most of these areas during the spring of 1978, that very little rhizome johnsongrass was present. Therefore, several of the Divisions delayed their initial treatment of johnsongrass 3 to 4 weeks during the spring of 1978 for the reason being that most of the johnsongrass existing in the demonstration areas was seedling johnsongrass.

WILLOW AND OTHER WOODY SPECIES CONTROL

Willows (Salix spp.) and other woody species such as cottonweed (Populus spp.) and elm (Ulmus spp.) are becoming more of a problem in Oklahoma along the highway rights-of-way. They have a tendency to invade areas near water and in areas which remain wet for prolonged periods of time. When willows and other woody species become established in drainage ways and ditches, they begin to impede water flow and start collecting debris. This becomes very unsightly and may restrict sight distance in some areas.

Willows less than 4 to 5 inches in diameter can be effectively controlled in the dormant season by a basal treatment using 2,4-D, low volatile ester (4 lbs. ai/gal.) at the rate of 8 gallons mixed with 200 gallons of diesel fuel (ratio 1:25). Basal treatments are used to spray the bark around the base of the tree. This is done by completely wetting the bark approximately one foot above the soil surface until runoff of the chemical to the groundline is noticeable.

Willows larger than 4 to 5 inches in diameter can be effectively controlled in the dormant season by injection. This involves using a tree injector and injecting 2,4-D in the concentrated form, without the addition of diesel fuel as a carrier. One milliliter of herbicide is injected per injection, with the injections being spaced three inches apart around the base of the tree.

Willows and other woody species less than 4 to 5 inches in diameter can be effectively controlled in the dormant season with basal applications, using a mixture of 4 gallons of 2,4-D low volatile ester (4 lbs. ai/gal.) and 4 gallons of 2,4, 5-T low volatile ester (4 lbs. ai/gal.), mixed with 200 gallons of diesel fuel. Willows and other woody species larger than 4 to 5 inches can be effectively controlled by injection of 2,4-D mixed with 2,4,5-T combined in a 1:1 ratio in their concentrated form, without the addition of carriers.

Four divisions participated in the willow and/or other woody species control activities in 1977. The willow control achieved has been quite successful, however it was observed in 1978 that two of the Divisions' demonstration areas for 1977 had become infested with seedlings. It was decided that these demonstration areas would be retreated in 1978. The remaining two Divisions set up new demonstration areas for willow and/or other woody species control.

In 1977 the willow and other woody species control demonstration areas in Division I were located on S.H. 2, ¼ mile north of I-40, on both sides of the highway and on U.S. 266, 1½ miles west of S.H. 2 on both sides of the highway. These areas were treated beginning on March 18, 1977. In August, an evaluation of the demonstration areas was made, estimating 95 percent of the willows and other woody species were controlled. Two new demonstration areas were initiated in 1978 with the treatment date beginning on March 9, 1978. One area is located on S.H. 10, 2 miles south of Braggs; the other on S.H. 2, beginning 3 miles south of Warner and extending 10 miles south. An evaluation of these areas has not been made prior to July 1, 1978.

In 1977, the willow and other woody species control demonstration areas in Division 3, were located in Ada on North Broadway near the Fairgrounds, and west of Ada on S.H. 19, 2 miles west of S.H. 13 on the south side of the highway. In October, an evaluation of these demonstration areas was made, estimating that 90-95 percent of the willows and other woody species had been eliminated. It was also observed during the evaluation, an abundance of seedling willows had reinfested the demonstration areas. As a result, both of these demonstration areas were retreated on March 14, 1978. An evaluation of these areas has not been made in 1978 prior to July 1.

In 1977, the willow and other woody species control demonstration areas in Division 7 were located on U.S. 81 starting south of Chickasha at the junction

of S.H. 19, and continuing south approximately 25 miles to the Stephens County line, south of Rush Springs. These areas were treated beginning on March 29, 1977. In October, an evaluation of the demonstration areas was made, estimating 95-98 percent of the willows and other woody species had been controlled. It was noted during evaluation, several seedling willows were present in some parts of the demonstration areas. It was decided to treat in 1978 the seedlings and also those trees that were not controlled in 1977. These areas were then treated in 1978 beginning on March 17. An evaluation of these areas has not been made in 1978 prior to July 1.

In 1977, the willow control demonstration areas were located near Tulsa on U.S. 64 (Broken Arrow Expressway), ¼ mile northwest of 161st E. Avenue Exit, on U.S. 64 on the westbound side at the on-ramp at Lynn Lane, and on U.S. 75 on the east side between 141st and 151st streets. These areas were treated beginning on March 1, 1977. In October, an evaluation of the demonstration areas was made, estimating 95 percent of the willows were controlled. During the time of evaluation, it was decided that the demonstration area near Lynn Lane should be retreated in 1978, after observing some of the willows on the west end of the demonstration area had not apparently been treated in 1977. Two new demonstration areas were initiated in 1978 in Tulsa, with the treatment date beginning March 20, 1978. These areas are located at the intersection of I-44 (Skelly Bypass) and 21st Street, and at the intersection of I-44 and U.S. 75 on the northeast corner of the interchange. An evaluation of these areas has not been made prior to July 1, 1978.

BINDWEED CONTROL

Over one-half million acres of land in western Oklahoma are infested with bindweed. Bindweed is a perennial plant that has a very extensive root system containing stored food materials which can support the plant for long periods of time. In deep fertile soils, roots have been traced down beyond 25 feet. A young seedling has the ability to develop a deep tap root in about 11 weeks. Within a single season one plant may spread up to 10 feet in diameter. The bindweeds' prolific seed producing ability, its extensive lateral root system containing numerous buds capable of producing new plants, and its fleshy roots in which it stores reserve food supplies, makes it a very difficult plant to control.

Bindweed can be effectively controlled with one quart of 2,4-D low volatile ester (4 lbs. ai/gal.) in 40 gallons of water per acre per treatment. The best control is obtained when the bindweed is in the late bud or early bloom stage, while the plant is in a vigorous growing condition.

Two divisions participated in the bindweed control activity in 1977. The demonstration areas in both divisions were retreated twice in 1977. Retreatments in 1978 are still continuing in both demonstration areas in both divisions.

In Division 5, the bindweed control demonstration area is located east of Clinton on I-40, 10.7 miles east of S.H. 183. The area is in the center median between the two mainlines of I-40, consisting of a 16 foot strip on the south side of the median. The area continues east for approximately 1.2 miles. This area was treated twice in 1977, with the treatment dates being June 3 and July 6. In October, an evaluation of the demonstration area was made, estimating 75-80 percent of the bindweed being eliminated.

In Division 6, the bindweed control demonstration area is located on U.S. 64 beginning east of Buffalo and continues 15 miles east to the Cimarron River, on both sides of the highway. The demonstration areas was treated twice in 1977, with the treatment dates being May 24 and June 30. An evaluation of the demonstration area was not made in 1977.

BROADLEAF WEED CONTROL

Broadleaf weeds detract from the overall beauty of our highways and compete with the desirable plants for space and nutrients. Not only are they an eyesore, but necessitate the need for mowing the highway rights-of-way.

Most broadleaf weeds can be effectively controlled with one annual treatment of 2,4-D amine (4 lbs. ai/gal.) at the rate of 1 quart in 40 gallons of water per acre per treatment. Broadleaf weeds can be treated anytime May through July while they are actively growing.

In 1977, Division 1 was the only division participating in the broadleaf weed control activity. The demonstration area (the same area for johnsongrass control) is located south of Muskogee on the "Nat Irish" freeway. This area was retreated for broadleaf weeds on June 9, 1977. In August 1977, an evaluation of the demonstration area was made, estimating 90-95 percent of the broadleaf weeds had been controlled. The area has been retreated again in June 1978.

SANDBUR CONTROL

Sandbur (Cenchrus pauciflorus) is an annual grass that produces numerous spiny burs which virtually renders an area unusable by man or animal. This

weed is found statewide and has become a problem and a nuisance in some of the rest area locations in Oklahoma. It not only detracts from the overall beauty of an area, but it may inflict physical pain if brought into contact with a person.

Sandburs can be effectively controlled with disodium methanearsonate (DSMA) liquid (3.6 lbs. ai/gal.) at the rate of 1 gallon per acre in 40 gallons of water per treatment. A repeat application approximately 3 weeks after the initial application may be needed for complete control. Retreatments the following second and third year may be necessary to control sandburs that have germinated from seed.

In 1977, with only Division 4 participating in the sandbur control activity, the demonstration area was treated twice with the treatment dates being June 15 and July 26. The sandbur control demonstration area is located at the rest areas on both sides of the mainline on I-35 south of Guthrie at the 150 mile marker. In October, an evaluation of the demonstration areas was made, estimating 98-100 percent of the sandburs had been controlled. It was observed in 1978 that no sandbur plants were in the demonstration areas, and prior to July 1, 1978, these areas have not yet been treated.

I-40 SPECIAL PROJECT

In January 1977, a special project in Division 4 on I-40 in Oklahoma City was initiated. The purpose of this project was to initiate a total land management program in this demonstration area and compare maintenance costs to a like area in size that is maintained by the Department of Transportation, using their normal operating maintenance practices. At the end of approximately 5 years, a comparison of the costs will be made to determine the economic

feasibility of a total land management program.

The demonstration area is located in Oklahoma City on I-40 starting at the North Canadian River bridge and extends east 6.37 miles to and including the Douglas Boulevard interchange. Maintenance practices initiated in the program include johnsongrass control; broadleaf weed control; complete plant suppression under guardrails, around signposts and delineators; elm control; and bermudagrass fertilization.

Activities that were completed in 1977 include johnsongrass control, broadleaf weed control (pre-emergence), complete plant suppression under guardrails, along curbs, around signposts and delineators, and elm control. It was observed in 1977, by the end of the growing season, that 30-40 percent of the johnsongrass had been controlled; 85-90 percent of the broadleaf weeds had been eliminated; 100 percent of the elms had been controlled; and that complete plant suppression under guardrails, along curbs, around signposts and delineators was still in effect.

Beginning on March 28, 1978 the area was treated with a pre-emergence application of atrazine to control annual grasses and broadleaf weeds. Treatment of johnsongrass is still continuing and the bermudagrass fertilization activity has begun.

IMPLEMENTATION ACTIVITIES

As a result of the implementation program, many activities have been initiated in all eight highway divisions across the state by the Department of Transportation in addition to the demonstration areas. The following is a breakdown by division with its respective implementation activities:

DIVISION 1 - MUSKOGEE: Johnsongrass is being treated on 450 acres of right-of-way in Muskogee County and 350 acres of right-of-way in Okmulgee County including Highway 75 across Okmulgee County.

DIVISION 2 - ANTLERS: A preemergent application using atrazine to control many annual grasses and broadleaf weeds has been applied along the roadside in all of Pittsburg County, consisting of approximately 1212 acres. This same area is being treated for johnsongrass. Portions of the remaining 8 counties, ranging from 200-350 acres of right-of-way in each, are also being treated. An area of willows north of McAlester on Highway 69 were treated with a tree injector.

DIVISION 3 - ADA: Johnsongrass is being sprayed along all the highway roadsides in Coal County - which consists of approximately 100 miles. An area of willows approximately ½ acre in size were treated 1 mile south of Ada on Highway 3.

DIVISION 4 - PERRY: Johnsongrass is being sprayed in Kay County on all highway roadsides totaling approximately 149 miles.

DIVISION 5 - CLINTON: Johnsongrass is being sprayed in Washita County on approximately 300 acres of highway right-of-way. An area beginning east of Clinton on I-40 extending east to the Division line near El Reno is also being treated to control Johnsongrass. Some isolated areas in the division have been treated to control broadleaf weeds.

DIVISION 6 - BUFFALO: Broadleaf weeds and johnsongrass are being sprayed along all of the highway roadsides in Alfalfa County - which consists of approximately 150 miles.

DIVISION 7 - DUNCAN: Johnsongrass is being treated division wide in each county along all highway roadsides. There are several isolated areas in the division that are being treated to control broadleaf weeds.

DIVISION 8 - TULSA: All of the highway roadsides in Tulsa County are being sprayed to control johnsongrass, with portions of Rogers, Mayes, and Delaware Counties also being treated to control johnsongrass.

1979

Interim Report

IMPLEMENTATION OF ROADSIDE EROSION CONTROL RESEARCH RESULTS

by

Wayne W. Huffine

Lonnie M. Cargill

JOHNSONGRASS CONTROL

Johnsongrass (Sorghum halepense L.) has manifested itself as the number one weed problem along highway rights-of-way in Oklahoma. Efforts are underway statewide to eliminate this problem through the use of herbicides. This method has proven to be the most efficient and effective means for the control of johnsongrass.

In 1976, demonstration areas were designated in each of the eight highway maintenance divisions for the chemical control of johnsongrass. During 1976 and 1977, treatments made in these demonstration areas, using both DSMA and MSMA (organic arsenicals), virtually eliminated the rhizome johnsongrass present. However, in 1978 and 1979, seedling johnsongrass became evident as the biggest problem in each of the demonstration areas. In a few weeks, these seedlings established themselves as perennial plants if untreated with either MSMA or DSMA. Fortunately, most of the demonstration areas were treated before the seedlings had time to develop into perennial plants (form rhizomes). (Refer to 1977 or 1978 Interim Report for specific locations in each maintenance division).

Treatment dates for johnsongrass control in each of the demonstration areas for 1978 and 1979 are as follows:

	* Treatment Dates	
Division	1978	1979
1	6-8; 6-22; 7-10	6-12; 6-29; 7-23
2	5-8-9; 5-23&24; 6-9; 6-12; 6-14; 7-17; 8-9; 8-18	4-27; 6-7; 7-2; 7-18; 7-30; 10-2
3	8-28	7-19
4	6-27; 8-21	9-25
5	5-23-25; 6-28-30	6-25&26; 7-20; 8-29
6	No dates available	5-31
7	6-7	5-29; 8-10
8	6-14	5-31; 9-21
4-Special Project I-40	5-15; 5-25; 5-30&31; 6-1; 6-7; 6-9; 6-14&16; 6-19-21; 7-11-13; 8-14; 8-17-18; 8-21-25; 8-28	9-3&4

* These treatments, for the most part, were spot treatments and not necessarily broadcast treatments.

Evaluations of the johnsongrass control demonstration areas were made in September 1978. The percent johnsongrass controlled in these areas varied from 85-98%. However, in 1979, evaluations of these areas had not been made prior to October 1.

Soil and vegetation samples were collected in the fall of 1978 in each of the johnsongrass control demonstration areas for analyses of arsenic levels present. These samples have been analyzed and a report is being prepared for publication at a later date.

WILLOW CONTROL

Willows (Salix spp.) continue to create problems in certain areas in Oklahoma along highway rights-of-way. They are found in areas near water and areas that remain wet for prolonged periods of time. These areas are usually drainage ways, or ditches, and at the ends of box culverts. When willows establish themselves in these areas, they impede water flow, collect debris, which becomes unsightly and may restrict sight distance in certain areas. Previously sawing and chopping willows in these areas has been a very inefficient and ineffective means of eliminating this problem. These methods offer only temporary relief as the willows will resprout and become a recurring problem. Chemical control offers the most efficient and effective means of willow control. The present method, using 2,4-D in early March, while the willows are dormant, has proven to be an excellent method to control willows in these areas. It can be applied either as a basal treatment to willows less than 4-5 inches in diameter, using diesel fuel as a carrier, or

by using a tree injector for willows larger than 4-5 inches in diameter. (For specific instructions in procedures and rates of application, refer to Interim Report 1978). Evaluations of the willow control demonstration areas in 1976 and 1977 indicated a range of 90-100 percent control of the willows in these areas.

In 1978, Divisions 1, 3, 7 and 8 participated in the willow control activity. The willow control demonstration areas in Division 1 were located on SH-10, 2 miles south of Braggs and the other on SH-2 beginning 3 miles south of Warner and extending 10 miles south. These areas were treated beginning March 9, 1978. An evaluation of these areas in September 1978 indicated 95-98 percent control of the willows.

In Division 3, in 1978, the willow control demonstration areas designated as such in 1977 were retreated due to a reinfestation of willow seedlings. These areas are located in Ada on North Broadway, near the Fairgrounds, and west of Ada on SH-19, 2 miles west of SH-13 on the south side of the highway. These areas were retreated on March 14, 1978. An evaluation in September 1978 indicated that 99-100% of these willows were controlled.

In 1978, in Division 7, portions of the 1977 designated willow control demonstration area was retreated due to a reinfestation of willow seedlings. This area extends south of Chickasha on US-81 beginning at SH-19 and continuing south approximately 25 miles to the Stephens county line, south of Rush Springs. These areas were treated beginning on March 17, 1978. An evaluation was made in September 1978 indicating 98-100 percent control of willows in these areas.

In Division 8, in 1978, two willow control demonstration areas were designated in Tulsa. One area is located at the intersection of I-44 (Skelly

Bypass) and 21st street, and the other being on the northeast corner of the interchange of I-44 and US-75. These areas were treated on March 20, 1978. In September 1978, an evaluation of these demonstration areas was made indicating 100% control of the willows treated.

In 1979 however, no willow control demonstration areas were designated or treated.

BINDWEED CONTROL

Over one-half million acres of land in western Oklahoma are infested with field bindweed (Convolvulus arvensis). In the past few years, bindweed has been steadily creeping eastward, especially on highway rights-of-way. Bindweed is a perennial plant which has a very extensive root system containing stored food materials which can support the plant for long periods of time. A young seedling has the ability to develop a deep tap root in about 11 weeks. Even though many of the perennial plants have been eliminated in the two bindweed control demonstration areas, there is a continual battle to control seedlings which emerge. Bindweed seed is viable in the soil for a number of years, which creates problems of having to continually treat an infested area. The bindweed control demonstration areas (Refer to Interim Report 1978 for specific areas) have been treated for the past four years. The following are the respective Divisions in which treatments to control bindweed are being made and the treatment dates:

	Treatment Dates	
Division	1978	1979
5	4-28	None
6	None	5-31

These demonstration areas were each treated twice in 1976 and 1977. An evaluation of both demonstration areas in 1978 still revealed some bindweed present. However, evaluation of these two demonstration areas have not been made this year prior to October 1, 1979.

