B-892

Weed Control in Texas Pastures

TEXAS AGRICULTURAL EXTENSION SERVICE
J. E. HUTCHISON, DIRECTOR, COLLEGE STATION, TEXAS

CONTENTS

PRECAUTIONS

FOR 2,4-D USE. 1. A cup of 2,4-D concentrate properly distributed can kill an acre of tomatoes or ruin several acres of cotton.

2. Use 2,4-D only when necessary and use no more than necessary.

3. Use the amine salt form unless esters are suggested specifically, because the volatile fumes or vapors of most esters of 2,4-D may cause injury to nearby sensitive plants.

4. Do not apply the material to seedling grasses or legumes.

5. Use every precaution to prevent injury from drift or misapplication.

6. Do not apply 2,4-D when wind speed is over 5 miles per hour.

7. Use low pressures and nozzles that permit coarse sprays to prevent fine, misty spray.

8. Keep the spray boom or nozzle as close to the ground as possible and still obtain good coverage.

9. Do not apply 2,4-D to weeds growing slowly because of drouth or that are approaching maturity, since poor control is likely.

10. Do not use 2,4-D contaminated equipment to apply other materials to susceptible crops.

11. Keep 2,4-D containers closed and store the material away from seed, fertilizer, insecticides and fungicides; destroy empty containers.

12. Livestock may eat poisonous plants they normally avoid after the plants have been sprayed with 2,4-D.

13. Read Extension Service leaflet L-210, "Dangers in the Use of Hormone-Type Weed Killers."

FOR OTHER MATERIALS. Dinitro is poisonous to man and livestock; precautions on the container should be observed; the straw or forage to which the material has been applied should not be fed to livestock. Dalapon and TCA are not poisonous when used at the rates recommended in this bulletin.

Observe carefully all label instructions regarding residue tolerances.

STATE HERBICIDE LAW. Texas has specific regulations governing the use of 2,4-D and other plant growth regulator-type herbicides. The restrictions are not the same for all areas of the State; some areas are exempt; use of 2,4-D is prohibited in some areas without special approval; the herbicides may be used only during certain periods in some areas and application by airplane is forbidden in some areas. Every user should be thoroughly familiar with all provisions of the law in his area and his situation to help prevent ill feeling and lawsuits. Copies of the law may be obtained from the Commissioner of Agriculture, Austin, Texas. These regulations should be carefully observed and 2,4-D type compounds used only where and when permitted by the State herbicide law.

Weed Control in Texas Pastures

*E. M. Trew and John A. Long**

THIS BULLETIN DISCUSSES control and prevention of weeds in cultivated pastures and meadows. It does not include native rangeland, although some suggestions given will apply. Pastureland usually justifies a greater expenditure per acre for weed control and more intensive management to prevent weed invasion.

Weeds often reduce pasture yields by 50 percent. They reduce pasture and hay yields by competing with the desirable plants for plant nutrients, moisture and light. They lower hay quality, harbor insects and diseases and increase labor and equipment costs. Some weeds are poisonous and are direct causes for livestock losses. Many are low-quality forage or are unpalatable and prevent proper utilization of pasture and hay; for example, sandbur and bullnettle.

Weeds are undesirable in a pasture or meadow. Under some circumstances a pasture plant normally considered valuable must be treated as a weed. Examples are Bermuda or Johnsongrass in fields where pure stands of grasses or legumes are desired for seed production; burclover, sweetclover or alfalfa in sufficient amounts to cause bloat; and, burclover or sweetclover in areas to be established to alfalfa.

Weed control is essential for best returns from productive pastures and meadows. Higher forage yields and quality with greater livestock production per acre are necessary because of narrow margins of profit. However, weed control is not always profitable. Chemical or mechanical control is not a substitute for proper fertilization and management of adapted plants and is temporary if proper maintenance is not followed. Weed control usually is not profitable when:

1. Desirable grasses or legumes will not replace weeds killed.

2. The soil fertility level is too low to support a good stand and growth of desirable grasses or legumes.

3. The plants are kept grazed or cut so close that they are not vigorous enough to resist weed invasion.

4. Other pasture, meadow or livestock management practices result in low production.

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Figure 1. A well adapted grass fertilized and grazed properly will keep out most weeds.

