Journal of
RANGE MANAGEMENT
Volume 10, Number 4
July, 1957

New Developments in Chemical Brush Control in Arkansas

HURLON RAY

Range Conservationist, Soil Conservation Service, Fayetteville, Arkansas

Eradication and control of noxious brush on rangelands, pasturelands, and woodlands offer excellent opportunities for improved forage and timber production in Arkansas. The fight against low grade trees and brush has been going on here for many years. Farmers, timber companies, chemical companies and Federal and State agencies are now working side by side in the battle. The progress in the last six years is most encouraging.

With the advent of chemicals made especially for control of broadleaf plants, many large scale aerial applications have been made on Soil Conservation District cooperators' farms in Arkansas. To date, over 68,000 acres have been aerial sprayed on these farms and many more thousands of acres have received ground applications.

These applications follow field trial plots established in the years 1950 to 1956. Technicians of the chemical industry provided most effective cooperation in setting up the trial plots. This paper gives some of the important techniques learned from applications on these farms. These applications included treatment on pasture lands, rangeland, and removing hardwoods in woodlands.

General Information on the Herbicides Used

Both the high-volatile and low-volatile esters of 2,4-D and 2,4,5-T have been used. The high-volatile esters used were methyl, ethyl, propyl, butyl and pentyl. The low-volatile esters used were isooctyl, butoxy ethyl, tetrahydrofurfuryl, butoxy propyl, butoxy ethoxy propyl, ethoxy ithoxy propyl, and propylene glycol, butyl ether ester.

Work is now underway using urea herbicides. The mode of action of these herbicides provides a new and fundamentally different approach to the control of woody plants. Urea herbicides are applied to the soil surface and subsequently are absorbed by the roots of the plants and translocated to the aerial parts of the plant, where toxicity is expressed. The symptoms of urea herbicide toxicity are typically a chlorosis of the foliage, which is followed by necrosis of leaf parts and finally by leaf abscission and defoliation of the plant. These changes take place slowly, and are progressive throughout the growing season. Several seasons usually are required to kill most woody plants of any size.

Of considerable interest in the field of brush control with chemicals is the current work underway with herbicides in pellet form. The pellets are applied to the surface soil, and the chemical is moved to the root zone by rainfall. This type of application has great possibilities in Arkansas. Ammate emulsions are being evaluated by various field trials to determine the

FIGURE 1. Aerial application of chemicals for brush control in Arkansas. Chemicals are being applied by a Stearman airplane flying 75 mph. on 26 ft. swaths and as low as possible.

effectiveness of standard sprays with ammate solution.

Application

Most of the large scale chemical brush control work on the farms of Soil Conservation District cooperators in Arkansas has been with 2,4-D, 2,4,5-T and propionic acids. The application has employed many types of equipment. The foliage application has been done with modified Stearman airplanes, Super Cubs, helicopters, ground equipment, and hand sprayers.

The method used most extensively on farms in Arkansas has been aerial application of the chemical with the Stearman airplane, using a 220-horsepower engine. Approximately 55,000 acres of brush have been sprayed on farms in Arkansas with the Stearman airplane since 1950. Most of the Stearmans used have an improved hydraulic-driven pump unit operating a boom equipped with 12 nozzles, delivering 5 gallons of spray solution per acre in swaths of 26 feet, flying 75 miles per hour. These planes have a capacity of 100 gallons.

A high percentage of the brush work has been done with Super Cubs, using an engine having 150 horsepower. Best results have been obtained with a pressure of 30 pounds, using a boom with 16 nozzles with a Number 6 spray jet. The Super Cubs have a capacity of 110-120 gallons and deliver 5 gallons of spray solution per acre in swaths of 30 feet, operating at 80 miles per hour.

There is an increasing interest by landowners in Arkansas in the use of helicopters. They are more expensive than the Stearman and Super Cubs, but they do have an advantage in that they can take off and land straight up and down without a runway. Most of the helicopter work has been done using a pressure of 30 pounds on a boom with 12 nozzles. The rate of speed is usually 45 miles per hour, using a swath of 35 feet when applying 5 gallons of mixture per acre.

Table 1. Recommended treatments using foliage application.