BROADLEAF WEED CONTROL

Broadleaf weeds detract from the overall beauty of our highways and compete with the desirable plants for space and nutrients. They are not only a eyesore, but they necessitate a need for mowing the highway rights-of-way.

Division 1, in Muskogee, is the only area in which a broadleaf control demonstration is located. This area (See Interim Report 1978 for location) has been treated once each year, beginning in 1976 through 1978. The last treatment was made in June 1978. However, no treatment has been made since that time. An evaluation of the area in September 1978 revealed approximately 95-98 percent control of the broadleaf weed species. The area has not been evaluated this year prior to October 1, 1979.

SANDBUR CONTROL

Sandbur, (Cenchrus pauciflorus) is an annual grass that produces numerous spring burs which virtually renders an area unusable by man or animal. This weed is found statewide and has become a problem and a nuisance in some of the rest area locations in Oklahoma. It not only detracts from the overall beauty of an area, but it may inflict physical pain if brought into contact with a person. (Refer to Interim Report 1978 for herbicide and rate of application).

The only sandbur control demonstration area is located in Division 4,

at the rest areas on both sides of I-35, south of Guthrie, at the 150 mile marker. These areas were treated both in 1976 and 1977. It was observed in 1978 that no sandbur plants were in the demonstration areas, and for this reason, the area was not treated in 1978. Again in 1979, no sandbur plants were observed in the demonstration areas, therefore the areas were not treated in 1979.

PLANTING HONEYSUCKLE

Japanese honeysuckle (Lonicera japonica spp.) is an Asiatic plant that has been used in this country as an ornamental. Its growth habit has enabled it to also be used for erosion control, especially on highway rights-of-way. This type of honeysuckle remains green throughout the year (evergreen) and produces showy and fragrant flowers which adds an aesthetic quality to the landscape. In Oklahoma, it is better adapted to the eastern half of the state where precipitation is usually more abundant.

In April 1979, in Division 3, a west-facing backslope west of Ada, on the Richardson Loop, was benched and planted with honeysuckle. The benches were made approximately 2 to 3 feet in width. Honeysuckle, which had been rooted and grown in the greenhouse at the O.S.U. Agronomy Research Station in Stillwater, was then planted on approximately 18-24 inch centers. In May 1979, approximately 80 percent of the honeysuckle plants were still living. Since that time, an evaluation has not been made, as to percent survival or coverage of the area, prior to October 1, 1979.

I-40 SPECIAL PROJECT

In January 1977, a special project in Division 4 on I-40, in Oklahoma City, was initiated. The purpose of this project was to initiate a total land management program in this demonstration area and compare the maintenance costs to a like area in size, and nearby in the same division, that is maintained by the Department of Transportation in their normal maintenance program. At the end of approximately 5 years, a comparison of the costs will be made to determine the economic feasibility of a total land management program.

The demonstration area is located in Oklahoma City on I-40, starting at the North Canadian River bridge on I-35, and extending east 6.37 miles to and including the Douglas Boulevard Interchange. Maintenance activities initiated in the program include johnsongrass control, broadleaf weed control, complete plant suppression under guardrails and around signposts and delineators, elm control and bermudagrass fertilization.

Activities that were completed in 1977 included johnsongrass control, broadleaf weed control (pre-emergence), complete plant suppression under guardrails, along curbs, and around signposts and delineators, and elm control.

Activities that were completed were johnsongrass control, broadleaf weed control (pre-emergence) and bermudagrass fertilization. Excellent results were obtained in 1978 with the broadleaf weed control activity and where the bermudagrass was fertilized. Thin stands of bermudagrass in areas were fertilized again in 1979 to speed up the recovery rate of the bermudagrass. However, complications due to the lack of equipment and manpower hampered johnsongrass control activities both in 1978 and again in 1979. As a result, the area was mowed in the late summer of 1979 due to the problem of tall vegetation growing on the rights-of-way. At this time, efforts are underway

to begin pre-emergence treatments with atrazine to control many of the undesirable annual grasses and broadleaf weed problems in the area. Evaluations of the area have not been made this year prior to October 1, 1979.

IMPLEMENTATION ACTIVITIES

As a result of this implementation program, many activities have been initiated in all eight highway maintenance divisions across the state by the Department of Transportation. Implementation activities initiated in 1979 by division are as follows:

Division 1 - MUSKOGEE: Johnsongrass is being treated in portions of Okmulgee, McIntosh, and Muskogee counties.

Division 2 - ANTLERS: Johnsongrass is being treated division wide (total division). Atrazine (for pre-emergence control of undesirable annual grasses and broadleaf weeds) has been applied to areas in Bryan, Choctaw, and Atoka counties.

Division 3 - ADA: Not Available.

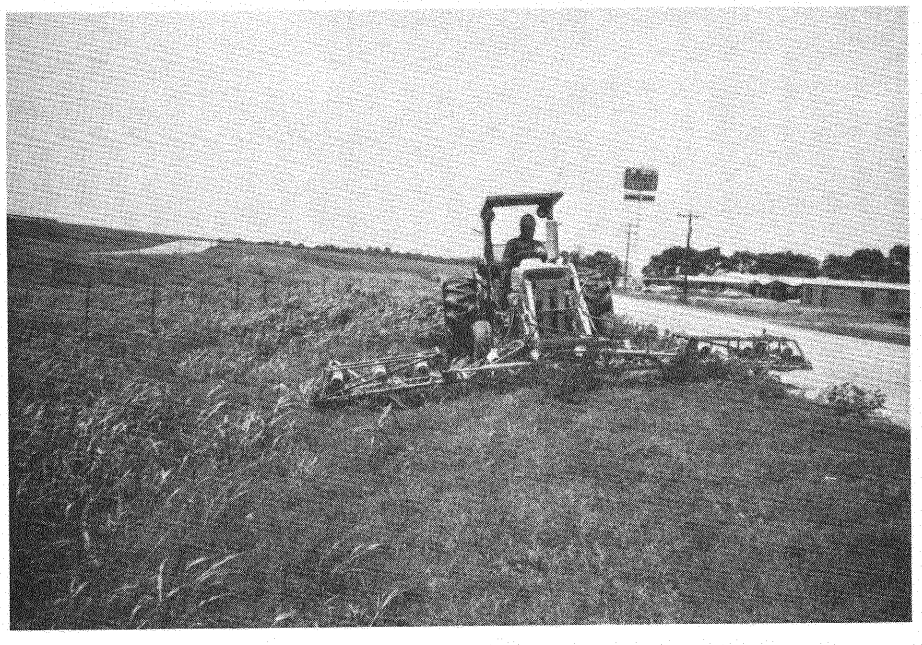
Division 4 - PERRY: Johnsongrass is being treated in all of the following counties; Kay, Garfield, Kingfisher, Logan, Noble, and Payne.

Division 5 - CLINTON: Johnsongrass is being treated in portions of the following counties; Tillman, Jackson, Greer, Beckham, Custer, Washita, Dewey and Harmon. Interstate 40 has been treated from the Texas border in Division 5 eastward approximately 118 miles, to the eastern boundary of Division 5, to the Canadian County line.

Division 6 - BUFFALO: Johnsongrass is being treated in all of Alfalfa county.

Division 7 - DUNCAN: Johnsongrass is being treated in each county in the entire division.

Division 8 - TULSA: Johnsongrass is being treated in all of Tulsa and Osage counties with portions of the following counties being treated; Washington, Delaware, Rogers and Pawnee.



The use of the rope-wick herbicide applicator has given ODOT another tool to combat unwanted weeds on roadsides in Oklahoma.

1980

Interim Report

Project No. 76-04-3

IMPLEMENTATION OF ROADSIDE EROSION CONTROL RESEARCH RESULTS

by

Wayne W. Huffine

Lonnie M. Cargill

JOHNSONGRASS CONTROL

The major weed problem along Oklahoma roadsides still remains to be johnsongrass (Sorghum halepense L.). Because of its adaptability to a wide variety of soils and the capability of producing large quantities of seed and rhizomes, make it a very difficult perennial grass plant to control successfully within the first year of treatment with selective herbicides. Although the Oklahoma Department of Transportation (ODOT) has had excellent success with the use of the selective herbicides DSMA and MSMA, they are continually waging a constant war to control seedling johnsongrass in areas being presently maintained until a competitive, erosion resistant ground cover such as bermudagrass, or native grasses can become established. When these ground covers are once established, they do an excellent job of inhibiting johnsongrass seedlings and most annual grasses and broadleaf weeds from germinating.

Demonstration areas were designated in 1976 in each of the eight highway maintenance divisions, to control johnsongrass with the organic arsenical herbicides DSMA (disodium methanearsonate) and MSMA (monosodium methanearsonate). (Refer to Interim Reports 1977 or 1978 for specific locations in each maintenance division). Treatments made in 1976 and 1977 in these demonstration areas virtually eliminated the rhizome johnsongrass. The most evident weed problem in these areas since that time until the present has been seedling johnsongrass. Until such an area can be covered by an erosion resistant ground cover, such as bermudagrass or native grasses, to inhibit seedling germination, the johnsongrass seed infesting the soil will continue to germinate and create serious weed problems for ODOT. In just a matter of a few weeks, these johnsongrass seedlings if left untreated with selective herbicides, will establish

themselves as perennial plants. It is much easier to control johnsongrass in the seedling stage, than an established perennial plant. As a consequence, it is very important to retreat an area once the treatments begin, prior to the time a seedling johnsongrass plant has an opportunity to form rhizomes and become an established perennial plant. Treatment dates using either MSMA or DSMA for the control of johnsongrass in each of the demonstration areas for each Division in 1980 are as follows:

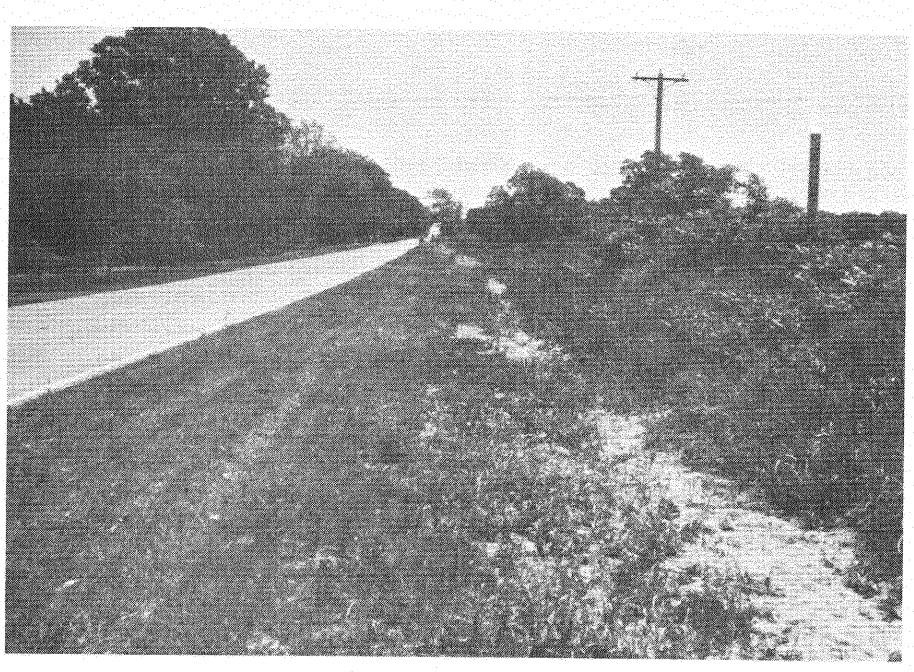
Division	Treatment Dates
1	No treatments applied
2	Mid-June
3	6-24; 10-7
4	No treatments applied
5	6-9; 6-20; 8-20; 9-4
6	No treatments applied
7	No dates available (Entire Div. treated first application; spot treated entire division for second application:
8	No date available (spot-treated once)

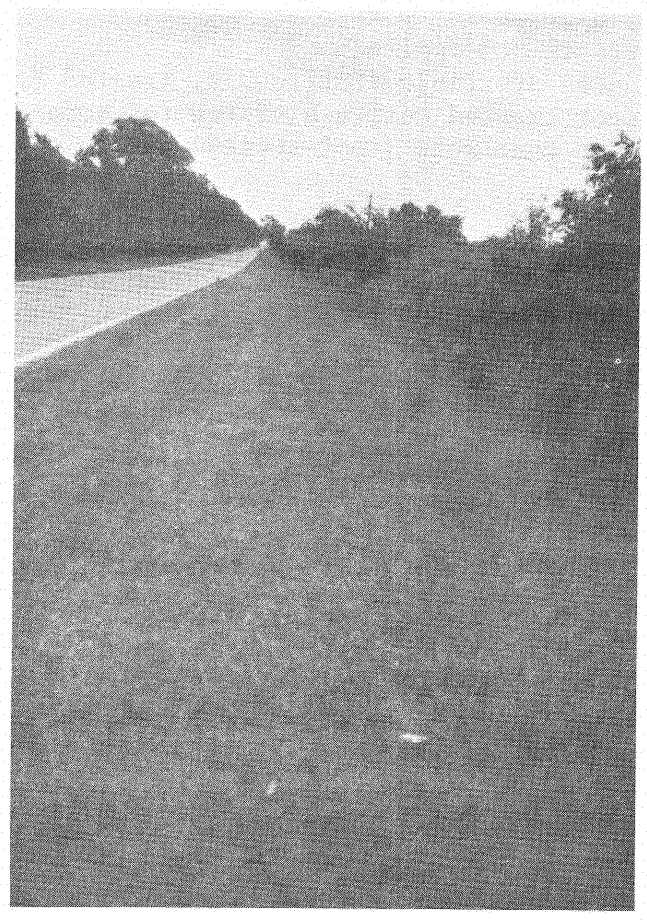
Final evaluations of the johnsongrass control demonstration areas were made in October 1980 and are as follows:

Division	Percent Johnsongrass Controlled
1	95-98
2	98
3	95-98
4	95
5	98
6	50
7	98-100
8	95-98

Soil and vegetation samples were collected in the fall of 1978 and again in 1979 in each of the johnsongrass control demonstration areas for analyses of arsenic levels present.

Total arsenic content in samples taken in 1978 from treated soils ranged from 0 to 8 pounds per acre. However, in untreated soils, total arsenic content ranged from 0 to 10 pounds per acre. Only one of eight vegetative





A johnsongrass control demonstration area located in Division 7, southeast of Comanche on SH-53 in 1976 (top photo). Note the bare area along ditch where very little vegetation remains. After being treated with DSMA and MSMA to control johnsongrass and with atrazine to control many annual grasses and broadleaf weeds, the area is now covered with an erosion resistant ground cover of bermudagrass (bottom photo).

samples collected from a treated area was found to contain arsenic. This sample contained the equivalent of 0.05 pounds of total arsenic per ton of vegetation.

From samples collected in 1979, total arsenic content in treated soils ranged from 4 to 200 pounds per acre. However, in untreated soils, total arsenic content ranged from 0 to 200 pounds per acre. In most cases, the greatest amounts of total arsenic content was found in the 4 to 6 inch soil depths. Total arsenic content in vegetation samples in treated areas ranged from 0 pounds per ton, to 0.175 pounds per ton of vegetation. In the untreated areas, total arsenic content in vegetation samples ranged from 0 to 0.25 pounds per ton of vegetation.

WILLOW CONTROL

Willows (Salix spp.) still remains a problem in areas which remain wet for prolonged periods of time, such as drainage ways and ditches along the highway rights-of-way in Oklahoma. Final evaluations were made of all the designated willow control demonstration areas in October 1980. (See Interim Reports 1977, 1978 and 1979 for specific locations and treatment dates). Even though there have not been any new demonstration areas designated for willow control since 1978, there were still remains of the old willows in most of the demonstration areas, which had been treated with 2,4-D.

The treatment method using 2,4-D applied in early March, while the willows are still dormant, has proven to be an excellent and efficient method of control. Evaluations of these areas one year later generally ranged between 95 to 100 percent control. In all of the willow control demonstration areas evaluated, the problem still exists because of reinfestation by young willows. The environment in these areas is conducive

to germination and growth of willows. To keep the willow population under control it will necessitate an ongoing chemical control program, to effectively and economically control the willows in these areas.

BINDWEED CONTROL

Bindweed (Convolvulus arvensis L.) is a perennial broadleaf plant that is another serious weed problem along roadsides, especially in western Oklahoma. Final evaluations were made of the two bindweed control demonstration areas in October 1980. (See Interim Reports 1977 or 1978 for herbicide used, rate of application and specific locations.) The bindweed control demonstration area in Division 5 was not treated in 1980, and the demonstration area located in Division 6 was treated once in 1980. Even though the demonstration area located in Division 5 had been disturbed as a result of road construction during 1980, evaluations of both this area and the other demonstration area revealed 75 percent of the bindweed had been eliminated.

BROADLEAF WEED CONTROL

Another weed problem that exists along Oklahoma roadsides is the group of broadleaf weeds. When not controlled with the use of herbicides, not only do they necessitate the need for mowing and become an eyesore, they also compete with the desirable plants for nutrients and space, while detracting from the overall beauty of our roadsides.

A final evaluation of the only broadleaf weed control demonstration area, which is located in Division 1 (See Interim Reports 1977 or 1978 for herbicide used, application rate and specific location), was made in October 1980. Even though the demonstration area had not been treated since June 1978, 95 to 98 percent of the broadleaf weeds had been eliminated in this area.