5. Removal of the weed canopy results in damage to the grass and soil from severe sun baking.

Prevention

The best weed control is through weed prevention. Weeds are a minor problem in good stands of adapted grasses that are fertilized as needed and properly grazed or utilized. The necessity for weed control measures often can be prevented by:

1. Proper pasture and meadow establishment and management.

a. Thorough seedbed preparation.

b. Planting high-quality seed of adapted plants.

c. Using the right amount of seed and best planting method at the proper time.

d. Proper fertilization.

e. Proper grazing or forage use.

2. Preventing weed establishment and seed production.

a. Keep fencerows and roadsides clean.

b. Clean combines thoroughly to prevent bringing in weed seed.

c. Do not buy feed containing live weed seed.

d. Mow, spray or cultivate to kill any weeds that get started; most weeds are killed easily when they are young and have small root systems.

e. Rotate crops; temporary or annual pastures often favor a buildup of annual weeds and permanent pastures of perennial plants favor a buildup of perennial weeds.

Mechanical Control

CULTIVATION

Weeds should be eradicated before seeding pastures to allow the pasture plants the best opportunity for establishment. Most annual weeds are easily killed by shallow cultivation that cuts the stems below the soil surface or entirely covers them with soil. A few troublesome annual weeds require repeated cultivation for control and some must be plowed when the topsoil is dry to prevent the cut stems from producing new roots.

Perennial weeds may be killed with one cultivation while they are in the seedling stage. After they are well established and have reserve food material stored in their root system, several cultivations may be required for eradication. Repeated cultivation a few days after weed emergence depletes the root reserves because new shoots grow on food stored in the roots until enough leaf area is developed to manufacture the needed food. The root reserves must be exhausted so new shoots cannot grow.

A common practice is to plow at a uniform depth of 4 to 5 inches with 12 to 30-inch sweeps that overlap 3 to 4 inches. Moldboard plows may be used. Cultivation with sweeps generally is done every 2 to 3 weeks through the growing season. Some operators prefer to grow close-tilled crops in conjunction with repeated cultivation to clean up infestations of established perennial weeds.

Figure 2. Proper seedbed preparation and later cultivation often eliminate the need for mowing or spraying.

Figure 3. Properly timed mowing kills most permanent pasture weeds and prevents their stealing moisture, plant nutrients and light.

MOWING

Mowing has been associated with improved pasture practices for many years. Frequently too much in the way of weed control is expected from mowing alone. Fertilization, seeding and other good management practices often are necessary to make weed control profitable. Mowing threeawn (needlegrass) and weeds on land too poor to support a good stand and growth of a desirable pasture grass generally is a waste of time. In addition to mowing for weed control, pasture growth not needed for grazing should be cut and put up as hay or silage. Also, coarse, mature growth should be mowed to allow growth of new material that is more palatable and nutritious.

TIME TO MOW. Mowing for weed control should begin when the worst weeds are budding or starting to bloom. Mowing should begin in ample time for all the pasture to be covered before weed seed are produced. Bitter sneezeweed, *Helenium tenuifolium,* commonly called eastern bitterweed, generally makes enough regrowth to mature seed after one or two clippings. This requires early and repeated mowing; the first mowing should be high, just low enough to catch the blooms, and successive clippings should be lower to prevent seed production on the mowed stubble. Yankeeweed, *Eupatorium compositifolium,* incorrectly called rosinweed, and other fall-blooming perennial weeds, will