Airplane Spraying

Type of Brush	Herbicide	Pounds Acid Per Acre	Volume Spray Per Acre*	Remarks
Mixed oaks and associated hardwoods	2,4,5-T	2	5	Re-treat the second year with 1 to 2 lbs. per acre
Oaks	Propionic Acid	2	5	Re-treat the second year with 1 to 2 lbs. per acre
Willow, cottonwood, locust	2,4-D 2,4,5-T (50/50)	2½	5	Re-treat the second year with 1 to 2 lbs. per acre
Persimmon, sassafras, sumac	2,4-D 2,4,5-T (50/50)	1½	7½**	Re-treat the second year with 1 lb. per acre
Release of coniferous trees	2,4,5-T	2	5	Spray after June 25

* Use 1 gallon diesel oil in 3½ gallons of water
** Use 1 gallon diesel oil in 6 gallons of water

Ground Spraying

Type of Brush	Herbicide	Pounds Acid Per 100 Gal. Water	Remarks
Mixed oak and associated species	2,4,5-T	4	Mix 4 lbs. of chemical with 5 gal. diesel oil before mixing with water. Re-treat the second year with 2 lbs. of same material per 100 gal. water. Apply as wetting spray. Volume per acre depends on density and size of brush
Persimmon, sassafras, willow, cottonwood, locust	2,4-D 2,4,5-T (50/50)	3	

With all types of aerial application on farms, best results have been obtained when the equipment has some type of pressure pump. The pressure behind the spray seems to give an even, controlled flow and good atomization. The orifice outlet faces rearward to give a coarse droplet.

Behind every good aerial spray job is planning, which includes flagging. Permanent and swath flagging is difficult in some areas in Arkansas because of the terrain, height of trees, and type of brush. Adequate flagging has been one of the most important factors. Many types of flagging have been used including: balloons, smoke pots, flags in trees, radios, and so forth. At the present, the best flagging is done by placing the flags in tree tops fastened to 20-30 foot cane poles, the permanent flags being spaced every ten swaths, or 260 feet. With this type of permanent flagging, it is best to use the colors of white, yellow and orchid. Experienced swath flagmen are essential. They must get to their next station before the pilot is ready to line up for his next pass. Most flagmen use three-foot squares of white cloth atop cane poles, which are mounted on aluminum tubing.

In addition to insuring good coverage, proper flagging will enable the pilot to make quick checks on the volume of material per acre that is being applied.

Airplane application appears to be the only feasible method for applying spray rapidly and economically on large areas of moderate to heavy brush. Also, airplanes can operate when it is too wet for ground sprayers. Aerial application of chemicals for brush control is a very sensitive operation. Good

FIGURE 2. *Left*: Portion of brush covered area before aerial spraying with 2,4,5-T on May 22, 1955. *Right*: Same area on June 1, 1956. Rate of application was 2 pounds of acid of 2,4,5-T with one gallon of diesel oil and 3½ gallons of water per acre.

results are obtained only when all phases of the operation are carried out correctly. The important factors in a proper aerial application include the following:

1. Study of the area to be sprayed
   a. Soil types
   b. Types of woody plants
   c. Purpose of spraying—such as timber stand improvement, or brush control on range or pasture land
2. Time of day—early morning, late evening
3. Time of year — May, June, early July
4. Temperature—65°-80° F.
5. Wind—less than 5 miles per hour
6. Humidity—high
7. Soil moisture—favorable for plant growth at time of application and for several weeks following application
8. Proper spray system on aerial equipment
9. Pilot trained in aerial application of herbicides
10. Area properly flagged with permanent flags
11. Trained flagging crew
12. Reliable chemicals and carrier, mixed correctly
13. Correct flying of airplane

Number 2 diesel oil is the principal oil used as a carrier for the ester formulations. Oil-water emulsions prepared with emulsifying agents also give effective and economical carrier solutions. Some work is now underway using nontoxic oils as a carrier. A formulation containing a new emulsifier is now being used that permits mixtures in straight oil without the difficulties of the emulsifiers and other settling to the bottom of the spray mixture. This new emulsifier has been designated as O S (oil stable) formulation.