SANDBUR CONTROL

A weed problem which infests some of the rest areas in Oklahoma is sandbur (Cenchrus pauciflorus). It is an annual grass which produces an abundance of spiny burs that are capable of inflicting physical pain if brought into contact with a person.

The only sandbur control demonstration area is located in Division 4. (See Interim Report 1977 for herbicide used, application rate and specific location). Sandbur plants have not been observed growing in the demonstration area since the final treatment applied in 1977 and when evaluated in 1978, 1979 and the final evaluation made in October 1980.

SEEDING PLAINS BLUESTEM

(See Interim Report 1977 for seeding rates and specific locations). Final evaluations of the plains bluestem seeding demonstration areas were made in October 1980. Approximately 30 percent of the slope in Division 4 is covered by plains bluestem. The demonstration area located north of Boise City in Division 6 did not survive due to environmental conditions. Approximately 1 percent of the demonstration area in Division 6 located north of Seiling remains established with plains bluestem. The plains bluestem demonstration located in Division 8 was plowed up one year after being seeded and sprigged with bermudagrass.

PLANTING HONEYSUCKLE AND MULTIFLORA ROSES

(See Interim Reports 1977, 1978 and 1979 for specific locations and planting information). The activity of planting honeysuckle on backslopes in Divisions 5 and 3 has not been successful. Final evaluations made in October 1980 revealed that no honeysuckle had survived in Division 5 and only approximately 5 percent of the original planting of honeysuckle

survived in Division 3. This may be largely attributed to the severe environmental conditions (mainly due to lack of precipitation) and/or weed competition.

The only multiflora rose planting is located in Division 5. A final evaluation made in October 1980 revealed 10 to 15 percent of the original plantings remain alive, although Texoka buffalograss which was hand-seeded at the time the roses were planted, has become the climax vegetation and has stabilized the backslope.

IMPLEMENTATION ACTIVITIES

As a result of the present Implementation Project, the eight ODOT maintenance Divisions have initiated and expanded their weed control programs. The following list is a breakdown by Division of activities implemented in 1980:

Division 1 - Muskogee: Johnsongrass was treated from Warner to Vian and from Sallisaw to the Arkansas border with the rope-wick herbicide applicator, using Roundup. A 2 percent solution of Roundup was used to treat guardrails from Warner to the Arkansas border on I-40.

Division 2 - Antlers: Approximately 90 percent of the entire Division was treated with DSMA to control johnsongrass. In addition, approximately one-half of Marshall County was treated with the rope-wick herbicide applicator, applying Roundup for johnsongrass control. Aatrex 4L (atrazine) was applied to approximately one-half of the entire Division to control annual grasses and broadleaf weeds. Spike was applied in small isolated areas for brush control. Approximately 15 percent of the entire Division was treated with 2,4-DP for brush control.

Division 3 - Ada: Johnsongrass was treated Division-wide with DSMA. Aatrex 4L (atrazine) was applied on I-35 and on I-40 and portions of all counties throughout the entire Division.

Division 4 - Perry: Johnsongrass was treated with DSMA in the following counties: Payne, Logan, Kay, Noble, Garfield and Kingfisher. Payne county was treated with Aatrex 4L (atrazine) to control annual grasses and broadleaf weeds.

Division 5 - Clinton: Johnsongrass was treated with MSMA Division-wide. In addition, a portion of I-40 east of Clinton was treated with Roundup, using the rope-wick herbicide applicator.

Division 6 - Buffalo: Woods, Woodward and Alfalfa counties applied DSMA to control johnsongrass. Woodward and Woods counties, plus portions of Alfalfa county, were treated with 2,4-D to control broadleaf weeds. A 2 percent solution of Roundup was applied around bridge-ends, delineators, signposts and guardrails for total vegetation control in Woods and Woodward counties, while Alfalfa county used Hyvar X for the same purpose in similar areas.

Division 7 - Duncan: The entire Division was treated with DSMA to control johnsongrass and with Aatrex 4L (atrazine) to control annual grasses and broadleaf weeds. Roundup was applied using the rope-wick herbicide applicator on US-81, south of Chickasha.

Division 8 - Tulsa: Portions of all counties applied DSMA to control johnsongrass. Aatrex 4L (atrazine) was applied on SH-117, US-169 north of Owasso, in Pawnee county on US-64 and SH-18 and on I-244 and I-44 in Tulsa county. Roundup was applied through the rope-wick herbicide applicator on I-44 and I-244 in Tulsa county to control johnsongrass and other weeds.

1981

Interim Report

Project No. 76-04-3

IMPLEMENTATION OF ROADSIDE EROSION CONTROL RESEARCH RESULTS

by

Wayne W. Huffine

Lonnie M. Cargill

This interim report deals with the implementation activities initiated by each Division in 1981. The weed and brush control demonstration areas mentioned in Interim Report 1980 have either been discontinued or are now a part of the chemical control maintenance program of each respective Division.

IMPLEMENTATION ACTIVITIES

Division 1 - Muskogee: Aatrex 4L (atrazine) has been applied on US-69 from Muskogee to Checotah to control annual grasses and broadleaf weeds. A 2 percent solution of Roundup is being applied under guardrails in Cherokee, Muskogee, Okmulgee and Sequoyah counties and the Checotah Interstate unit.

Division 2 - Antlers: Aatrex 4L (atrazine) was applied to approximately 85 percent of the entire Division for annual grasses and broadleaf weed control.

Division 3 - Ada: Johnsongrass is being sprayed throughout the entire Division with DSMA. Aatrex 4L (atrazine) has been applied Division-wide to control many annual grasses and broadleaf weeds. The rope-wick herbicide applicator is being used to apply Roundup on several interchange areas on I-35.

Division 4 - Perry: Aatrex 4L (atrazine) was applied throughout the Division for control of many annual grasses and broadleaf weeds. DSMA is being applied Division-wide to control johnsongrass.

Division 4 - Clinton: Aatrex 4L (atrazine) was applied on I-40 from the Texas border east to the east boundary of Division 5, approximately 4 miles from El Reno, to control annual grasses and broadleaf weeds.

Division 6 - Buffalo: Alfalfa county was treated with Aatrex 4L (atrazine) to control annual grasses and broadleaf weeds. Harper, Texas,

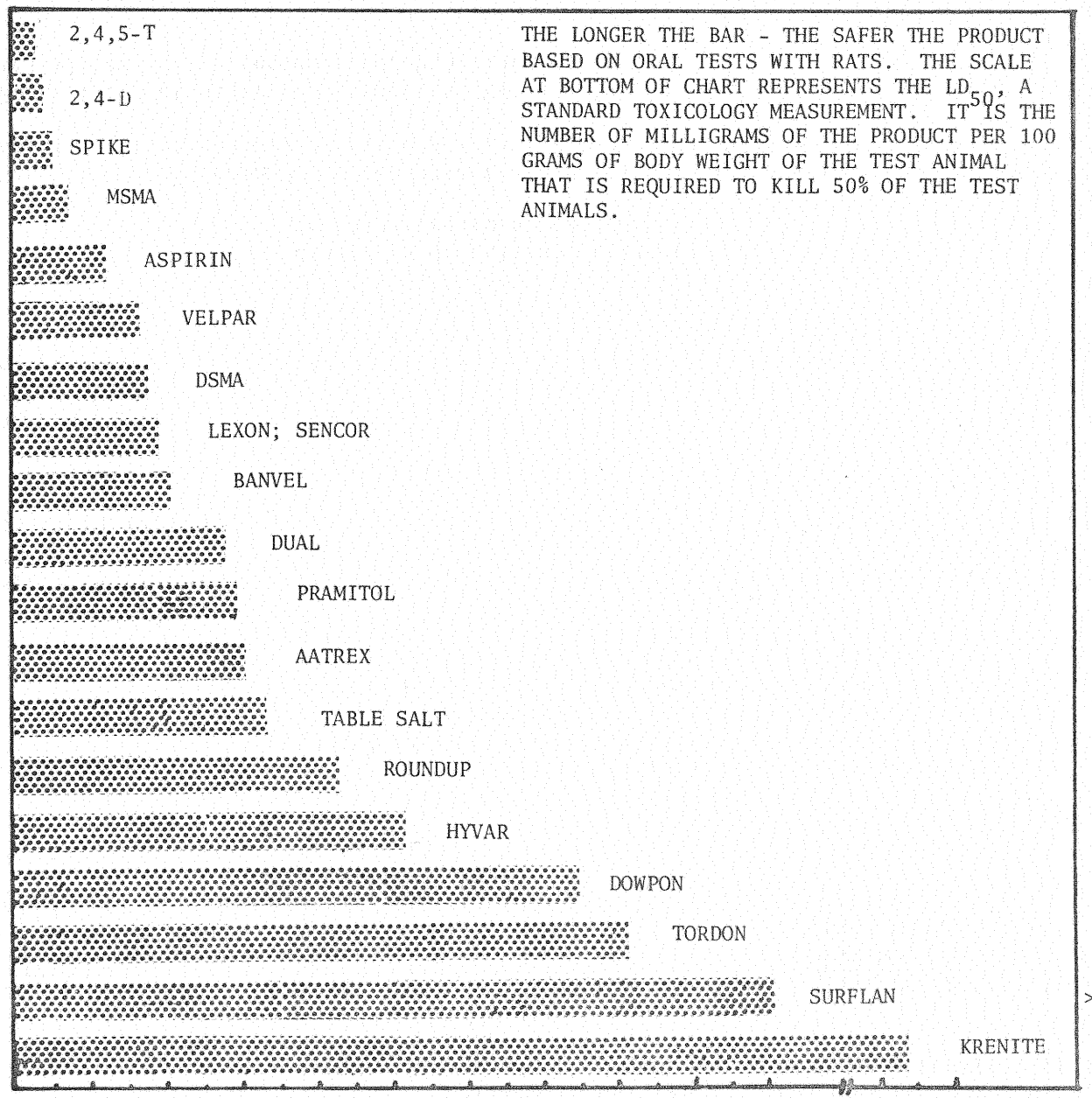
Beaver and Alfalfa counties were treated with 2,4-D amine to control broadleaf weeds. DSMA is being applied in Harper and Alfalfa counties to control johnsongrass. Most counties, with the exception of Cimarron county, are using a 2 percent solution of Roundup to control unwanted vegetation around bridge-ends, signposts, delineators and under guardrails.

Division 7 - Duncan: The entire Division was treated with Aatrex 4L (atrazine) to control annual grasses and broadleaf weeds. DSMA is currently being applied throughout the Division for johnsongrass control. Roundup has been applied through the rope-wick herbicide applicator to control unwanted vegetation south of Chickasha on US-81.

Division 8 - Tulsa: MSMA is currently being used throughout the Division to control johnsongrass. The rope-wick herbicide applicator is being used to apply Roundup to control mainly johnsongrass on I-44 and I-244. Aatrex 4L (atrazine) was applied to control annual grasses and broadleaf weeds on all of the interstate system in Tulsa; in all of Pawnee county; US-66, SH-33, and SH-88 in Rogers county, on US-64, US-75 and US-169 in Tulsa county; and on SH-60 in Washington county.

APPENDIX

(Included in this section are the training materials and information developed for ODOT.)



	ACUTE ORAL LD_{50}	GENERAL TOXICITY TO WILDLIFE & FISH
2,4,5-T	300	*NEGLIGIBLE
2,4-D	300-1000	**NOT HARMFUL
SPIKE	644±27	MODERATE
MSMA	700	MODERATE
ASPIRIN	1240	MODERATE
VELPAR	1690	LOW
DSMA	1800	MODERATE
LEXON; SENCOR	1937-1986	LOW
BANVEL	2900±800	LOW
DUAL	2828-4286	LOW
PRAMITOL	2980	VERY LOW
AATREX	3080	VERY LOW
TABLE SALT	3320	MODERATE
ROUNDUP	4320	VERY LOW
HYVAR	5200	LOW
DOWPON	7570-9330	VERY LOW
TORDON	8200	LOW
SURFLAN	>10,000	LOW
KRENITE	24,400	LOW

* AT RECOMMENDED RATES
**UNDER USE CONDITIONS

1981
SUGGESTED MAINTENANCE PRACTICES FOR ROADSIDE
WEED & BRUSH CONTROL AND BERMUDAGRASS FERTILIZATION

ACTIVITY	HERBICIDE(S) AND RATE(S) OF APPLICATION	*TIME OF APPLICATION	COMMENTS
WILLOW CONTROL (Less than 4-5 inches in diameter)**	Mix 1 gallon of 2,4-D low volatile ester (4 lbs. active ingredient per gal.) in 25 gallons of diesel fuel (1:25 ratio).	Anytime February through April when willows are dormant.	Completely wet the bark one foot above the soil surface. Spray until a runoff of the chemical to the ground line is noticeable. Avoid drift to susceptible plants.
BINDWEED CONTROL	Use 2,4-D low volatile ester (4 lbs. active ingredient per gal.) at the rate of 1 lb. active ingredient (1 qt.) per acre in 40 gal. of water per treatment.	Anytime mid-May through August when plants are in the bud or early bloom stage and are actively growing.	Repeat applications may be necessary for best control. Avoid drift to susceptible plants.
BROADLEAF WEED CONTROL (Post-emergence)	Use 2,4-D amine (4 lbs. active ingredient per gal.) at the rate of 1 lb. active ingredient (1 qt.) per acre in 40 gal. of water per treatment.	Anytime in May through July when plants are actively growing.	One application per year should control the broadleaf weeds. Avoid drift to susceptible plants.
BROADLEAF WEED CONTROL (Pre-emergence)	Use atrazine 4L at 2 quarts (2.0 lbs. active ingredient) in 40 gallons of water per acre/ treatment per year, or, atrazine 80 W (80% Wettable Powder) at 2.5 lbs (2.0 lbs active ingredient) in 40 gallons of water per acre/treatment per year.	March, or, to control early germinating species such as sweet clover, apply in February.	Atrazine will also control many of the undesirable annual grasses.

* Consult the Oklahoma State Department of Agriculture for possible changes in the "Restricted Areas" for the application of phenoxy herbicides (i.e., 2,4-D, MCPA, Silvex, and 2,4-DB).

** For willows or other woody species that are larger than 4-5 inches in diameter, use a tree injector; inject 1 milliliter of the recommended herbicide per inch.

ACTIVITY	HERBICIDE(S) AND RATE(S) OF APPLICATION	TIME OF APPLICATION	COMMENTS
SANDBUR CONTROL	Use DSMA liquid (3.6 lbs. active ingredient per gal.) at the rate of 1 gal. per acre in 40 gal. of water per treatment.	May through October. Repeat application 2 or 3 weeks after initial application.	Two or three applications per year for each of 2 or 3 years may be needed for complete eradication.
JOHNSONGRASS CONTROL	Use MSMA liquid (6.0 lbs. active ingredient per gal.) at ½ gal. per acre in 40 gal. of water per treatment for the first application. Use DSMA liquid (3.6 lbs. active ingredient per gal.) at 1 gal. per acre in 40 gal. of water per treatment for the second and third treatments at 2 to 3 week intervals.	April through October Treat anytime the johnsongrass plants reach a height of 8 to 12 inches and are actively growing. Best results are obtained if the first application is made with MSMA liquid if the air temperature is between 70° and 80°F and the sun shining brightly. Repeat applications 2 or 3 times, at 2 to 3 week intervals with DSMA liquid when the air temperature is above 80°F and the sun shining brightly, may be needed for best control.	Two or three applications per year for each of 2 or 3 years may be needed for complete eradication.
NON-SELECTIVE WEED CONTROL ON ROADSIDE SHOULDERS	Use Pramitol 25E (2.0 lb. ai/gal.) at 20 gallons per acre. Hyvar X 80 WP at 8 lbs./acre, plus Velpar 90SP at 2 lbs per acre Use Roundup applied as a 2% solution (2 gallons Roundup + 98 gallons water); or apply 5 quarts Roundup per acre.	Both these materials can be applied anytime the soil is not frozen. Probably the period March through May would be most desirable. This treatment is to be applied to actively growing vegetation only.	Appears to be most effective across the state with a minimum of migration. Is equally as effective as Pramitol but tends to migrate somewhat more. Retreatments are to be made as necessary.

ACTIVITY	HERBICIDE(S) AND RATE(S) OF APPLICATION	TIME OF APPLICATION	COMMENTS
PRE-SURFACING APPLICATION OF NON-SELECTIVE HERBICIDES	Pramitol 25E (2 lbs. ai/gal.) at 20 gallons per acre can effectively be used for this purpose.	Prior to surfacing roadways.	
	Hyvar X 80 WP at 6 lbs. per acre is effective for soil sterilization.	Prior to surfacing roadways.	
ELM CONTROL	Use 2,4-D amine (4 lbs. active ingredient per gal.) Inject 1 milliliter of 2,4-D amine per inch of tree stem diameter with spacings every three inches around base of tree just above the soil surface.	Anytime except March or April.	Avoid drift to susceptible plants.
BERMUDAGRASS FERTILIZATION (EAST OF US-81)	Apply 200 lbs. of urea (45-0-0) or equivalent, 75 lbs. of 0-45-0 or equivalent, and 50 lbs. of 0-0-60 or equivalent per acre.	To utilize the maximum amount of nitrogen, delay fertilizer application until the bermudagrass is growing rapidly as in late April or May.	Areas where a drop type spreader such as the "Gandy" or something similar can be used, when properly calibrated, will provide the most uniform coverage. Rough areas where the spreader can't be used, can be fertilized with the spray truck if equipped with adequate agitation to keep the heavy materials in suspension until sprayed in approximately 100 gal/acre.
WEST of US-81	Apply 200 lbs. of urea (45-0-0) or equivalent, and 150 lbs. of 0-45-0 or equivalent per acre. Generally the potassium level will be adequate.	Same as above.	