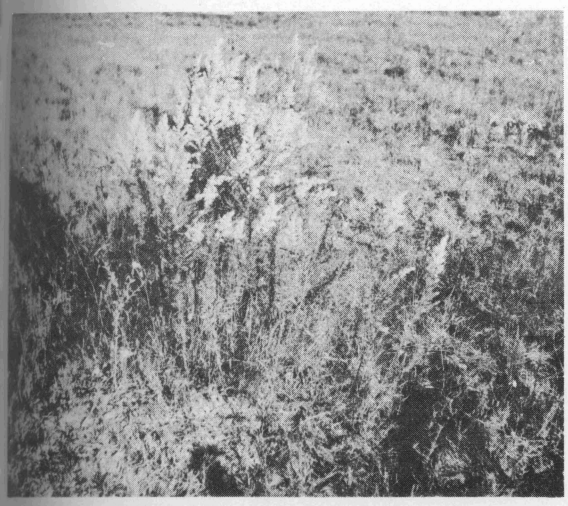


Figure 4. Some fall-blooming weeds, such as the yankeeweed shown here, require mowing in the summer to check growth and again in the fall when they bloom.

require mowing in the summer to retard growth and again at blooming time in the fall.

HEIGHT TO MOW. The best height to mow often depends on the desirable grass or legume present. Sod-forming grasses such as Bermuda may be mowed at a height of 3 to 4 inches if necessary. Blue panic, buffel and many other bunchgrasses should not be mowed closer than 6 to 10 inches. Mowing tall bunchgrasses too often damages the stand. When seedling stands of alfalfa must be mowed for weed control, the mower should be set high enough not to disturb the young alfalfa plants. When the alfalfa plants are about as tall as the weeds, mowing should be delayed until the alfalfa is in the one-fourth bloom stage.

EQUIPMENT FOR MOWING. The two types of mowers commonly used for pasture mowing are the conventional cutter-bar type and the rotary or shredder type. A third type machine, built on the principle of the rolling stalk cutter, is sometimes used on areas too rough for the cutter-bar or rotary mowers and where brush is too large to cut with the other two types. When the cutter-bar and rotary types are compared, the rotary is faster, requires less maintenance and chops plants into short lengths so that there is less danger of shading desirable plants when tall weeds and grass are mowed.

Any heavy duty power takeoff cutter-bar type mower generally will be satisfactory for mowing weeds in an improved pasture. For average mowing, a 6 or 7-foot cutter bar with heavy pointed rock guards is satisfactory. For heavier growth, including sprouts up to 1 inch in diameter, use a shorter cutter-bar with an extra heavy knife, heavy-duty clips and a set of snub-nosed brush guards. For a short, dense growth of Bermuda, use the double-guard type commonly called the lespedeza guard.

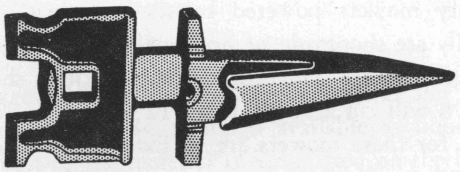


Figure 5. This heavier, longer type of guard is used on heavy duty bars. They are malleable, spaced approximately 3 inches apart, may have serrated ledger plates, and make full contact with each other at the base.

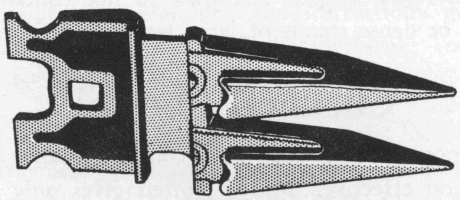


Figure 6. This type guard is designed for cutting lespedeza, Bermuda and needlegrass. With 1½-inch spacing, it is used with a 3-inch spaced knife or sickle, allowing a double number of serrations per stroke.

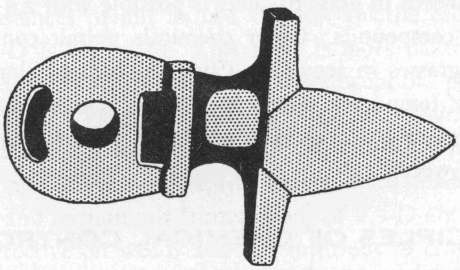


Figure 7. This guard is designed for cutting heavy weeds and light brush up to 1 inch in diameter. It is heavy, blunt and has no lips. An extra heavy knife and heavy duty clips are used with it.