Ground Equipment

Spray solutions may be applied to the foliage of brush with many types of ground equipment. The character, density, and type of woody plants will determine the type of equipment to use. Hand sprayers are good for small areas of brush, fence rows, and seedlings. With any equipment, it is necessary to completely wet the foliage. Best results have been obtained with a mixture of one gallon 2,4,5-T, five gallons diesel oil and 94 gallons of water. However, some species, such as willow, persimmon, sassafras and cottonwood, can be controlled better with half 2,4-D and half 2,4,5-T.

Power equipment such as tractor, truck, or jeep drawn vehicles is becoming popular for many types of brush control work in Arkansas. The spray solutions applied by ground power equipment are the same as hand equipment. Good results have been obtained with power equipment on a foliage application as late as August. However, best results have been obtained when the brush was sprayed in May, June, and July.

Several kinds of power sprayers are on the market. Some are driven by tractor, power take-off or belt, some are trailer mounted and driven by small gasoline motors, and others are mounted on jeeps, tractors and trucks. Good results usually have been obtained when the following procedures and precaution have been observed:

1. Use nozzles that give a fine fan-shaped spray.
2. Mixture: one gallon 2,4,5-T (4 lbs. acid) with 5 gallons diesel oil mixed with 94 gallons water.
3. Wet foliage thoroughly.
4. If a boom is used, it must be well braced.
5. Use a by-pass valve to insure uniform pressure from 20 to 100 lbs.
6. Use a pressure gauge to assure constant pressure.
7. Use screens or filters to keep nozzles from clogging.
8. Use a detergent, such as "Tide", to add a sticking characteristic to the mixture.

The spray equipment for control of woody plants must be of sturdier construction and capable of delivering a larger volume of liquid than those used in weed control. The equipment should be as compact as possible.

Observations made over a 6-year period indicate that control of broadleaf plants with foliage

Table 2. Recommended treatments using basal application

Method of Application	Herbicide	Pounds of Acid	Remarks
Hand sprayer	2,4,5-T	4 lbs. per 25 gal. diesel oil; ½ to 1 pint per 3 gal. diesel oil	Lower dilution may be used on stems up to 3 inches in diameter.
Hand sprayer	Propionic acid	Same	Same
Tree Injector	2,4,5-T	2 lb. per 4½ gal. diesel oil	One injector will hold enough chemical for approx. 400 injections. Use from Sept. to March
Tree Injector	Propionic acid	Same	Same
Frill and spray	2,4,5-T	Use 1% solution	Apply solution in a frill
Stump Treatment	2,4,5-T	4 lbs. per 25 gals. diesel oil; ½ to 1 pint per 3 gal. diesel oil	Spray entire stump. Adequate wetting necessary for best results.
Stump Treatment	Propionic acid	Same	Same
Power sprayer	2,4,5-T	16 lbs. acid per 100 gal. diesel oil	Spray lower 12-15 inches of stem until wet. For small brush wet whole plant.
Power sprayer	Propionic acid	Same	Same
Tree Girdling	2,4,5-T	½ lb. per 5 gal. motor oil	Apply to lower part of groove with brush
Ground Application	Monuron (unsubstituted urea)	⅛ to ¼ lb. per one gal. water	Apply a four inch band around, and a foot away from tree

most of the broadleaf type plants.

Spraying the stems of trees less than five inches in diameter is a common method that has proved successful. This treatment consists of spraying the lower 12 inches with a mixture of one gallon 2,4,5-T (4 lbs. acid) mixed with 25 gallons diesel oil. For effective control encircle the stem to the point of runoff. Best results have been when the spraying was done from October to March.

Another basal treatment that has proven successful, especially in removing unwanted hardwoods in pine stands, is frilling the tree and applying a one percent solution of 2,4,5-T in the frill. The frills are made by making a single hack girdle at chopping height. This treatment is good for trees 6 to 10 inches in diameter.

A new method of controlling worthless trees with chemicals is proving successful in Arkansas. An injector is used to shoot the chemical—2,4,5-T—into the inner part of the tree. The injector is driven through the outer bark into the inner bark of the tree. Better results are obtained when the injector is literally thrown at a

sprays has been much better on some soils than on others. Greater success has been obtained on such soils as Muskingum, Hector, Pottsville, and Fayetteville fine sandy loam, than on Cleburne fine sandy loam, Waynesboro fine sandy loam, Newtonia loam, Pulaski, and Centerton.