1981

*GENERAL WEED CONTROL PRACTICES
WITH ROUNDUP, APPLIED THROUGH
THE BOBAR ROPE APPLICATOR

ACTIVITY	HERBICIDE(S) AND RATE(S) OF APPLICATION	TIME OF APPLICATION	COMMENTS
JOHNSONGRASS CONTROL	Mix one gallon of Roundup with 1-2 gallons of water.	Apply to actively growing johnsongrass plants when most have reached the boot to head stage of growth. Allow plants to reach at least 18 inches average weight.	For best results, the rope-wick applicator should be operated at less than 6 mph. For heavy johnsongrass stands, one should reduce speed to 3-4 mph to obtain best control and insure adequate coverage.
ALFALFA CONTROL	Mix one gallon of Roundup with 1-2 gallons of water.	Apply to actively growing alfalfa plants when most have reached the late bud to early bloom stage.	
PERENNIAL BROADLEAF WEEDS	Mix one gallon of Roundup with 1 gallon of water.	Apply when plants are actively growing and have reached the late bud and early bloom stage.	

* When cleaning the rope-wick applicator, one word of caution, do not use a steam cleaner to clean either the nylon or polyester ropes. This practice promotes shrinkage of the fibers, consequently reducing the flow rate. Use water and/or detergent under high pressure when cleaning the ropes.

1981

SUGGESTED MAINTENANCE PRACTICES FOR THE PREEMERGENCE CONTROL OF BROADLEAF WEEDS AND ANNUAL GRASSES

HERBICIDE(S) AND RATE(S) OF APPLICATION

Use Aatrex (atrazine) 4L at 2 quarts (2.0 lbs. active ingredient) in 40 gallons of water per acre per treatment per year, or, atrazine 80W (80% wettable powder) at 2.5 lbs. (2.0 lbs. active ingredient) in 40 gallons of water per acre/treatment per year.

TIME OF APPLICATION

Apply Aatrex (atrazine) in March, or, to control early germinating species such as sweet clover, apply in February.

SPEED(MPH) CHART FOR BOOMLESS SPRAYER CALIBRATION

When calibrating the boomless sprayer (off-center nozzle), the following chart has been calculated and may be helpful for the determination of ground speed in miles per hour. Once the speed has been determined, the sprayer will then be delivering 40 gallons per acre.

For example, a sprayer is delivering 20 gallons per minute, the spray pattern width is 25 feet; then by following the two columns to where they intersect, we find the number 9.9. From this, the sprayer will need to travel at a speed of 9.9 or 10 miles per hour to deliver 40 gallons per acre.

GPM (GALLONS PER MINUTE)	SPRAY WIDTH (FEET)														
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	SPEED (MILES PER HOUR)														
15	13.3	12.4	11.6	10.9	10.3	9.8	9.3	8.8	8.4	8.1	7.7	7.4	7.1	6.9	6.6
16	14.1	13.2	12.4	11.6	11.0	10.4	9.9	9.4	9.0	8.6	8.3	7.9	7.6	7.3	7.1
17	15.0	14.0	13.1	12.4	11.7	11.1	10.5	10.0	9.6	9.1	8.8	8.4	8.1	7.8	7.5
18	15.9	14.9	13.9	13.1	12.4	11.7	11.1	10.6	10.1	9.7	9.3	8.9	8.6	8.3	8.0
19	16.8	15.7	14.7	13.8	13.1	12.4	11.8	11.2	10.7	10.2	9.8	9.4	9.0	8.7	8.4
20	17.7	16.5	15.5	14.6	13.8	13.0	12.4	11.8	11.3	10.8	10.3	9.9	9.5	9.2	8.8
21	18.6	17.3	16.2	15.3	14.4	13.7	13.0	12.4	11.8	11.3	10.8	10.4	10.0	9.6	9.3
22	19.4	18.2	17.0	16.0	15.1	14.3	13.6	13.0	12.4	11.8	11.3	10.9	10.5	10.1	9.7
23	20.3	19.0	17.8	16.7	15.8	15.0	14.2	13.6	12.9	12.4	11.9	11.4	10.9	10.5	10.2
24	21.2	19.8	18.6	17.5	16.5	15.6	14.9	14.1	13.5	12.9	12.4	11.9	11.4	11.0	10.6
25	22.1	20.6	19.3	18.2	17.2	16.3	15.5	14.7	14.1	13.5	12.9	12.4	11.9	11.5	11.0
26	23.0	21.5	20.1	18.9	17.9	16.9	16.1	15.3	14.6	14.0	13.4	12.9	12.4	11.9	11.5

PESTICIDE

APPLICATION RECORD

Date: _____ Time: _____

Location: _____

Approximate Acres Treated: _____

Pesticide Applied: _____ Gals. of Mixture: _____

Trade name: _____

Manufacturer: _____

Concentration: _____

Type of Applicator: _____

Rate of Application: _____

Rate of Carrier: _____gpa (Water; Oil)

Target Species: _____

Wind Velocity: _____ Direction: _____

Temperature: _____

Weather: _____

EPA Reg. No. _____ _____
Applicator

EPA Est. No. _____

Notes:

PRECAUTIONS IN HANDLING HERBICIDES

Most herbicides are safe when stored, handled, mixed, and used in accordance with label instructions and sound agricultural practices. Most phenoxy herbicides are low in toxicity. However, some can cause injury to man, many domestic animals, and fish and wildlife if improperly used.

Most of the phenoxy herbicides are toxic to many crop plants and ornamentals. Many are volatile and their vapors and spray drift will cause damage to desirable plants. Avoid spraying when windy conditions exist. Always use a drift control additive when using phenoxy herbicides.

Keep herbicides away from children, livestock, and pets. Store herbicides in closed, well-labeled containers in a dry place where they cannot contaminate food, feed, or water.

When handling herbicides wear clean, dry clothing. Launder clothing after each spraying operation before wearing again. Be sure to check and read the herbicide label for further clothing requirements.

Do not inhale herbicides and avoid contact with spray mist and drift with your skin. Avoid spilling it on any part of your body - especially your eyes, nose, and mouth. If you spill it on your body, wash it off immediately with soap and water and remove contaminated clothing.

To protect fish, wildlife, and livestock, do not clean spraying equipment or dump excess spray material near lakes, streams, or ponds.

Empty herbicide containers may be hazardous. Dispose of them in accordance with the label instructions.

CLEANING AND CARE OF SPRAYER EQUIPMENT

To prevent accumulation of chemicals, thoroughly flush the tank with water, both inside and out after each days' use. Chemicals should not be left in the tank over night. Cleaning stops corrosion, and also prevents contamination which may result in a kill of desirable vegetation.

It is important to discharge the cleaning water where it will not contaminate water supplies, streams, crops, or injure other plants, and where puddles will not be accessible to children, livestock, pets, or wildlife.

The following steps are suggested for thoroughly cleaning sprayers, both inside and out:

(1) Completely hose down the tank both inside and out. Flush out the cleaning water through the nozzle by operating the sprayer.

(2) Repeat the procedures given in Step 1.

(3) Remove nozzle tip(s) and screen(s). Clean them in kerosene, or in a detergent solution, or an ammonia solution, using a soft brush.

Do not use a knife, wire, or other hard object to clean the nozzle tip(s). The fine machined surfaces of the tips can be easily damaged causing distortion of the spray pattern and increased rates of application.

(4) Fill tank (300 gals. capacity) with 25 gals. of water. For larger tanks, (1000 - 1500 gals.), add approximately 100 - 150 gals. of water. Then add any of the following cleaning materials in these proportions:

(A) 1 lb. Detergent per 50 gals. of water
(b) 1 lb. Detergent plus 1 lb. activated charcoal per 50 gals. of water
(c) 1 quart household ammonia with each 25 gals. of water

(5) Flush the entire sprayer system with the cleaning solution.

If you have used a phenoxy herbicide, before going to Step 6, follow this additional procedure:

(A) Replace nozzle tip(s) and screen(s).
(B) Fill the tank about half full of water and add one pint of ammonia for each 25 gals. of water.
(C) Operate the pump to circulate the ammonia solution throughout the sprayer for about five minutes, and discharge a small amount through the boom and nozzle(s).
(D) Keep remaining solution in the sprayer overnight.
(E) In the morning flush out the remaining ammonia solution through the nozzle(s) by operating the sprayer.

(6) Fill the tank about half full of clean water while hosing down both the inside and outside, then flush out through the boom.

When you have finished with the sprayer for the season, remove and store the nozzle tip(s), screen(s), and strainers(s) in light oil. Store the sprayer in a clean, dry shed, if possible. If the pump cannot be drained completely, store in where it cannot freeze.

CLEANUP OF PESTICIDE SPILLS [1/]

According to federal pesticide regulations it is the applicator's legal responsibility to clean up any pesticide spills that are a result of his pesticide application. Not only is he liable for damages and subject to penalties resulting from spills, but he has an obligation to clean up and decontaminate the area in which a pesticide spill has occurred. Often concentrates are spilled during mixing and these can be acutely hazardous. Children who play in the area of an uncleaned spill are in danger of being seriously and perhaps fatally poisoned.

Animals may drink the runoff from the area of the spill and be poisoned, or the runoff may flow into surface waters and harm organisms living in those waters or predators feeding on them. The usual danger resulting from herbicide spills is that they will damage or kill desirable plants either on or off the right-of-way or mixing site.

Minor Spills

Keep people away from spilled chemicals. Rope off the area and flag it to warn people. Do not leave unless someone is there to warn of the danger. Herbicide spills are most common for right-of-way applicators, since these are the materials they most commonly use. If the pesticide was spilled on anyone, give the correct first aid. Confine the spill. If it starts to spread, dike it up with sand or soil. Use an absorbant material to soak up the spill. You can use soil, sawdust, or a special product made to do this. Shovel all contaminated material into a leakproof container for disposal. Dispose of it as you would excess pesticides. Do not hose down the area. This spreads the chemical.

Put something on the spill to stop the chemical action. You may be able to use common household bleach or a solution of lye or ammonia, or activated charcoal. Activated charcoal absorbs the herbicide from the soil (ties it up) and makes it unavailable to plants. By reducing the availability of the herbicide to plants, injury is minimized. If spills are noticed, immediately remove about one inch of treated soil with a shovel or flat spade and dispose of in areas where bare ground is desired. This should remove most of the herbicide. The trees should then be inspected periodically to determine whether any chlorosis develops. If in doubt as to complete removal, or as an extra-precautionary measure, seven pounds of activated charcoal per 1,000 sq. ft. should be spread evenly, then incorporated lightly with a rototiller. If spills are noticed after rain, the soil should be removed to a depth of 4-6 inches then charcoal broadcast over the area and incorporated. If you are not sure what to use, call the chemical manufacturer. Always work carefully. Do not hurry. Do not let anyone enter the area until the spill is all cleaned up.

1/ Information taken from the Right-of-Way Pesticide Applicator Manual, Cooperative Extension Service, Division of Agriculture, Oklahoma State University; and from Apply Pesticides Correctly - A guide for commercial applicators, USDA and EPA.

Major Spills

The cleanup job may be too big for you to handle. You may not be sure of what to do. In either case, keep people away, give first aid, and confine the spill. Then call the manufacturer for help.

The National Agricultural Chemicals Association has a Pesticide Safety Team Network. They can tell you what to do. Or they can send a safety team to clean up the spill. You can call them toll-free any time at (800) 424-9300.

If a major pesticide spill occurs on a highway, have someone call the highway patrol or the sheriff for help. (Carry these phone numbers with you.) Do not leave until responsible help arrives.

Report all major spills by phone to the Oklahoma State Department of Agriculture. You also may need to notify other authorities:

If the spill is on a State highway, call:
- the highway patrol, or
- the State highway department.

If the spill is on a county road or a city street, call:
- the county sheriff, or
- the city police.

If food is contaminated, notify:
- State or Federal food and drug authorities, or
- city, county, or State health officials.

If water is contaminated, notify:
- State health officials,
- regional, State, or Federal water quality or water pollution authorities, and
- the State fish and game agency.

CIBA-GEIGY

Deactivating residual herbicides with activated charcoal

Herbicides are a boon to weed control. The effectiveness of residual chemicals is due, in part, to the fact that they actively control weeds for extended periods of time.

This extended period of effectiveness, which is one of their major advantages, can also be a disadvantage under certain conditions. Since these herbicides are selective with respect to plant tolerance, they should be used with care and with thought to future use of the treated area.

A change in planned use of a treated area following application, or actual misuse of a herbicide, can cause problems. Accidental spilling of a herbicide can result in a heavy concentration in a small area, effectively sterilizing the soil. Or movement of chemical from a treated area into nearby areas may also cause problems.

This sheet is intended to help you deactivate residual herbicides where their presence in the soil is undesirable.

Which herbicides

Activated charcoal is effective in deactivating many organic pesticides. Here, we are referring specifically to the following Ciba-Geigy products:

*AAtram 20G
AAtrex 80W
AAtrex 4L
*Atratol 8P
*Atratol 80W
Caparol 80W
*Conquer granules
*Conquer liquid
Cotoran 80WP
Evik 80W
Igran 80W
Maloran 50WP
Milogard 80W
*Pramitol 5PS
Pramitol 25E
Princep 4G
Princep 80W
Sancap 80W
Tenoran 50WP
Tolban 4E

Activated charcoal is generally effective against organic chemicals, and **not** against inorganic chemicals. All of the herbicides listed above fall in the organic category.

*Combination herbicides (those containing more than one active chemical) may contain both organic and inorganic ingredients. So the charcoal may be effective against only some of the ingredients.

Fortunately, most inorganic ingredients of herbicides are relatively short-lived, compared to the organic ones. However, their presence should be considered in any deactivation program.

What is activated charcoal

It is ordinary charcoal that has been finely ground to increase its absorptive surfaces, and has been electrically charged so it will attract herbicide molecules. In effect, the herbicide is still present in the soil, but it is unavailable for plant uptake. Activated charcoal has no significant effect on the soil, plants, or fertilizers.

The use of activated charcoal to deactivate herbicides in the soil is a new practice that shows great promise, but there may be instances where it will not always be 100 percent effective. For this reason, where large areas are involved, it is suggested that a small area be treated first to determine whether satisfactory results can be obtained.

Where to use

Activated charcoal can be used wherever residual herbicides (see list above) are present in the soil, and plans for plant growth in the area require their deactivation.

Examples are:

- along flower beds
- along fences
- turf areas
- around buildings
- around plants, shrubs, and trees
- where spilling has occurred during mixing

How much herbicide is present

You must determine, insofar as possible, the amount of herbicide you are dealing with.

Herbicide formulations vary in the amount of active chemical they contain, and since it is only the active ingredients you are concerned with, find the formulation you used in Table 1, and from it the relative amount of active ingredients involved.

continued

Table 1

Formulation	Unit	Pounds a.i./Unit
25E	1 gal.	2.0
80W	1 lb.	0.8
4L	1 qt.	1.0
4G		
20G	10 lbs.	2.0
5PS*	10 lbs.	0.575
8P*	10 lbs.	0.8
50WP	1 lb.	0.5
4E	1 qt.	1.0
Conquer G*	10 lbs.	0.57
Conquer L*	1 gal.	0.19

*The starred formulations contain inorganic ingredients which should be considered.

NOTE: Use this information with Table 2 to determine the amount of chemical you must deactivate on a unit basis (Acre, 1,000 sq. ft., or 100 sq. ft.)

Formulations which contain active ingredients which are not (organic) will not be completely deactivated by charcoal.

For example, Pramitol 5PS contains prometon and simazine (organic) and chlorates and borates (inorganic). These inorganic ingredients are usually less persistent in the soil, but should be considered when making plans for the area.

Estimating the amount of active ingredients present will usually be accurate enough for your purpose. On small areas where the amount of charcoal needed is relatively small, just be sure to use plenty.

Another, more accurate, way of determining the amount of chemical you are dealing with is to have a chemical analysis run on a soil sample taken from the area. The sample should be taken from the surface 3 inches; deeper if the chemical has been applied some time before, if considerable rainfall has occurred since application, or if the soil is especially coarse textured and porous. If the analysis from a three inch sample shows one part per million (ppm) of chemical present, this is equivalent to one pound of chemical per acre in the top three inches of soil. One ppm in a six-inch sample is equivalent to two pounds of chemical per acre in the top six inches of soil.

1,000 square foot basis

Assuming the equivalent of 1 pound active chemical per acre (0.02 lb./1,000 sq. ft.), you will need from 2.3 to 3.5 pounds of activated charcoal per 1,000 square feet (from Table 2).

Use at least 2.3 to 3.5 pounds of activated charcoal per 1,000 sq. ft., even though the amount of active chemical might call for less. If you find more than the equivalent of 1 pound active chemical per acre present, increase the rate of charcoal, as recommended in Table 2.

Table 2

Pounds a.i.* present/acre	Pounds a.i.* present/ 1,000 sq. ft.	Pounds charcoal needed/ 1,000 sq. ft.
up to 1.0	up to 0.02	2.3 — 3.5
2.0	0.04	4.6 — 6.9
3.0	0.06	6.9 — 10.3
5.0	0.11	11.5 — 17.2
10.0	0.22	22.9 — 34.4
20.0	0.45	45.0 — 67.5

*a.i. = active ingredient

How to apply charcoal

If you use dry, powdered charcoal, spread it evenly over the affected area. Some charcoal is treated so it can be added to water to form a slurry and applied as a spray.

Incorporate the charcoal four to six inches deep, with a rototiller, or similar implement. This assures getting the charcoal intermixed with the herbicide in the soil.

After incorporation, water the area thoroughly every day for three to four days before reseeding or planting. If possible, wait a few more days because, under some conditions, deactivation is slowed. If working with large areas, test-seed a small plot to check effectiveness of the treatment.