Rotary mowers are of two types—those driven by power takeoff and those powered by the supporting

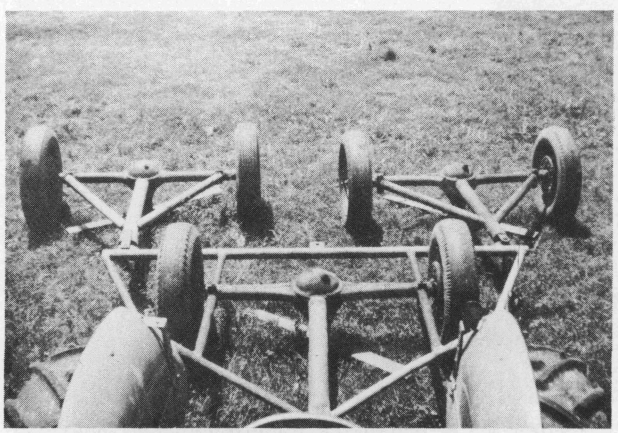


Figure 8. This inexpensive shop-made mower rig is fast and satisfactory on smooth pastures that are free of large sprouts and dense stands of large weeds.

wheels. The commercially manufactured rotary mowers and stalk shredders driven by power takeoff have been used successfully in mowing pasture weeds and brush up to ¾ to 1 ½ inches in diameter.

Rotary mowers powered by the supporting wheels generally are shopmade or homemade from old auto or tractor rear ends. Three of the units such as shown in Figure 8 will cut a swath 10 to 12 feet wide. Specifications for these mowers are in Extension Service plan No. 368, available from county agricultural agents. Safety shields should be installed to protect the operator. This type mower generally can be used only on pastures that are fairly smooth and that do not contain large sprouts or dense stands of large weeds.

Chemical Control

Proper spraying for weed control usually is fast, cheap and effective. Mowing often gives only fair to good control, and weeds often resprout after clipping. Spraying sometimes gives near-complete control for one season. Practical, economical control of most broad-leaved weeds in grass pastures is possible with 2,4-D and related compounds. Other chemicals permit control of weedy grasses in legumes. Chemical control alone will be only temporary unless it is used with other good management practices that will help prevent reinfestation by weeds.

PRINCIPLES OF CHEMICAL CONTROL

One who uses chemicals for pasture and meadow weed control should understand certain principles. Failure to observe these likely will result in unsuccessful

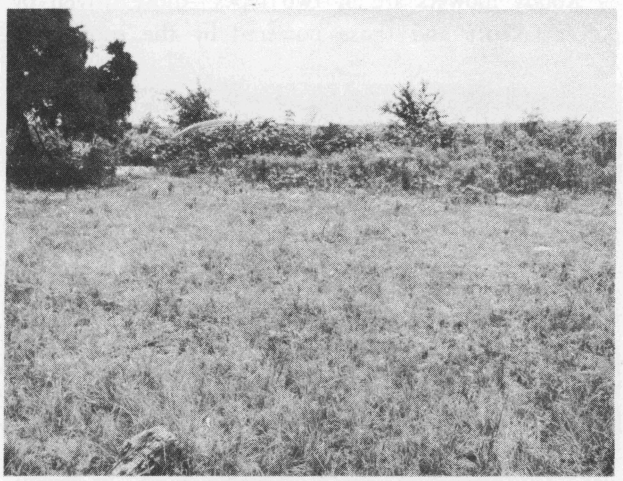


Figure 9. A mid-March application of ½ pound of 2,4-D per acre killed practically all the weeds. Note the dense stand of broomweeds on the untreated background area.