Basal Treatment

This refers to a chemical spray application by hand or ground equipment to the lower stem, cut stump, actual injection of chemical into the trunk, application of chemical into frills made with an axe, or application of chemical into a groove made by a girdling machine.

Basal application of chemicals is the most common method used for controlling unwanted trees in desired stands. This application has been highly effective for control of

FIGURE 3. Portion of an area having shortleaf pine mixed with oaks and other hardwoods one year after spraying with 2 pounds of propionic acid in one gallon of diesel oil and 3½ gallons of water per acre. Note good kill of hardwoods and no damage to the pines. Area sprayed May 19, 1955.

downward angle into the tree. When done properly, a cup is formed and the chemical is released through the injector bit. The chemical remains in the cut and is absorbed into the inner bark. It is necessary to hit some trees harder than others, depending on the type of bark. The important thing is to see that the bit goes into the inner bark and a pocket is formed to hold the chemical. With some practice, a rhythm can be developed so that each injection can be made in one or two seconds. Injections are made every 2 to 4 inches around the tree.

Best results have been obtained using a mixture of one-half gallon of 2,4,5-T in 4½ gallons of diesel oil.

The tree girdling machine commonly known as the "Little Beaver" is being used extensively with an application of chemicals applied with a paint brush on the lower side of the groove. This application is proving very successful in pine stands to remove unwanted hardwoods. The mixture used with this method is one pint of 2,4,5-T mixed with 5 gallons of used motor oil. The application of chemical should be done immediately following the girdling.

Conclusion

Brush is the number one agricultural problem in Arkansas, and the annual loss in dollars due to brush invasion would be impossible to measure. For the past hundred years the loss due to the invasion of brush has increased yearly due to burning and overgrazing.

The method of brush control used most extensively in Arkansas has been the applying of chemicals by airplane. Many thousands of acres of brushland have been airplane-sprayed since 1950. Complete eradication of all brush is seldom accomplished by a single aerial spraying, although present indications are that over 90 percent or more of the scrub hardwood brush can be eliminated with one spraying. When complete eradication is desired, it may be necessary to make a repeat spraying to control undergrowth that was not affected with the first application. Also, seedlings will come up from acorns and nuts in the ground after the first spraying.

Experience in Arkansas shows that in achieving successful control *the efficiency of application is fully as important as the chemicals used.* In aerial applications it is necessary that the applicators be experienced in brush control work and that the area to be sprayed be plainly marked and flagged.

Certain general conclusions can be drawn from the various data presented:

1. Air temperature affects the activity of the herbicide and the effectiveness decreases when the temperature is above 85° F.
2. Soil moisture affects the activity of the herbicide. Better controls are obtained when soil moisture is favorable for plant growth.
3. The type of soil affects the percent of control.
4. Time of year and time of day are important factors in a good spray operation. The most favorable time of year is May and early June, while the most favorable times of day are early morning and late afternoon.
5. Some esters appear to affect the terminal buds of pine less than other esters.
6. July and August sprays appear to affect terminal buds of pine less than May and June sprays.

Foliage sprays applied with ground equipment have also given good results in Arkansas. Basal applications of herbicidal chemicals have been used successfully to remove unwanted species from stands of desired trees.

Screw-worm Eradication Tests Begun in Florida

Pilot-type field tests to evaluate and improve procedures and equipment for screw-worm eradication by using sterile male screw-worm flies have been started in the 2,000-square-mile area southeast of Orlando, Florida. The State of Florida and USDA are cooperating in these tests. Screw-worms are the larvae, or maggots, of the fly, *Callitroga hominovorax,* which develops from eggs laid on open wounds on animals. They cause heavy losses to livestock producers in Florida and Texas.

Eradication of the screw-worm by this method is based on the fact that when normal females of the species mate with sterile males, the eggs produced will not hatch. If enough sterile male flies can be introduced into a screw-worm infested area at proper intervals, they will cause a progressive reduction in the laying of fertile eggs, and the fly population will eventually be wiped out.

The flies used in the tests will be rendered sterile by radio-active treatment. The program calls for the release of about 2,000,000 laboratory-reared flies per week for a period of four months. The program is expected to yield information essential for the planning and operation of an all-out eradication effort.