If the seedlings die, water for three or four more days before seeding again. It may be necessary to add more charcoal, but usually the extra time will be sufficient.

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Greensboro, NC 27409

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OKLAHOMA STATE DEPARTMENT OF AGRICULTURE
122 STATE CAPITOL
OKLAHOMA CITY, OKLAHOMA 73105

RULES AND REGULATIONS
OKLAHOMA PESTICIDE APPLICATORS LAW

(2 O.S. 1971, Sections 3-81 through 86
as amended by S.B. #190 of 1977 Oklahoma Legislature)

3-352 CERTIFICATE OF EMPLOYMENT - When an unlicensed operator signs a certificate of employment to work for a licensed operator, the unlicensed operator is an employee of the licensed operator.

3-354 RESTRICTED AREAS FOR THE APPLICATION OF PHENOXY HERBICIDES

A. Phenoxy herbicides shall not be applied by commercial applicators in Harmon County between the dates listed for each of the following areas:

1. Area A - April 25 - October 31
Area A begins at the southwest corner of Section 36, T4N, R27W in Harmon County (approximately 2 miles north and 2 miles west of Arnett in Harmon County at the Texas state line) and extends 11 miles east of the Oklahoma-Texas state line, thence six miles south, thence three miles east, thence one mile south, thence two miles east, thence 11 miles south to the Jackson County line, and includes that portion lying south and west of the Area A boundary line.

2. Area B - May 2 - October 31
Area B begins at a point in Section 1, T4N, R27W where the Salt Fork of the Red River intersects the Texas state line and extends east along said river to a point in Section 4, T4N, R24W where the Salt Fork of the Red River intersects the Greer County Border and includes all lands in Harmon County south of the Salt Fork of the Red River and north and east of the Area A boundary line.

3. Area C - May 25 - October 31
Area C begins at a point where the north line of Section 36, T6N, R27W intersects the Texas state line (approximately 3½ miles west of Carl) and extends east approximately five miles to the State Highway 30, thence south three miles along said highway, thence east 6½ miles, thence north two miles to the Greer County line, and includes all lands in Harmon County south of this line and north of the Area B north boundary line, (the Salt Fork of the Red River).

4. Area D - No cut-off date specified
Area D includes all areas of Harmon County not previously described in Areas A, B or C and lying north of the Area C boundary line.

B. Phenoxy herbicides shall not be applied by commercial applicators in the following areas of Coal County, Oklahoma between the dates of May 15 and November 1.

1. All of Township 1 South, Range 8 East.
2. All of Township 1 South, Range 9 East.
3. Sections 21, 22, 23, 24, 25, 26, 27, 28, 33, 34, 35, and 36 of Township 1 North, Range 8 East.
4. Sections 19, 20, 21, 28, 29, 30, 31, 32, and 33 of Township 1 North, Range 9 East.

C. Phenoxy herbicides shall not be applied by commercial applicators in Bryan County, Oklahoma between the dates listed for each of the following areas.

1. Area A - No date restriction
Area A lies both east of Highway 75 and north of Highway 70.

2. Area B - May 15 - September 15
Area B begins south and west of Area A bounded by the line starting at the NW corner of Section 25, T7S, R7E and proceeds east 17 miles to a point at the northeast corner of Section 27, T7S, R10E, thence 1½ miles south, thence one mile east, thence 1½ miles south to a point at the southwest corner of Section 1, T8S, R10E, thence three miles east to the northeast corner of Section 8, T8S, R11E, and from that point south to the Red River.

3. Area C - May 1 - September 15
Area C lies south and west of Area B and bounded by Lake Texoma and Red River.

E. Phenoxy herbicides shall not be applied by commercial applicators in the following areas of Love County, Oklahoma, between the dates of May 1 and September 15.

1. Starting on Highway 32 at the Jefferson County line, thence east to the east line of Section 19, Township 7 South, Range 1 West, thence south along banks of the Red River to the Jefferson County line, thence north to Highway 32 and the point of beginning.

F. Phenoxy herbicides shall not be applied by a commercial applicator in the following described portion of Alfalfa County without a "Special Permit" from the Oklahoma State Department of Agriculture.

1. Area

a. Township 29 North, Range 9 West
Sections 17, 18, 19, 20, 29, 30, 31, and 32

b. Township 29 North, Range 10 West
Sections 13, 24, 25, and 36

c. Township 28 North, Range 10 West
Sections 1, and 12

d. Township 28 North, Range 9 West
Sections 5, 6, 7, and 8

2. Restrictions

a. Special Permit - No phenoxy herbicide may be applied in specifically defined localities within the restricted area unless the commercial applicator holdsa "Special Permit" for each application location issued by the Oklahoma State Board of Agriculture.

b. Request for Special Permit - This request must show the specific use, and include the type and formulation of phenoxy herbicide to be used; also, the legal description of the properties to be sprayed, anticipated date of spraying, signature of the commercial applicator and the occupan of the land to be sprayed and such other information as the Board may request.

3. Denial of Request - Request for "Special Permit" may be denied by the Board if in its determination the application of phenoxy herbicides under the conditions, so requested, could constitute undue effects to health, property, environment, or for any other reason deemed essential.

G. Phenoxy herbicides shall not be applied in Canadian County, Oklahoma under the restrictions as listed below:

1. Commercial aerial applicators between the dates of May 15 to October 1. Beginning at a point at the southeast corner of Section 5, Township 12N, Range 7W, thence north along Highway 81 approximately 9 miles to the northeast corner of Section 29, Township 14N, Range 7W, thence west along section line road approximately 12 miles to southwest corner of Section 21, Township 14N, Range 7W, thence north approximately 2 miles to the northeast corner of Section 17, Township 14N, Range 9W, thence approximately four miles west along section line road to northwest corner of Section 14, Township 14N, Range 10W, thence south following section line road approximately 11 miles to southwest corner of Section 2, Township 12N, Range 10W, thence east along section line to starting point.

2. Commercial applicators between the dates of May 10 to October 1. Beginning at the southeast corner of Section 34, Township 11N, Range 8W, thence west along county line to southwest corner of Canadian County, thence north along county line to Section 7, Range 10W, Township 12N, or south side of river, thence, along south side of river to the starting point.

H. Phenoxy herbicides shall not be applied between the dates of March 10 and November 1, in that following described portion of Rogers County, Oklahoma except under restrictions as outlined below:

1. Area - that portion of Rogers County lying south and east of a line beginning at the NE corner of Section 25, R17E, T21N, thence approximately nine miles west along section line to the NW corner of Section 27, R16E, T21N, thence approximately four miles south along section line till it intersects the Verdigris River, thence approximately four miles south along this river to the Rogers County line.

2. Restrictions

a. Special Permit - No phenoxy herbicides may be applied in specifically defined localities within the restricted area unless the commercial applicator holds a "Special Permit" for each application location issued by the Oklahoma State Board of Agriculture.

b. Request for Special Permit - This request must show the specific use, and include the type and formulation of phenoxy herbicide to be used; also, the legal description of the properties to be sprayed, anticipated date of spraying, signature of the commercial applicator and the occupant of the land to be sprayed and such other information as the Board may request.

3. Denial of Request - Request for "Special Permit" may be denied by the Board if in its determination the application of phenoxy herbicides under the conditions, so requested, could constitute undue effects to health, property, environment, or for any other reason deemed essential.

I. Phenoxy herbicides shall not be applied between the dates of May 10 and October 30 by commercial pesticide applicators in that portion of Grady County, Oklahoma lying north of a line beginning at the southwest corner of Section 31, Township 9 North, Range 8 West, thence east along section line to McClain County.

J. Phenoxy herbicides shall not be applied by commercial applicators, between the dates of March 10 and November 1, in that following described portion of Craig County, Oklahoma, except under restrictions as outlined below:

1. Area - That portion of Craig County lying within the boundary of a line beginning at the intersection of the Nowata-Craig County line and Highway 10, thence east along Highway 10 for six miles, thence eight miles south along section line, thence six miles west along section line to the Nowata-Craig County Line, thence north along county line to Highway 10.

2. Restrictions

a. Special Permit - No phenoxy herbicide may be applied in specifically defined localities within the restricted area unless the commercial applicator holds a "Special Permit" for each application location issued by the Oklahoma State Board of Agriculture.

b. Request for Special Permit - This request must show the specific use, and include the type and formulation of phenoxy herbicide to be used; also, the legal description of the properties to be sprayed, anticipated date of spraying, signature of the commercial applicator and the occupant of the land to be sprayed and such other information as the Board may request.

3. Denial of Request - Request for "Special Permit" may be denied by the Board if in its determination the application of phenoxy herbicides under the conditions, so requested, could constitute undue effects to health, property, environment, or for any other reason deemed essential.

K. Phenoxy herbicides shall not be applied by commercial pesticide applicators in any portion of Tillman County between the dates of May 1 and October 31.

L. Phenoxy herbicides shall not be applied by commercial pesticide applicators in any portion of Jackson County between the dates of May 1 and October 31.

M. Phenoxy herbicides shall not be applied by pesticide applicators in the following areas of Kiowa County, Oklahoma between the dates of May 1 through October 31

1. Sections 1, 12, 13, 24, 25, and 36 of Township 3 North, Range 17 West.
2. All of Township 3 North, Range 16 West.
3. Sections 1, 24, 25 and 36 of Township 2 North, Range 17 West.
4. All of Township 2 North, Range 16 West.

N. Phenoxy herbicides shall not be applied by commercial applicators in the followin described portion of Okmulgee County, Oklahoma except under restrictions as outlined below:

1. Area - That portion of Okmulgee County lying within the boundary of a line beginning at the southeast corner of Section 33, Township 13 North, Range 15 East then north eleven miles to northeast corner of Section 9, Township

14 North, Range 15 East then West six miles to northwest corner of Section 10, Township 14 North, Range 15 East then south eleven miles to the southwest corner of Section 34, Township 13 North, Range 14 East then east six miles to the point of origin at the southeast corner of Section 33, Township 13 North, Range 15 East.

2. Restrictions

a. Special Permit - No phenoxy herbicide may be applied in specifically defined localities within the restricted area unless the commercial applicator holds a "Special Permit" for each application location issued by the Oklahoma State Board of Agriculture.

b. Request for Special Permit - This request must show the specific use, and include the type and formulation of phenoxy herbicide to be used; also, the legal description of the properties to be sprayed, anticipated date of spraying, signature of the commercial applicator and the occupant of the land to be sprayed and such other information as the Board may request.

3. Denial of Request - Request for "Special Permit" may be denied by the Board if in its determination the application of phenoxy herbicides under the conditions, so requested, would constitute undue effects to health, property, environment, or for any other reason deemed essential.

3-361 COMMERCIAL AND NON COMMERCIAL CATEGORIES OF PESTICIDE APPLICATION

A. Permitted Categories

1a. Agricultural Plant Category - Includes the application of pesticides to agricultural crops, agricultural grassland, noncrop agricultural land. This category does not include the production of trees for any purpose.

1b. Agricultural Animal Category - Includes the application of pesticides to animals, including those in feedlots, sale barns, egg production facilities, etc. This excludes Doctors of Veterinary Medicine applying pesticides as drugs or medication during the course of their normal practice.

2. Forest Pest Control Category - Includes the application of pesticides in forest nurseries, forest seed production areas and other forest areas. This is to include trees grown for the production of forestry products, or for recreation.

3. Ornamental and Turf Pest Control Category - Includes the application of pesticides within residential or business areas, to lawns, ornamental trees and shrubs, excluding structures as described in permitted Category 7. This also includes park areas, golf courses, and other recreational areas, except forests.

4. Seed Treatment Category - Includes the application of pesticides to seeds for any purpose.

5. Aquatic Pest Control Category - Includes the application of pesticides to standing or running water. This excludes public health activities (i.e. mosquito control).

6. Right-Of-Way Pest Control Category - Includes the application of pesticides for public road maintenance, power line maintenance, railroad right-of-way, storage tank areas, and other similar areas.

7a. General Pest Control Category - The application of pesticides within and immediately adjacent to a structure, except for fumigation activities, control of termites and other wood destroying organisms in or on a structure, and control of birds or predatory animals.

7b. Structural Pest Control Category - The application of pesticides for the purpose of controlling termites or other wood destroying organisms in or on a structure.

7c. Fumigation Category - The use of liberated gas within a structure or storage area, to include railcars, ships, etc.

7d. Food Processing Category - The application of pesticides, except fumigants, in structures where bulk food is processed or stored.

8. Public Health Pest Control Category - The application of pesticides by state, federal or other governmental employees in public health programs.

9. Regulatory Pest Control Category - Includes the application of pesticides by state, federal or other government employees for the control of designated regulated pests.

10. Demonstration and Research Pest Control Category - Includes persons engaged in the application of pesticides for scientific or research or for the purpose of demonstrating pesticide products or methods or application.

11. Bird and Predatory Animal Control Category - The application of pesticides for the control of birds or predatory animals in any area and subject to the rules of the Oklahoma Department of Wildlife Conservation, The Predatory Animal Control Division of the Board and as set forth herein.

12. Timber Treating Category - Includes wood treated by the impregnation or application of chemical solutions for the purpose of retarding or preventing deterioration or destruction by insects, fungi, bacteria, or other wood destroying organisms.

13. Specialty Category - includes any area of pesticide application not defined in category 1 thru 12 when the pesticide to be used is classified as restricted

3-362 PREREQUISITES FOR PERMITTING

A. Certified Applicator Required

1. Each person or firm permitted shall be a certified applicator or have a minimum of one certified applicator in his employ who is qualified in each permitted category in which application is made.

B. Aerial Applicator Bond Requirements

1. The amount of bond to be posted for the commercial aerial application of pesticides shall be as follows:

a. Resident Aerial Applicators - $3,000. for one or two aircraft plus $1,000. for each additional aircraft;

b. Nonresident Aerial Applicators - $15,000. for one or two aircraft plus $2,000. for each additional aircraft.

C. Application for Permit Required

1. An application for permit on a form provided by the Board shall be completed and properly filed with the Board prior to the issuance of any permit.

2. An application for permit shall be considered to be properly filed when the Board has received the following:

   a. An application with all applicable required information provided and authorized signature affixed.

   b. Cash, check or money order from the firm in the proper amount for the permit or permits desired.

3. If an application for permit renewal is not properly filed by March 1 of any permit year, each commercial applicator shall be required to recertify by examination as if never certified or permitted.

4. Any commercial applicator found to be operating with an expired permit after December 31 and who has not properly filed a current application for permit renewal shall be subject to prosecution for operating without a valid permit.

3-363 EXAMINATIONS

A. Examination of Applicants for Certified Applicators

1. The written examination for certification consists of two phases. Phase I contains knowledge requirements common to all permitted pest control categories. Phase I must be successfully completed before qualification is attempted in any permitted category or categories. Phase II consists of knowledge requirements for each of the permitted categories. An applicant may choose to test in as many different categories as he desires.

2. Satisfactory completion of a written examination conducted by the Board shall be:

   a. Commercial and Noncommercial Applicators - a score of 75% or greater on each separate phase of the examination.

   b. If an applicant chooses to test in more than one category, he must score 75% or greater in each category to be licensed therefor.

3. No written examination is required for private applicators.

4. A private applicator shall be certified upon completion of a certification form satisfactory to the Board which contains adequate information and affirmations to carry out the intent of the Pesticide Applicators Law, and includes the affirmation the private applicator has completed a training course approved by the Board.

B. Commercial and Noncommercial Applicators

1. Examination shall be given in an appropriate area and at dates and times within the State Capitol Complex designated by the Board.

2. Other such examinations may be conducted at locations within Oklahoma designated by the Board for groups of five (5) or more applicators and provided that no less than ten (10) examinations shall be administered. Such other examinations shall be at the discretion of the Board and when requested by a group, such request shall be a minimum of thirty (30) days in advance of the desired examination date.

3-364 APPROVED CHEMICALS

A. Only those chemicals which are properly labeled as pesticide products and registered with the Oklahoma State Department of Agriculture shall be approved for use as provided for in this act.

B. Any use in any manner contrary to the pesticide product labeling, registered with the Oklahoma State Department of Agriculture, is specifically prohibited unless prior written approval for such contradictory use has been obtained from the Board. Such approval shall become a part of the associated labeling of the product for the period, the pest and the site specified on the application for contradictory use.

C. The term "use" is defined herein as transportation, storage, mixing, application, safety, waste and container disposal and any other specific instructions contained on the label and associated labeling.

D. The term "application of pesticides" is defined herein as the advertising of services, recommendation for use, the preparation for application and the physical act of application of a pesticide.

3-365 FLUOROACETATE COMPOUNDS

A. The term fluoroacetate compounds shall mean, sodium fluoroacetate (Compound 1080), fluoroacetamide (Compound 1081) or related Fluoroacetates and/or any mixtures, formulations, dilutions, or any combination thereof by whatever name known.

B. The use of fluoroacetate compounds, as defined above, is specifically prohibited without specific written authorization granted by the Oklahoma State Department of Agriculture. Such authorization may only be granted following a written request including justification on the need for such use, documentation that all alternative rodent control methods have been tried and found to be ineffective, demonstration that the public health and welfare is in jeopardy and any other requirements to be specified by the Board to safeguard the public health, safety and welfare.

3-367 UNLAWFUL ACTS

A. Commercial applications of general pesticides and applications of restricted pesticides shall only be by a certified applicator or an employee working under direct supervision of a certified applicator.

B. Unless otherwise prescribed by its labeling, a pesticide shall be considered to be applied under the direct supervision of a certified applicator if it is applied by a competent person acting under the instructions and control of a certified applicator who is available if and when needed, even though such certified applicator is not physically present at the time and place the pesticide is applied.