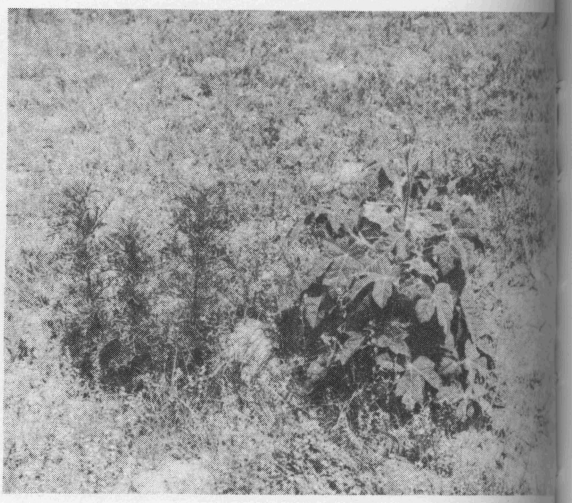


Figure 10. Chemicals are most effective when applied to young, rapidly growing weeds. Some weeds are resistant to 2,4-D after they reach the bloom stage. Good coverage with spray is difficult on large weeds and dense stands of weeds.

control with chemicals. Use of chemicals for weed control generally is based on weed growth habit, length of life (annual, biennial or perennial) and method of reproduction (seed, stems, rhizomes, crowns, etc.).

Soil moisture, humidity and air temperature, in addition to stage of growth, influence susceptibility of plants to herbicides. Weed growth is most rapid with favorable moisture and temperature conditions. Fast-growing weeds generally are more susceptible to herbicides than plants growing slowly due to less favorable conditions. The best temperature range for action of herbicides is 70 to 80 degrees F., although the 55 to 90 degrees F. range generally is satisfactory. Grasses may be injured if 2,4-D type herbicides are applied as a spray when temperatures are above 95 degrees F.

ANNUAL AND BIENNIAL WEEDS. Annual weeds complete their life cycle in one season by coming from seed, growing, producing seed and dying. Thus, preventing seed production on annual weeds for several years will provide effective control. Biennial weeds usually make only vegetative growth during the first growing season and produce seed the second season. As with annuals, preventing seed production generally gives satisfactory control.

Chemical applications on annual or biennial weeds should be made when the weeds are in the seedling or young stage. Most plants in this stage are susceptible to chemicals and regrowth usually does not occur when the tops are destroyed.

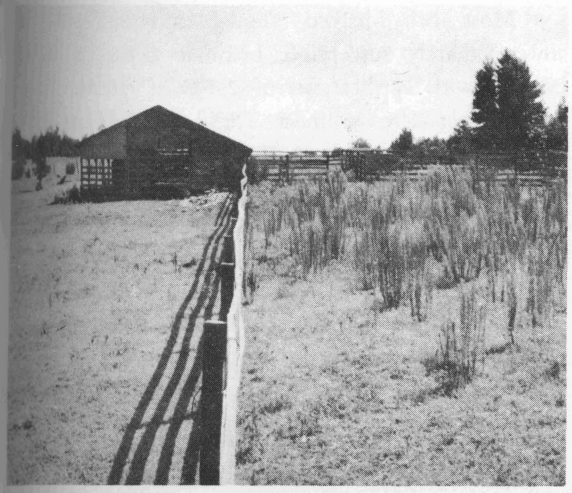


Figure 11. One application of herbicide to the left of the fence the previous summer killed the yankeeweeds. They did not come back the following year.

PERENNIAL WEEDS. These weeds may live 3 years or more and most produce seed every year after they are established. They reproduce by both seed and vegetative parts, such as crowns, rhizomes and bulbs. Perennial weed control must include stopping seed production on established plants to prevent reinfestation by seedlings and destruction of established plants, including roots, crowns, rhizomes and bulbs to prevent vegetative spread.

Many seedling perennial weeds are easily killed with chemicals and should also be treated in the young stage before they can establish a strong root system. Applications of 2,4-D for the control of established perennial broad-leaved weeds should be made, if practical, when the plants are in the bud or early bloom stage. The 2,4-D type herbicides generally are most effective at this stage of growth because the plants are weakened and less likely to recover. Application of 2,4-D at this stage of growth for established perennial weed control may not always be practical because of the danger to susceptible crops or for other reasons. Use of the chemical in earlier stages of plant growth likely will give good control of most susceptible plants and often will prevent further growth and seed development on many intermediate to resistant plants.