3-368 IDENTIFICATION OF EQUIPMENT USED BY COMMERCIAL APPLICATORS

A. All ground equipment (vehicles) used by any person defined as a commercial applicator during the conduct of business shall be identified by displaying the name and permit number of the person or firm to whom the permit is issued. Such display shall be on both sides of the vehicle in letters not less than two inches in height.

B. Each aircraft used by any person defined as a commercial applicator, to apply pesticides shall be identified by a decal provided by the Board bearing the "N" identification number of the aircraft. If restricted pesticides are used this shall also apply to noncommercial applicators.

3-369 DENIAL OF PERMIT

A. Any cause listed in 2 O. S. Supp. 1977, Section 3-86 shall also be grounds for the denial of a permit to any applicant. Said period of denial shall be set in the Board's discretion.

B. The Board may in its discretion deny a permit to any applicant who has received more than one suspension, cancellation or revocation.

3-370 REVIEW OF PERMIT

An applicator's permit will be reviewed by the Board in its discretion to determine if suspension, cancellation, revocation or denial of a permit is appropriate in the event of a criminal conviction or a final order imposing a civil penalty under Section 14, Public Law 94-140, or its successor and shall be grounds for suspension, cancellation, revocation or denial of a permit.

3-371 RESTRICTED USE PESTICIDE

Restricted use pesticide determined pursuant to the authority of 2 O. S. Supp. 1977, Section 3-64 (a) (2) is any pesticide that in the professional discretion of the Board of Agriculture is found to cause an unreasonable, adverse effect on man or the environment.

3-372 PRIVATE APPLICATORS PERMIT IS EFFECTIVE FOR 5 years from date of issue, and may be renewed by reapplication.

3-373 Under the Provisions of 2 O. S. 1971, Section 3-82 as amended by Senate Bill 190 of the 1977 Legislature, commercial applicators shall be reexamined prior to the issuance of a 1978 permit.

3-374 REQUIRED RECORD KEEPING

Commercial applicators of general use pesticides and all commercial and noncommercial applicators of restricted use pesticides shall keep and maintain for a period of at least two years true and accurate records containing information on kinds, amounts, uses, dates, and addresses or such identification as necessary to determine location of such application of pesticides and shall make such records available to appropriate state officials.

3-375 RIGHT OF ENTRY

Authorized agents and employees of the Board of Agriculture shall have the right and authority to enter by consent or warrant any place where pesticide materials were applied or stored for purposes of sampling, inspection, and observation purposes.

Date of last revision: April 18, 1979

This edition dated April 18, 1979 supercedes all previous editions.

This publication, printed by the State Board of Affairs, was reprinted by the State Department of Agriculture, Plant Industry Division at a cost of $150.00.

Calibration of Boomless Sprayer (Off-Center Nozzle)

(1) Add water to tank.

(2) Check all strainers (includes filters or screens) to be sure they are clean.

(3) Flush entire sprayer system with clean water.

(4) Adjust sprayer system to the desired pressure. (Normally 30 PSI will produce the best distribution pattern. Pressures higher than 30 PSI will atomize the spray producing smaller droplets that could drift away from the target area).

(5) Place a container under the spray nozzle and catch the discharge for one minute.

(6) Measure this quantity in gallons.

(7) Measure the width of the spray pattern and convert to inches.

(8) To calculate the ground speed, we use this formula:

$$\text{MPH (miles per hour)} = \frac{5940 \times \text{GPM (gallons per minute)}}{\text{GPA (gallons per acre)} \times \text{spray width (inches)}}$$

(9) Multiply the constant 5940 times the discharge rate in gallons per minute (given in Step 5)

(10) Divide this quantity by the number of gallons per acre that you want to apply, (this broadcast rate is generally 40 GPA) multiplied by the width of the spray pattern in inches (Step 7).

(11) The number you obtain is miles per hour.

Example:

Discharge Rate = 20 GPM
Spray width = 25 Feet (300 inches)
GPA (Broadcast Rate) = 40

$$\text{MPH} = \frac{5940 \times 20 \text{ GPM}}{40 \text{ GPA} \times 300 \text{ inches}}$$

$$\text{MPH} = \frac{118800}{12000}$$

MPH = 9.9 (or 10)

CALIBRATION OF BOOM-TYPE SPRAYER

Lonnie M. Cargill
Agronomy Department
Oklahoma State University

(1) Add water to tank.

(2) Check all strainers (includes filters and screens) to be sure they are clean.

(3) Flush entire sprayer system with clean water.

(4) Adjust sprayer system to the desired pressure. (Normally 30 PSI will produce the best distribution pattern. Pressures higher than 30 PSI will atomize the spray producing smaller droplets that could drift away from the target area).

(5) Adjust the spray boom above the ground for uniform coverage of the area. The height should be set so that the spray pattern will overlap two to four inches when using the flat fan spray tips.

(6) Check the discharge rate by placing two containers under two different nozzles and measure the quantity of water discharged in one minute using a stop watch or watch with a sweep second hand.

(7) Pour the water collected from the two containers into a measuring container marked in ounces and divide the total quantity collected by two.

(8) This quantity is the average amount of liquid discharged per minute per nozzle. (An alternative method in place of Steps 6 & 7 would be to determine the average number of seconds required to collect one quart of water per nozzle.)

(9) Measure the distance between the nozzle tips on the spray boom.

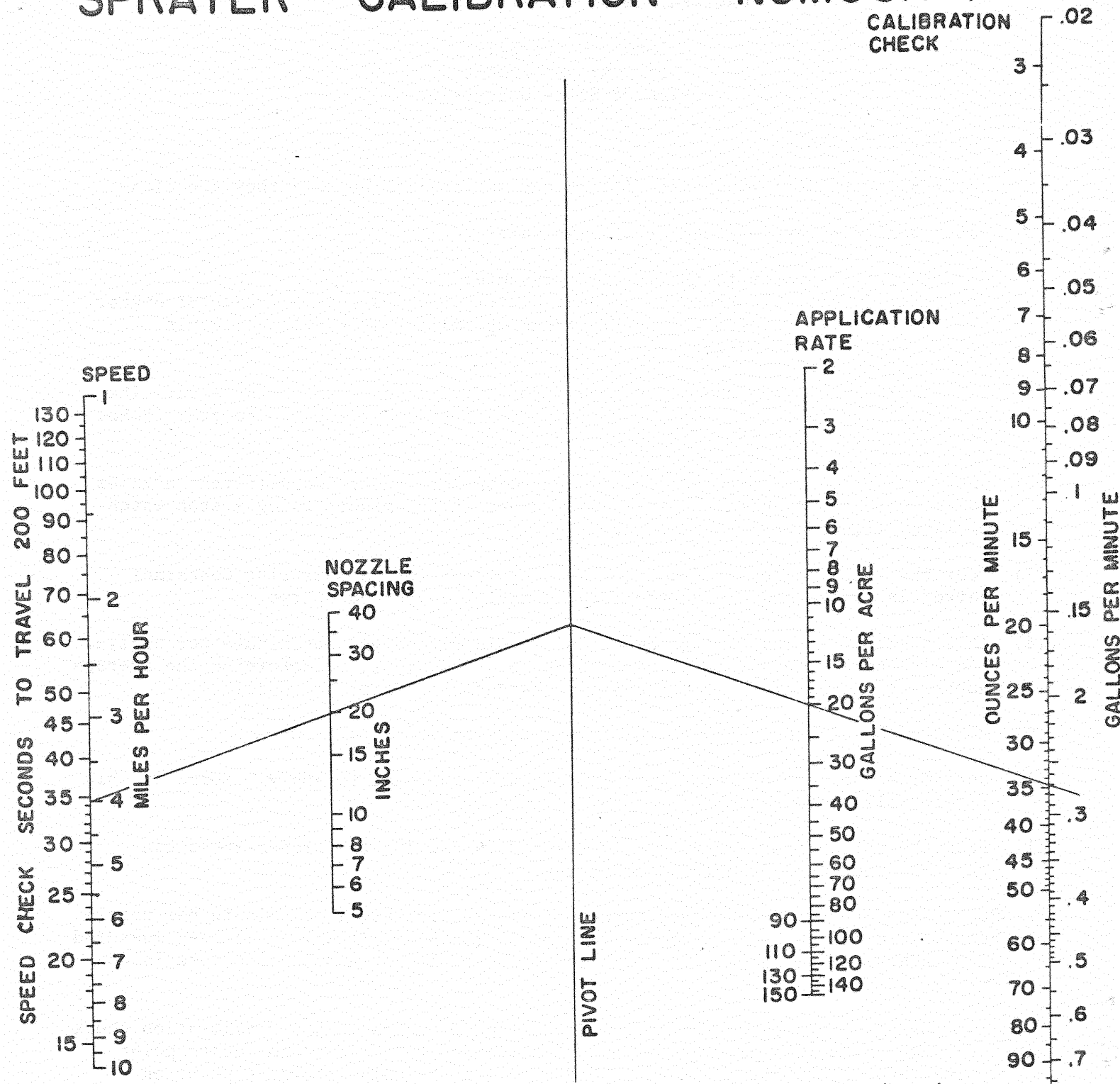
(10) Determine the carrier rate (gallons per acre) you want to apply. Normally this figure will be 40 gallons per acre.

(11) From the three figures obtained in steps 8, 9 and 10, the proper speed can then be calculated by using a monograph.

EXAMPLE: From Step 8, the average amount of liquid discharged per minute per nozzle has been determined to be 52 ounces. In Step 9, the nozzle spacing has been measured to be 20 inches. From Step 10, the desired carrier rate or application rate is 40 gallons per acre.

SOLUTION: Using a straight edge, draw a line from 52 ounces on the "calibration check line" through 40 gallons per acre on the "application rate" line and locate point where line intercepts "pivot line". Now draw a line through intercept point on "pivot line" and through 20 inches on "nozzle spacing line" and locate point where line intercepts "speed line". Read either 3 miles per hour or 46 seconds to travel 200 feet.

SPRAYER CALIBRATION NOMOGRAPH



Example: Sprayer ground speed is 4 mph, nozzle spacing is 20 inches, and desired application rate is 20 gal./acre. Solution: Using a straight edge, draw a line from 4 mph on "speed line" through 20 inches on "nozzle spacing line" and locate point where line intercepts "pivot line". Now draw a line through intercept point on "pivot line" and through 20 gal./acre on "application rate line" and locate point where line intercepts "calibration check line". Read either 35 oz./min. or 0.27 gal./min. Select nozzle size to give 0.27 gal./min. at desired pressure. Adjust pressure regulator to give a flow rate of 35 ounces/minute from each nozzle.

J.E.G.
AGRI. ENGR.
DEPT. - O.S.U.

FOR DISTRIBUTION AND USE ONLY WITHIN OKLAHOMA

SUPPLEMENTAL LABELING FOR
SPECIAL LOCAL NEED IN OKLAHOMA

TO BE USED IN CONNECTION WITH
AATREX® 4L HERBICIDE
EPA Reg. No. 100-497

For control of annual weeds in bermudagrass highway rights-of-way in Oklahoma.

Keep Out of Reach of Children

CAUTION

Follow all applicable directions, restrictions, and precautions on the EPA-registered label.

This labeling must be in the possession of the user at the time of pesticide application.

Directions for Use

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Control of Annual Weeds in Bermudagrass Highway Rights-of-Way

Apply 2-4 qts. of AAtrex 4L in 40-80 gals. of water per acre for control of annual bluegrass, black nightshade, cheat, cocklebur, common hop clover, (annual) broomweed, crabgrass, downy brome, Japanese brome, foxtails, horseweed, kochia, lambsquarters, little barley, marestail, mustards, pigweed (carelessweed), poorjoe, ragweed, Russian thistle, smartweed, smutgrass, sunflower, wild lettuce, and wild oats. Use the lower rates on coarse textured soils having lower organic matter percentages, and the higher rates on fine textured soils having higher organic matter percentages. For control of summer annual weeds, apply AAtrex 4L in the spring before weeds emerge. To control winter annual weeds, apply AAtrex 4L in the fall before weeds emerge or in the early spring before active growth resumes.

Note: Do not cut for hay or graze treated areas within 3 months following application. Apply only once per year. Do not seed or transplant species which are sensitive to AAtrex 4L within 18 months after application.

AAtrex® trademark of CIBA-GEIGY for atrazine

24(c) Registrant:
Agricultural Division
CIBA-GEIGY Corporation
Greensboro, North Carolina 27409

EPA SLN No. OK-790005

CGA 7L73 039

March 15, 1979

TROUBLE SHOOTING

1. No delivery of materials through the nozzles.

   Check for:

   a. Empty tank
   b. Clogged lines, screens or nozzle tips
   c. Sharp kinks in hoses
   d. Tank vent closed
   e. Poor mixture of material
   f. Pump failure
   g. Pressure regulator failure

2. Fluctuating pressure.

   Check for:

   a. Material in supply tank low
   b. Dirty screens
   c. Trash in the seat of the pressure regulator
   d. Pump drive slipping

3. Excessive abrasive action in the pump.

   Check for:

   a. Sand, grit, dirt, crystals
   b. Failure to use suction strainer
   c. Poor agitation of chemicals or mixtures containing solids

4. Starved Pump

   Check for:

   a. Too small suction hose or pipe
   b. Leaks in suction line
   c. Collapse in suction hose
   d. Kinks in suction hose
   e. Too long suction
   f. Too high suction lift
   g. Stopped up suction strainer
   h. Worn pump

5. Dry Pump

   Check for:

   a. Running pump too long a period without liquid
   b. Running pump too long while trying to pick up a prime
   c. Points mentioned in number 4 above

FOR DISTRIBUTION AND USE ONLY WITHIN OKLAHOMA

SUPPLEMENTAL LABELING FOR
SPECIAL LOCAL NEED IN OKLAHOMA

TO BE USED IN CONNECTION WITH
AATREX® NINE-O® HERBICIDE
EPA Reg. No. 100-585

For control of annual weeds in bermudagrass highway rights-of-way in Oklahoma.

Keep Out of Reach of Children

CAUTION

Follow all applicable directions, restrictions, and precautions on the EPA-registered label.

This labeling must be in the possession of the user at the time of pesticide application.

AAtrex®

4L

SAMPLE LABEL

Herbicide

For season-long weed control in corn, sorghum, and certain other crops

Active Ingredients:

Atrazine: 2-chloro-4-ethylamino-6-isopropylamino-s-triazine	40.8%
Related compounds	2.2%
Inert Ingredients:	57.0%
Total:	100.0%

2½ Gallons

U.S. Standard Measure

AAtrex 4L contains 4 lbs. active ingredients per gal.

Shake well before using.

Use entire contents at one time.

Caution:

Keep Out of Reach of Children.

Harmful or fatal if swallowed. Do not get in eyes. Avoid contact with skin, inhalation of vapors or spray mist, and contamination of food and feed.

Do not contaminate domestic or irrigation water supplies or lakes, streams or ponds.

Do not reuse container.
Destroy when empty.

AAtrex® trademark of CIBA-GEIGY for atrazine

EPA Est. 100-LA-1

EPA Reg. No. 100-497

See directions for use inside booklet.

Agricultural Division
CIBA-GEIGY Corporation
Greensboro,
North Carolina 27409

CGA 7L38I 059

CIBA–GEIGY

CGA 130-491

DIRECTIONS FOR USE AND CONDITIONS OF SALE AND WARRANTY

IMPORTANT: Read the entire **Directions for Use** and the **Conditions of Sale and Warranty** before using this product.

Conditions of Sale and Warranty

The **Directions for Use** of this product reflect the opinion of experts based on field use and tests. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness, or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application all of which are beyond the control of CIBA-GEIGY or the Seller. All such risks shall be assumed by the Buyer.

CIBA-GEIGY warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes referred to in the **Directions for Use** subject to the inherent risks referred to above. **CIBA-GEIGY makes no other express or implied warranty of Fitness or Merchantability or any other express or implied warranty. In no case shall CIBA-GEIGY or the Seller be liable for consequential, special, or indirect damages resulting from the use or handling of this product.** CIBA-GEIGY and the Seller offer this product, and the Buyer and user accept it, subject to the foregoing **Conditions of Sale and Warranty**, which may be varied only by agreement in writing signed by a duly authorized representative of CIBA-GEIGY.

General Information

This herbicide controls many annual broadleaf and grass weeds in corn and sorghum including barnyardgrass, witchgrass *(Panicum capillare)*, yellow foxtail, green foxtail, wild oats, large (hairy) crabgrass, giant foxtail, velvetleaf, morningglory, lambsquarters, pigweed, ragweed, nightshade, purslane, and mustard. This product may be applied before or after weeds emerge.

Where use directions give a range of rates, use the lower rate on coarse-textured soil and soil low in organic matter, and the higher rate on fine-textured soil and soil high in organic matter.

Since this product acts mainly through root absorption, its effectiveness depends on moisture to move it into the root zone. If weeds develop, a shallow cultivation or rotary hoeing will generally result in better weed control.

This product is nonflammable.

Avoid using where adjacent desirable trees, shrubs, or plants might be injured.

Note: CIBA-GEIGY does not recommend applications in combination with other herbicides or oils except as specifically described on the label or in literature published by CIBA-GEIGY.

Application Procedures

Ground application

For the most uniform distribution of broadcast applications, use 80° flat fan-type nozzles. For band applications, use flat fan even spray nozzles. Screens and strainers should be no finer than 50-mesh. Use a pump with capacity to (1) provide sufficient agitation during mixing and application to keep material in suspension, and (2) maintain 30-40 psi operating pressure. Unless otherwise specified, use a minimum of 5 gal of water/A for preplant incorporated, preemergence, and postemergence (without oil or surfactant) applications. Use a minimum of 10 gal of water/A for all postemergence applications combined with oil or surfactant.

For band applications, calculate amount to be applied per acre as follows:

$$\frac{\text{Band width in inches}}{\text{Row width in inches}} \times \text{Broadcast rate per acre} = \text{Amount needed per acre of field}$$

Aerial application

For preplant and preemergence broadcast treatments, apply at a 1:1 ratio to water (example: recommended rate of 1 qt of product is mixed with 1 qt of water) to be applied/A. For postemergence treatments, apply recommended rate in a minimum of 2 gal of water/A. Avoid applications under conditions where uniform coverage cannot be obtained or where excessive spray drift may occur.

Do not apply directly to humans or animals. Flagmen or loaders should avoid inhalation of spray mist and contact with skin and should wash thoroughly before eating and at the end of each day's operation.

Application in water or liquid fertilizer

Nitrogen solutions or complete liquid fertilizers may replace all or part of the water as a carrier for preemergence and preplant applications. Check the compatibility of this product with liquid fertilizer and/or nitrogen solution before use. Do not apply in liquid fertilizers after corn or sorghum emerges as crop injury may occur.

Application in water plus emulsifiable oil or oil concentrate

Adding emulsifiable oil or oil concentrate to postemergence water-based sprays may improve weed control. However, under certain conditions, use of either emulsifiable oil or oil concentrate may seriously damage corn or sorghum. To minimize this possibility, follow directions, procedures, and precautions below.

Use a crop oil designated for use with this product containing 1-2% suitable emulsifier, or a suitable crop oil concentrate designed for use with this product and containing not more than 20% emulsifier or surfactant blend. Several oils and crop oil concentrates of these types are on the market. Emulsifiable oil and oil concentrate contaminated with water or other materials can cause compatibility problems and/or crop injury.

Mixing procedures — all uses: (1) Be sure sprayer is clean and not contaminated with 2,4-D or other materials, as crop injury or sprayer clogging may result. (2) Fill tank ½ to ⅔ full with clean water. (3) Start agitation. (4) Pour product directly from container into tank. (5) Add emulsifiable oil, oil concentrate, or a tank mix herbicide. (6) Finish filling tank with water, nitrogen solution, or liquid fertilizer. (7) Empty tank as completely as possible before refilling to prevent buildup of oil or emulsifiable concentrate residue in tank. Maintain agitation to avoid separation of other materials from water, nitrogen solution, or liquid fertilizer remaining in tank. (8) If an oil or oil concentrate film starts to build up in tank, drain it, and clean with strong detergent solution or solvent. (9) Clean sprayer thoroughly immediately after use by flushing system with water containing a detergent. (10) For liquid nitrogen or liquid fertilizer, use suction screens of 16-mesh or coarser.

Directions for Use

FAILURE TO FOLLOW ALL PRECAUTIONS ON THIS LABEL MAY RESULT IN POOR WEED CONTROL, CROP INJURY, OR ILLEGAL RESIDUES.

Corn

Apply before planting, at planting, or after planting as indicated below.

Preplant (Broadleaf and grass control)

Broadcast in spring after plowing at rate in Table 1. Apply before, during, or after final seedbed preparation. If soil is tilled or worked after application, avoid deep incorporation. For best results, apply within two weeks prior to planting.

Preemergence (Broadleaf and grass control)

Apply during or shortly after planting, prior to weed emergence at rate in Table 1.

Postemergence (Broadleaf and grass control)

Apply before weeds exceed 1.5 inches in height, at rate in Table 1.

TABLE 1

Broadleaf and Grass Weed Control on Corn*

Soil texture	Broadcast rate/A
COARSE Sand, loamy sand, sandy loam	4 pt
MEDIUM Silt and clay loam low in organic matter	4.75 pt
FINE Silt and clay loam with medium to high organic matter, clay (including the dark prairie soils of the Corn Belt)	6 pt
Peat, muck, high organic clay (postemergence only)	6 pt

**Broadleaf weed control (eastern CO, western KS, western NE, NM, OK Pan Handle, west TX, and eastern WY):* On sand, loamy sand, sandy loam, mild to strongly alkaline soil, and all recently leveled soil, apply 2.4 pt/A, either preplant or preemergence. Controls many broadleaf weeds including pigweed, lambsquarters, nightshade, purslane, and kochia. On other soil types in these areas, apply at rate in Table 1 for broadleaf and grass control.

Lay-by treatment (Broadleaf and grass control)

Broadcast 2-4 pt/A in a minimum of 5 gal of water or nitrogen solution, before weeds are 1.5 inches high and corn is 20-30 inches high. When using nitrogen solutions, direct the spray to lower 3-4 inches of cornstalks to avoid corn foliage injury. Maintain agitation in spray tank during application.

Postemergence with emulsifiable oil or oil concentrate in water

Broadleaf and grass control: Broadcast 4 pt/A after weed emergence, but before weeds reach 1.5 inches in height. Add emulsifiable oil at rate of 1 gal/A for ground applications and 0.5 gal/A for aerial applications. Add oil concentrate at rate of 1 qt/A for ground applications.

Broadleaf control: Broadcast 2.4 pt/A for control of broadleaf weeds, such as annual morningglory, cocklebur, lambsquarters, mustard,

pigweed, ragweed, smartweed, and wild buckwheat. Add emulsifiable oil at rate of 1 gal/A for ground applications and 0.5 gal/A for aerial applications. Add oil concentrate at rate of 1 qt/A for ground applications. Apply before pigweed and lambsquarters reach 6 inches in height and before all other weeds reach 4 inches in height. A cultivation may be necessary if all weeds are not controlled or if weeds regrow.

Precautions for applications with emulsifiable oil or oil concentrate in water: (1) Do not apply when crop is under stress from prolonged cold, wet weather, poor fertility, or other factors, or when crop is wet and succulent from recent rainfall, as crop injury may occur. (2) Inbred lines or any breeding stock may be severely injured by applications with emulsifiable oil or oil concentrate. (3) Adding other insecticides, herbicides, liquid fertilizers, and other materials is not recommended because they may cause compatibility problems and/or crop injury. (4) Store and handle emulsifiable oil and oil concentrate carefully. Oil contaminated with even a small amount of water may not emulsify properly when added to tank. (5) Do not make more than one application per season except as recommended for control of yellow nutsedge and Canada thistle on this label.

Center pivot sprinkler application — Preemergence or postemergence (CO, KS, NE, SD, and WY)

Apply with irrigation water either after planting before corn and weeds emerge, or after corn emergence, but before lay-by (20-30 inches) and before weeds exceed 1.5 inches in height, at rates in Table 1. Prepare mixture with minimum ratio of 1 part product to 1 part water. Injecting a larger volume of a more dilute slurry per hour will assure more accurate calibration of metering equipment. Maintain sufficient agitation to keep herbicide in suspension. Meter slurry into irrigation water during entire period. Apply in ½-1 inch of water. Use the lower volume on coarser textured soils, the higher volume on finer textured soils. More than 1 inch of water may reduce weed control by moving herbicide below the effective zone in the soil. Inject dilute slurry into system through a positive displacement pump.

Refer to supplemental literature published by CIBA-GEIGY for more information on calibrating.

Precautions: (1) Apply only through irrigation systems containing anti-siphon and check valves to prevent contamination of well during shutdown and overflow of solution tank. (2) Inject ahead of any right angle turn in the main line to insure adequate mixing. (3) Chemical injection pumps and water pumps must have interlocking controls to insure simultaneous shutoff. (4) Application when drift may occur from windy conditions, when system joints and connections are leaking, or when nozzles are not providing uniform distribution may cause crop injury. (5) Where sprinkler distribution patterns do not overlap sufficiently, unacceptable weed control may result. Where sprinkler distribution patterns overlap excessively, crop injury may result.

Problem weeds

Yellow nutsedge and Canada thistle: This product will control yellow nutsedge *(Cyperus esculentus)* and Canada thistle *(Cirsium arvense)* when applied according to use directions. For best results, apply each year until yellow nutsedge or Canada thistle is eliminated or reaches a level of infestation where neither weed is a problem. If yellow nutsedge or Canada thistle regrow following last application, cultivate once. When this product is applied postemergence to the weeds, add 1 gal of emulsifiable crop oil or 1 qt of oil concentrate/A.

Six alternative methods of use for control of yellow nutsedge and Canada thistle are listed below in order of preference. If other weed species, such as annual grasses, are also expected, use alternative 2, 3, 5, or 6.

1. Broadcast 4 pt plus 1 gal of emulsifiable oil or 1 qt of oil concentrate/A, after crop and yellow nutsedge or Canada thistle emerge, but before yellow nutsedge reaches a height of 3 inches or Canada thistle reaches a height of 6 inches. Repeat application before lay-by (20-30 inches), 10-20 days after the first application has been made.
2. Broadcast 4 pt/A preplant. Follow with an application of 4 pt plus 1 gal of emulsifiable oil or 1 qt of oil concentrate/A, after corn and weeds emerge, but before yellow nutsedge reaches a height of 3 inches (yellow nutsedge control only).
3. Broadcast 4 pt/A during or shortly after planting, but prior to crop or weed emergence. Follow with an application of 4 pt plus 1 gal of emulsifiable oil or 1 qt of oil concentrate/A, after corn and weeds emerge, but before yellow nutsedge reaches a height of 3 inches or Canada thistle reaches a height of 6 inches.
4. Broadcast 8 pt plus 1 gal of emulsifiable oil or 1 qt of oil concentrate/A after crop emerges, but prior to lay-by (20-30 inches) and after yellow nutsedge and Canada thistle emerge, but before yellow nutsedge is 3 inches tall or Canada thistle is 6 inches tall.
5. Broadcast 8 pt/A preplant (yellow nutsedge control only).
6. Broadcast 8 pt/A during or shortly after planting, but prior to crop or weed emergence (yellow nutsedge control only).

Note: Do not use emulsifiable oil or oil concentrate when corn is wet or under stress, especially when using 8 pt of this product/A. See "Precautions for applications with emulsifiable oil or oil concentrate in water" for additional directions.

Quackgrass control on land going into corn production

Split application: Broadcast 4 pt/A in fall or spring. Plow 1-3 weeks later. Broadcast a second application at 4 pt/A in spring before, during, or after planting, but before weeds are 1.5 inches high. This split application will control both quackgrass and most annual broadleaf and grass weeds.

Single application: Broadcast 6-8 pt/A in fall or spring. Plow 1-3 weeks later.

Tank Mixtures for Corn

Dual® 6E

Use as tank mixture for control of certain broadleaf and grass weeds in corn. Refer to Dual 6E label for all directions, weeds controlled, precautions, and limitations.

Lasso® or Lasso EC (alachlor)

Use as tank mixture for control of many annual broadleaf and grass weeds in corn (field, hybrid seed, silage, sweet, popcorn), including barnyardgrass, carpetweed, crabgrass, fall panicum, Florida pusley, foxtails (giant, green, yellow), goosegrass, jimsonweed, kochia, lambsquarters, mustard, nightshade, pigweed, purslane, ragweed, signalgrass *(Brachiaria)*, smartweed, and witchgrass. This tank mix will reduce competition from the hard to control annual weeds — annual morningglory, cocklebur, and velvetleaf (buttonweed).

For preemergence or early postemergence broadcast application, use rates in Table 2. Apply tank mixture any time from immediately after planting until weeds reach 2-leaf stage and corn is no more than 5 inches tall. On sweet corn, apply before crop and weeds emerge. Application after the 2-leaf weed stage will not give satisfactory control. With postemergence application, occasional corn leaf burn should not affect growth or yield. If applied with liquid fertilizers, spray before crop emerges.

TABLE 2
Tank Mixtures with Lasso on Corn

	Broadcast rate/A			
	Less than 3% organic matter		3% or more organic matter	
Soil texture	This product	Lasso	This product	Lasso
COARSE* Sand, loamy sand, sandy loam	2 pt	1.5 qt	2 pt	1.5 qt
MEDIUM Loam, silt loam, silt	2-2.4 pt	1.75 qt	2.4-2.8 pt	2 qt
FINE Silty clay loam, sandy clay loam, silty clay, sandy clay, clay loam, clay	2.4-3.2 pt	2.25 qt	2.4-3.2 pt	2.5 qt

*When applied via center pivot irrigation on coarse soils, apply 2 pt of this product and 2 qt of Lasso/A.

For preplant incorporated applications, use 0.4 pt more of this product plus 0.5 qt more Lasso/A than indicated in Table 2. Use no more than 3.2 pt of this product plus 2.5 qt of Lasso/A. Broadcast within 7 days before planting and incorporate 2 inches deep.

Apply tank mixture in a minimum of 20 gal of water/A. Liquid fertilizer may replace all or part of the water. Add this product to spray tank, thoroughly mix with water, then add Lasso. Follow mixing procedures in the section, "Application Procedures" of this label.

Refer to Lasso label for information concerning center pivot irrigation applications and other directions, limitations, and cautions.

Princep® 80W or Princep 4L
Use as tank mixture for control of many annual weeds, including carpetweed, crabgrass, fall panicum, foxtail, lambsquarters, morningglory, pigweed, ragweed, and velvetleaf. Apply before planting, at planting, or after planting, but before crop and weeds emerge, at rates in Table 2a. Use 1:1 ratio for control of above weeds. Use 1:2 ratio for expected heavy infestations of crabgrass and fall panicum. Apply in a minimum of 20 gal of water/A. Cultivate shallowly if weeds develop.

Preplant: Apply in spring during or after final seedbed preparation. If soil is tilled or worked after application, avoid deep incorporation. For best results, apply within two weeks before planting.

Preemergence: Apply during or shortly after planting, but before crop and weeds emerge.

Refer to Corn sections of this label and to Princep 80W or Princep 4L label for further directions, limitations, and cautions.

Table 2a
Tank Mixtures with Princep on Corn

	Broadcast rate/A			
	1:1 Ratio*		1:2 Ratio**	
Soil texture	This product	Princep 80W or Princep 4L	This product	Princep 80W or Princep 4L
Sand, loamy sand, sandy loam	2 pt	1.25 lb or 2 pt	1.32 pt	1.67 lb or 2.67 pt
Loam, silt loam, silt, clay loam, sandy clay loam, silty clay loam, sandy clay, or silty clay with low organic matter	2.4 pt	1.5 lb or 2.4 pt	1.6 pt	2 lb or 3.2 pt
Loam, silt loam, silt, clay loam, sandy clay loam, silty clay loam, sandy clay, or silty clay with medium to high organic matter, and clay (including dark prairie soils of the Corn Belt)	3 pt	1.8 lb or 3 pt	1.92 pt	2.4 lb or 3.84 pt

*For control of above weeds.

**For control of expected heavy infestations of crabgrass and fall panicum.

Propachlor 65WP
Use as tank mixture for control of many annual broadleaf and grass weeds in corn (field, hybrid seed, silage and sweet corn only), including annual morningglory, annual ryegrass, barnyardgrass (watergrass), buttonweed (velvetleaf), carpetweed, cocklebur, crabgrass, fall panicum, Florida pusley, giant foxtail, green foxtail, yellow foxtail, goosegrass, groundsel, jimsonweed, lambsquarters, mustard, nightshade, pigweed, purslane, ragweed, smartweed, and sunflower. Broadcast 2.1-3.2 pt of this product plus 3.8-6 lb of propachlor 65WP/A on soil surface any time after planting until broadleaf and grass weeds reach the 2-leaf stage. Use lower rates on coarse-textured soil low in organic matter. Use higher rates on fine-textured soil high in organic matter.

Use a minimum of 2.8 pt/A of this product in tank mixture for better control of annual morningglory, buttonweed (velvetleaf), cocklebur, and sunflower.

Apply in a minimum of 20 gal/A. Non-pressure fluid fertilizer may replace all or part of the water used as a carrier for applications before crop and weeds emerge. Add this product to spray tank and thoroughly mix with water. Then, cut the propachlor 65WP bag and fill with water to fill line. Grasp neck of bag firmly, shake vigorously, and add contents to spray tank.

Refer to propachlor 65WP label for further directions, limitations, and cautions.

Paraquat CL
For control of existing vegetation and residual control where corn will be planted directly into cover crop, established sod, or in previous crop residues, broadcast 4-6 pt of this product and 1-2 pt Paraquat CL in 20-60 gal of water/A. Add 8 oz of a nonionic surfactant, such as X-77®, per 100 gal of spray mixture. Add this product to water in spray tank, agitate until thoroughly mixed with water, and then add Paraquat CL and surfactant.

Princep® 80W plus Paraquat CL
Use as tank mixture with Princep 80W plus Paraquat CL for kill of existing vegetation and residual weed control where corn will be planted directly into cover crop, established sod, or in previous crop residues. Add this product and Princep 80W to water in spray tank, agitating until thoroughly mixed. Then add Paraquat CL and a nonionic surfactant, such as X-77. Continue agitation during application. Apply 2-4 pt of this product plus 1.25-2.5 lb Princep 80W plus 1-2 pt Paraquat CL in 20-60 gal of water per sprayed acre within 3 weeks before, during, or after planting, but before corn crop emerges. Add 8 fl oz of a nonionic surfactant, such as X-77, per 100 gal of spray mixture. Use lower rates of this product and of Princep 80W on coarse soil, and higher rates on fine-textured soil. Use the 2 pt rate of Paraquat CL if existing vegetation is 4-6 inches tall. This mixture will not control weeds taller than 6 inches.

Refer to further limitations and precautions on labels for this product, Princep 80W, and Paraquat CL.

Precautions for all applications to corn: (1) Do not apply more than 8 pt/A of this product to corn in any one year. (2) Following harvest, plow (moldboard or disk-plow) and thoroughly till soil in fall or spring to minimize possible injury to rotational spring-seeded crops, regardless of rate used.

Note for all applications to corn: Do not graze or feed forage from treated areas to livestock for 21 days following application.