CHEMICALS USED

Chemical weed killers generally are grouped into two classes—selective weed killers and general contact weed killers. Selective weed killers are chemicals that kill some plants without harming others. They may function as general contact weed killers if not used properly. Adding wetting agents or using relatively high rates will reduce selectivity. Selective chemical weed killers discussed in this publication are: 2,4-D, 2,4,5-T, selective dinitros and low rates of sodium TCA and dalapon. General contact weed killers include chemicals which destroy all types of vegetation, desirable and undesirable.

Suggested rates of application for 2,4-D and 2,4,5-T are given in pounds, although available as liquids, because most of the material is formulated on the basis of 4 pounds of acid equivalent per gallon. One pound per acre would be 1 quart per acre. Rates for other materials are expressed in quarts (liquid measure) or pounds (dry weight). Precautions and instructions given by manufacturers on the labels of herbicide containers should be carefully observed.

2,4-D. This is considered the basic herbicide in most chemical weed control programs. It is available commercially in three forms; the ester, amine salt and sodium salt. The esters of 2,4-D seem to have a greater herbicidal action per unit of acid. When weed conditions demand the most active chemical and where circumstances permit its use, the low-volatile ester form of 2,4-D is suggested. This form is more hazardous to use near susceptible crops or other susceptible plantings and requires greater care in application. Damage has been reported in areas up to 20 miles from where aerial applications of 2,4-D esters were made. The amine and sodium salt formulations of 2,4-D are slightly less effective on weeds and less injurious to crops. The amine form generally is more effective than the sodium salt and is the most popular form of 2,4-D.

2,4,5-T, OR 2,4-D AND 2,4,5-T MIXTURES. The chemical 2,4,5-T is a variation of 2,4-D which is less effective against broad-leaved herbaceous weeds but much more effective against many brush and other woody plants not usually affected by 2,4-D. The combination of 2,4,5-T and 2,4-D provides a mixture effective against a wider range of plants than either material alone. Both 2,4,5-T and mixtures of 2,4,5-T and 2,4-D are more expensive than 2,4-D alone and are used mainly in brush control applications because they are more effective than 2,4-D. Both are available in ester and amine forms, the ester forms again being more effective. Follow the same precautions with 2,4,5-T as for 2,4-D.

DALAPON. Dalapon is available as the sodium salt of 2,2 dichloropropionic acid. It is readily soluble in water and is generally classified as selective for grasses.

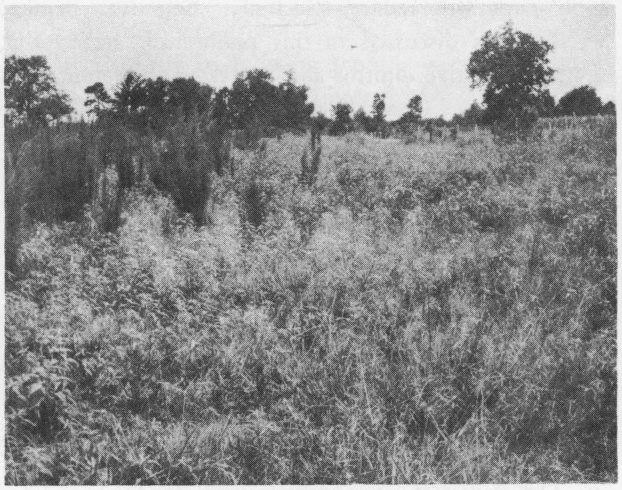


Figure 12. Yankeeweeds sprayed in the strip on the right the previous summer were killed. Another spraying was needed to kill the croton (goatweed) that came from seed the following spring.

TCA. TCA is available as the sodium salt of trichloroacetic acid. It also is soluble in water. TCA at rates suggested in this bulletin is selective but at higher rates may kill all vegetation.

SELECTIVE DINITROS. Selective dinitros are available as the amine salts of DNBP and designated commercially as Sinox PE, Dow select and Premerge. DNBP compounds are toxic to man and livestock. Directions for application on the container should be followed carefully. Dinitros should not be sprayed on forage near the time when it is to be grazed or cut for hay. A waiting period is required to prevent carryover of toxic residue on forage and to comply with residue tolerance regulations.