Rotational crops
(1) Do not rotate to any crop except corn or sorghum until the following year, as injury may occur. (2) If applied after June 10, do not rotate with crops other than corn or sorghum the next year, as crop injury may occur. (3) If used at a rate higher than 6 pt/A or equivalent band application rate, a crop of untreated corn or sorghum should precede the next rotational crop. (4) In the High Plains and Intermountain areas of the West where rainfall is sparse and erratic or where irrigation is required, use only when corn or sorghum is to follow corn or sorghum or when a crop of untreated corn or sorghum is to precede other rotational crops. (5) In eastern parts of the Dakotas, KS, western MN, and NE, do not rotate to soybeans if the rate applied to corn or sorghum was more than 4 pt/A or equivalent band application rate, as soybean injury may occur. (6) Injury may occur to soybeans planted in north-central and northwest IA, south-central and southwest MN, northeast NE, southeast SD, and other areas the year following application on soils having a calcareous surface layer. (7) Do not plant sugar beets, tobacco, vegetables (including dry beans), spring-seeded small grains, or small-seeded legumes and grasses the year following application, as injury may occur.

Sorghum and Sorghum-sudan Hybrids (Grain and Forage Types)

Apply before planting, at planting, or after planting. See Corn section for weeds controlled.

Preplant (Broadleaf and grass control)
Broadcast in spring after plowing at rate in Table 3. Apply before, during, or after final seedbed preparation. If soil is tilled or worked after application, avoid deep incorporation. For best results, apply within two weeks prior to planting.

Preemergence (Broadleaf and grass control)
Apply during or shortly after planting, but prior to weed or crop emergence at rate in Table 3.

TABLE 3
Preplant and Preemergence for Broadleaf and Grass Weed Control in Sorghum*

Soil texture	Organic matter	Broadcast rate/A
COARSE Sand, loamy sand, sandy loam, sandy clay loam	any level	DO NOT USE (except for preemergent use on bedded sorghum in AZ and CA as indicated below)
MEDIUM AND FINE Silt loam, clay loam, clay	less than 1%	
	1-1.5%	3.2-4 pt
	more than 1.5%	4-4.75 pt

*Do not apply preplant in AL, AR, FL, GA, LA, MS, NC, NM, SC, TN, and TX. Do not apply preemergence in NM, OK, and TX, except in northeast OK and the TX Gulf Coast.

In case of planting failure, sorghum may be replanted. Do not make a second broadcast application, as injury may occur. If originally applied in a band and sorghum is replanted in untreated row middles, this product may be applied in a band to the second planting.

Preemergence broadleaf control in furrow irrigated bedded sorghum (AZ and CA only)
For preemergence control of broadleaf weeds, including groundcherry, lambsquarters, morningglory, mustard, pigweed, and purslane, broadcast 1.6-2.4 pt/A. Apply after bed preparation, during or after planting, but before sorghum and weeds emerge, and before the first furrow irrigation. Follow with several regular irrigations to thoroughly wet all soil. Use lower rate on coarse-textured soil and soil low in organic matter; use higher rate on fine-textured soil and soil high in organic matter.

Precautions for preemergence application to furrow irrigated bedded sorghum grown in AZ and CA: To avoid possible sorghum injury, do not use on sand or loamy sand soil or on sorghum planted in the furrow. Application to sorghum growing on alkali soil or where cuts, fills or erosions have exposed calcareous or alkali subsoil may cause crop injury. Do not replant sorghum for 8 months following application. Corn may be planted immediately.

Postemergence (Broadleaf and grass control)
Apply at rate in Table 4 before weeds exceed 1.5 inches in height. Apply up to "close-in."

TABLE 4
Postemergence Broadleaf and Grass Weed Control in Sorghum

Soil texture	Minimum sorghum height at treatment	Broadcast rate/A
Sand or loamy sand	DO NOT USE	
Sandy loam	See directions for broadleaf weed control below	
Silt loam to sandy clay loam	Completely emerged	4-4.75 pt
Olton and Pullman clay soil	At least 6 inches high	4-4.75 pt
Silty clay loam and finer textured soil	Completely emerged	6 pt

Postemergence broadleaf control with emulsifiable oil or oil concentrate in water
Broadcast 2.4 pt/A for control of broadleaf weeds, including annual morningglory, cocklebur, lambsquarters, mustard, pigweed, ragweed, smartweed, and wild buckwheat. Apply before pigweed and lambsquarters reach 6 inches in height and before all other weeds reach 4 inches in height. In CO, western KS, NM, OK, TX, and the desert regions of AZ and CA, apply when sorghum is 6-10 inches in height, but before boot stage. In all other areas, apply after sorghum reaches the 3-leaf stage. Add emulsifiable oil at 1 gal/A for ground applications and 0.5 gal/A for aerial applications. Add oil concentrate at 1 qt/A for ground applications. A cultivation may be necessary if all weeds are not controlled or if weeds regrow.

Precautions for applications with emulsifiable oil or oil concentrate in water: See "Precautions for applications with emulsifiable oil or oil concentrate in water" in Corn section.

Postemergence broadleaf control with surfactant (CO, western KS, NM, OK, TX, and desert regions of AZ and CA only)
Broadcast 2.4 pt plus 0.75-1.5 pt of surfactant/A after sorghum reaches 6 inches in height, but before weeds reach 1.5 inches in height. Apply only on sandy loam and finer textured soil.

Precautions for all applications to sorghum: (1) Heavy rain immediately following application tends to cause excessive concentrations of herbicide in seed furrow, resulting in possible crop injury. Do not apply to furrow planted sorghum until furrows are leveled (plowed-in). Level deep planter marks or seed furrows before application. (2) Application to sorghum growing under stress caused by minor element deficiency or to sorghum growing on highly calcareous soils may result in crop injury. (3) Following harvest, plow (moldboard or disk-plow) and thoroughly till the soil in the fall or spring to minimize possible injury to rotational spring-seeded crops, regardless of rate used. (4) Injury may occur if both this herbicide, preplant or preemergence, and an at-planting systemic insecticide are used.

Note: Do not graze or feed forage from treated areas for 21 days following application.

Rotational crops
See "Rotational crops" at end of Corn section.

Tank Mixtures for Grain Sorghum

Igran® 80W
Use as tank mixture for control of certain broadleaf and grass weeds in grain sorghum. Refer to Igran 80W label for all directions, weeds controlled, precautions, and limitations.

Chemical Fallow

Wheat-Sorghum-Fallow
This treatment controls annual broadleaf and grass weeds following wheat harvest and in the following sorghum crop when grown under minimum tillage.

Apply 6 pt to wheat stubble immediately following wheat harvest. If weeds are present, remove them with a sweep plow or other suitable implement after application. Plant sorghum into wheat stubble the following spring with minimum disturbance of the soil. Use a surface planter or a planter leaving a shallow furrow. If weeds are present at planting, remove them with a sweep plow or other suitable implement before planting.

Precautions: (1) Use only on silt loam or finer textured soil. (2) Wheat-sorghum-fallow cropping sequence must be followed. (3) Do not apply following sorghum harvest.

Note: Do not graze or feed forage from treated area to livestock. Do not plant any crop other than those on this label within 18 months following treatment.

Tank Mixtures for Wheat-Sorghum-Fallow

Igran 80W
Use as tank mixture for control of certain broadleaf and grass weeds in wheat-sorghum-fallow rotations. Refer to Igran 80W label for directions, weeds controlled, precautions, and limitations.

Wheat-Corn-Fallow (KS, NE)
This product controls cheatgrass (downy brome, chess), kochia, mustards, pigweed, Russian thistle, wild lettuce, wild sunflower, and volunteer wheat during period after wheat harvest. Weed control may extend into following corn crop grown under minimum tillage.
Apply with ground equipment only.

Follow directions for use, notes, and precautions in the "Wheat-Sorghum-Fallow" section above, substituting corn for references to sorghum.

Tank Mixtures for Wheat-Corn-Fallow (KS, NE)

Igran 80W
Use as tank mixture for control of certain broadleaf and grass weeds in wheat-corn-fallow rotations. Refer to Igran 80W label for directions, weeds controlled, precautions, and limitations.

Wheat-Fallow-Wheat (CO, KS, MT, NE, ND, SD, and WY)
For preemergence control of cheatgrass (downy brome, chess), common lambsquarters, field pennycress, kochia, mustard, Russian thistle, wild lettuce, and suppression of volunteer wheat during fallow period of a wheat-fallow-wheat rotation, apply 1-2 pt in 10-40 gal of water/A for ground application, or in a minimum of 5 gal of water/A for aerial application, on all soils except those listed under "Precautions." For control of pigweed and wild sunflower, use the higher rate. Apply to stubble ground. Treat only once during same fallow period.

Tank Mixtures for Wheat-Fallow-Wheat (CO, KS, MT, NE, ND, SD, WY)

Igran 80W
Use as tank mixture for control of certain broadleaf and grass weeds in wheat-fallow-wheat rotations. Refer to Igran 80W label for directions, weeds controlled, precautions, and limitations.

Paraquat CL

If weeds are present at application, a tank mix with Paraquat CL may be used. Broadcast 1-2 pt of this product plus 1-2 pt of Paraquat CL in 20-60 gal of water/A by ground equipment. Add 0.5-1 pt of a nonionic surfactant, such as X-77, per 100 gal of spray mixture. Add this product to spray tank first and thoroughly mix with water. Then add Paraquat CL, followed by surfactant. Use the 2 pt rate of Paraquat CL if weeds are 4-6 inches tall. This mixture will not control weeds taller than 6 inches. Apply to stubble ground. Treat only once during same fallow period. Refer to Paraquat CL label for further directions, precautions, and limitations.

If weeds are present at application and this product is used alone, use either an approved contact herbicide before or after treatment, or tillage after treatment.

Use tillage to control weeds which escape during fallow period. Till before planting. For this product applied alone or in tank mixture with Paraquat CL, plant at least 2 inches deep and 12 months or more after application.

Precautions: (1) Do not use on sand soil. (2) Do not treat eroded hillsides, caliche and rocky outcroppings, or exposed calcareous subsoil. (3) Do not treat soils of the Rosebud and Canyon Series in western NE and adjoining counties in CO and WY. (4) Do not treat soils with calcareous surface layers. (5) Avoid spray overlap.

Note: Do not graze treated areas within 6 months after application.

Rangeland

To control certain weeds, including cheatgrass (downy brome, chess), common (annual) broomweed, little barley, medusahead, sagewort, and tumble mustard. Use lower rate where cheatgrass is major problem weed; use higher rate for other weeds.

For ground applications, use a minimum of 10 gal of water/A. For aerial applications, use a minimum of 5 gal of water/A. See "Application Procedures" for additional information.

Establishment of perennial range grasses in West (CA, ID, NV, OR, UT, WA)
Apply 1.6-2 pt/A in fall after rains begin but before ground freezes. Perennial range grass may be seeded when rain begins the next fall following treatment. Plant in deep furrows such as those made by a deep furrow rangeland drill. Treated areas may be grazed 7 months after seeding. However, to provide sufficient time for establishment of desirable range grasses, treated areas should not be grazed until the fall following seeding.

Renovation of existing stands of perennial range grasses
Central Great Plains (CO, KS, MT, NE, ND, SD, WY): Apply 1-2 pt/A in fall before ground freezes.

Southern Great Plains (OK, TX): Apply 2 pt/A in spring before April 30.

West (CA, ID, NV, OR, UT, WA): Do not graze area to be treated for 6 months prior to application. Apply 1-1.5 pt/A by ground equipment in fall before ground freezes.

Bluegrass and intermediate wheatgrass may be injured by this product at recommended rates.

Note: Do not cut or feed range grass hay. Do not graze treated areas within 7 months following fall application or 3 months following spring application. Apply only once per year.

Warm season perennial range grasses — Midwest

Switchgrass and Big Bluestem

For control of many annual broadleaf and grass weeds including cheatgrass, foxtails (giant, green, and yellow), lambsquarters, pigweed, ragweed, smartweed, and velvetleaf.

For ground application use a minimum of 15 gal of water/A.

Use only on loam, silt loam, silty clay loam, clay loam, and silty clay soils with at least 1 percent organic matter.

New seeding: Apply 2 qt/A after planting but before weeds emerge. Prepare a good, firm seedbed. Plant ½ inch deep with a grassland drill (preferred method) or a conventional drill. If a conventional drill is used on prepared seedbeds, remove all tension from the disk openers. For best results, cultipack or roll after planting. Clip weeds that escape in July or August. Avoid clipping switchgrass or big bluestem seedlings.

Established stands: Apply 2 qt/A in April or early May, before weed emergence.

Note

Do not cut for hay. Do not graze treated areas within 4 months following application at seeding or 3 months following application to established switchgrass or big bluestem. Treat only once per year.

Rotational crops: See "Rotational crops" in Corn section.

Sugarcane

For control of many annual broadleaf and grass weeds, including amaranths, crabgrass, fireweed, Flora's paintbrush, foxtails, junglerice, and wiregrass: Broadcast 2-4 qt in 20-50 gal of water/A for adequate coverage of the soil surface at time of planting or ratooning, but before cane emerges. One additional application may be made over cane as it emerges, and two additional applications may be made interline after emergence as directed sprays.

For control of emerged pellitory weed (Florida only): Apply 0.8-1.2 pt in at least 40 gal of water/A as a directed spray. Add 2 qt of surfactant for each 50 gal of spray. Thoroughly cover weed foliage.

Precautions: (1) Do not apply after "close-in." (2) Do not apply more than 10 qt/A to any one crop of cane.

For control of alexandergrass, large crabgrass, pellitory (artillery) weed, and spiny amaranth, use one of the following methods at planting or ratooning (Florida only):

1. Apply 4 qt in 20-50 gal of water/A, preemergence, broadcast or banded. Follow with one or two broadcast or banded over-the-top applications as needed, postemergence to sugarcane and weeds, at 2 qt in 20-50 gal of water/A. Treat before weeds exceed 1.5 inches in height.
2. Apply 1-3 times as needed, at 2 qt in 20-50 gal of water/A either broadcast or banded over-the-top, postemergence to sugarcane and weeds. Treat before weeds exceed 1.5 inches in height.

Douglas Fir, Grand Fir, Noble Fir, White Fir, Lodgepole Pine, Ponderosa Pine, and Scotch Pine

Annual broadleaf and grass weed control: Broadcast 2-4 qt in 20-40 gal/A between fall and early spring while trees are dormant or soon after transplanting. Apply before weeds are 1.5 inches tall.

Quackgrass control: Broadcast 4 qt/A in fall or early spring while trees are dormant and before quackgrass is more than 1.5 inches tall.

Precautions: (1) Do not graze treated areas. (2) Do not apply to seedbeds. (3) Apply only once per year.

Caution

Keep Out of Reach of Children.

Harmful or fatal if swallowed. Do not get in eyes. Avoid contact with skin, inhalation of vapors or spray mist, and contamination of food and feed.

Do not contaminate domestic or irrigation water supplies or lakes, streams or ponds.

Do not reuse container. Destroy when empty.

AAtrex® trademark of CIBA-GEIGY for atrazine
Dual® trademark of CIBA-GEIGY for metolachlor
U.S. Patent No. 3,937,730
Igran® trademark of CIBA-GEIGY for terbutryn
U.S. Patent No. 3,634,062
Princep® trademark of CIBA-GEIGY for simazine
Lasso® trademark of Monsanto Company for alachlor
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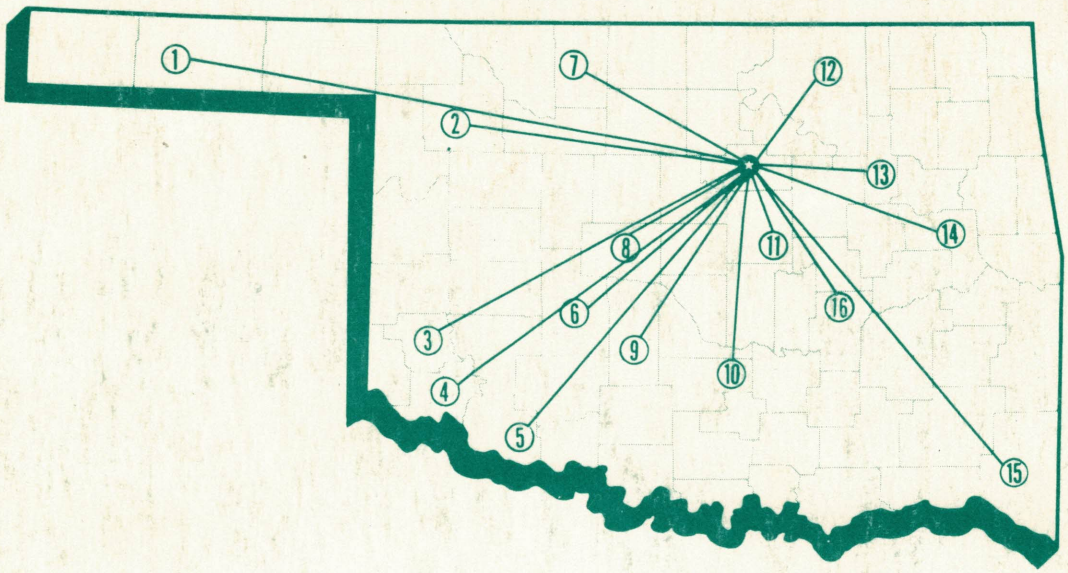

Main Station — *Stillwater, Perkins and Lake Carl Blackwell*

1. Panhandle Research Station — *Goodwell*
2. Southern Great Plains Field Station — *Woodward*
3. Sandyland Research Station — *Mangum*
4. Irrigation Research Station — *Altus*
5. Southwest Agronomy Research Station — *Tipton*
6. Caddo Research Station — *Ft. Cobb*
7. North Central Research Station — *Lahoma*
8. Southwestern Livestock and Forage Research Station — *El Reno*
9. South Central Research Station — *Chickasha*
10. Agronomy Research Station — *Stratford*
11. Pecan Research Station — *Sparks*
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