C-56. C-56 is an oil soluble liquid used to increase the penetrating ability of oils used as herbicides.

CONTROLS FOR SPECIFIC SITUATIONS

CHEMICAL CONTROL OF WEEDS IN PERENNIAL GRASS PASTURES AND MEADOWS. Most susceptible and intermediate broad-leaved weeds in perennial grass pastures and meadows may be controlled with properly applied 2,4-D. Grasses may be sprayed with 2,4-D after they have four leaves. Stands for seed production should not be sprayed with the material between the boot and hard dough stages. Spraying when weeds are actively growing and not too mature is essential for best results with 2,4-D. Excellent results have been obtained with applications of 2,4-D in the early spring when the weeds are in the seedling stage and *before cotton has emerged.* March 15 appears to be a fairly desirable date for Central Texas.

Most broad-leaved annual and susceptible an intermediately susceptible biennial weeds can be con trolled with applications of 2,4-D at rates of ½ to 1 pound per acre in most Texas areas. Time for the application depends on the stage of growth of the weeds and whether susceptible crops permit spraying When 2,4-D low-volatile esters are used instead of the amine salt form, use the lower rate. For the amine salt forms of 2,4-D, use ¾ to 1-pound rates. Avoid spray application when temperatures are above 90 degrees F., since some damage to grass has been observed at higher temperatures. Minimum temperature for spray application is about 55 degrees F.

Water volumes for ground spray applications should be between 10 and 25 gallons per acre. Volume for airplane application should be 2 ½ to 5 gallons per acre. The higher volume is suggested for ground spray equipment where the boomless sprayer is used. Use a wetting agent in the spray mixture for hard-to-wet weeds that have glossy-waxy leaves, hairy leaves or upright leaves that do not hold the spray droplets. If spray applications are made during the summer when high temperatures prevail, it may be desirable to leave the wetting agent out as it will cause more material to be held on the grass leaves, increasing the possibility of damage. Most commercial washing detergents are satisfactory as wetting agents. Use 4 to 8 ounces of liquid detergent per 100 gallons of spray mixture or 1 ½ to 2 pounds of the dry detergent per 100 gallons of spray mixture.

Many of the broad-leaved perennial weeds classified in Table 1 as susceptible and intermediate may be controlled satisfactorily with 2,4-D. Rates of application are ½ to 1 pound per acre for susceptible weeds and ¾ to 1 ½ pounds per acre for the intermediate weeds. Time of application and rate and stage of plant growth are important. Generally the spray should be applied when the weeds are in the bud or first bloom stage or in the early rapid growth stage. Use wetting agents and spray volumes as outlined for the annual weeds. When circumstances prevent spraying at the proper stage of growth, mow the weeds and spray the regrowth after mowing if conditions permit. Often it will not be possible to spray perennial weeds in the bud stage because of the danger of damaging susceptible crops, local restrictions or high temperatures. Then seed production should be prevented by mowing.

SEEDLING LEGUME STANDS AND SEEDLING GRASS-LEGUME MIXTURES. Seedling legumes grow slowly and usually are poor competitors with most weeds.

The cultural control measures are the safest. Plant in a seedbed relatively free of weeds or weed seed. The prevention of weed seed production in preceding crops, the use of cultivated crops and tillage after harvest are suggested. Mowing seedling legume stands will kill many annual broad-leaved weeds.

The dinitro selective chemical herbicides can be used for the control of many annual broad-leaved weeds in seedling alfalfa but are not satisfactory for controlling the weedy grasses in seedling alfalfa. The range of rates should be based on prevailing temperatures. Use 3 quarts when temperatures are 60 to 70 degrees F.; use 2 ½ to 3 quarts when temperatures are 70 to 80 degrees F. Do not spray when plants are wet, when the soil is wet or when the humidity is high. Use only a boom-type sprayer and water volumes of 40 to 60 gallons per acre. Seedling alfalfa should be well rooted and have 5 to 7 trifoliate leaves before this treatment is used.

Recent tests indicate that butyric forms of 2,4-D and MCP will give good control of curly dock in legume-grass pastures with little damage to pasture legumes when used at the rate of ¾ pound per acre. Applications made when hop and white clover on the Tyler Experiment Station were 2 to 3 inches high resulted in little injury to the clover. The control of dock was excellent when the weeds were sprayed in the seedling stage. Temperatures at the time of treatment were about 50 degrees F.

When weedy grasses threaten seedling legume stands, use 5 to 7 pounds of sodium TCA in 25 to 30 gallons of water per acre. The chemical will include a wetting agent. Apply the material when the weedy grasses are very small. Legumes should have 5 to 7 trifoliate leaves and be well rooted before they are sprayed with TCA for weedy grass control. Alfalfa and sweetclover are moderately tolerant to sodium TCA, while crimson clover, white clover and hop clover may be injured by the suggested rates.

SMALL GRAIN PASTURES. Broad-leaved weeds classified in Table 1 as susceptible or susceptible to intermediate may be controlled with 2,4-D. Application of 2,4-D is suggested only to prevent weed seed production or when weeds threaten to reduce forage yields. Delay spray applications until the small grains are fully tillered and are 4 to 6 inches high; stop application when the small grains have reached the boot stage. Do not exceed the ½ pound per acre rate since injury and reduced forage yields may occur at higher rates. Apply the 2,4-D in 10 to 25 gallons of water per acre. Use a wetting agent, as described under "perennial grass pastures and meadows," when the weeds to be controlled have glossy-waxy, hairy or upright leaves.

Broadcast spraying for the control of annual, biennial or perennial weedy grasses in small grains is not recommended. Where the weedy grasses occur in scattered spot infestations, consult the county agricultural agent. The same procedure is suggested for hard-to-kill broad-leaved weeds.

SUMMER TEMPORARY PASTURES OF ANNUAL GRASSES. Many seedling weeds will be destroyed in the normal land preparation operation before planting temporary summer pastures.

Broad-leaved weeds classified as susceptible in Table 1 and present in summer annual grass pastures in large enough quantities to reduce quality and quantity of forage may be controlled with ½ to ¾ pound of 2,4-D per acre applied in 10 to 25 gallons of water per acre. Do not use a wetting agent because of the high summer temperatures. Delay spray applications until the pasture plants are well tillered and are 4 to 6 inches high. Use the amine form of 2,4-D.

Use of 2,4-D to control broad-leaved weeds classified as intermediate to resistant probably is not justified since the higher rates required may also injure the pasture plants.

Broadcast spraying with chemicals for the control of annual, biennial or perennial weedy grasses is not recommended. Where hard-to-kill annual, biennial or perennial grass or broad-leaved weeds occur in summer temporary pastures as spot infestations, consult your county agricultural agent for control information.

ESTABLISHED STANDS OF PERENNIAL LEGUMES. The use of 2,4-D for the control of broad-leaved weeds in established perennial legumes (alfalfa and sericea lespedeza) requires special consideration. Application of 2,4-D should be made only when the legumes are dormant in late fall, winter or early spring. Serious yield losses and stand reduction may result from spraying actively growing perennial legumes with 2,4-D. Susceptible and some intermediate broad-leaved weeds may be controlled in stands of perennial legumes with ½ to ¾ pound of 2,4-D applied with 10 to 25 gallons of water per acre. A wetting agent should be used as described under "perennial grass pastures and meadows."

Selective dinitros at 3 quarts in 30 to 40 gallons of water per acre may be used to control many winter annual broad-leaved weeds, such as chickweed, henbit

Figure 13. Spot treatment may be necessary for hard-to-kill weeds, dense clumps or cleaning up isolated spots.

and mustards, in established, actively growing alfalfa. Spraying should take place in the fall or early spring when the weeds are in the seedling stage. *Do not use a wetting agent* because this will make the dinitros toxic to the alfalfa.

Sodium TCA may be used to control small annual weedy grasses in perennial legumes. Use 5 to 7 pounds in 30 to 40 gallons of water per acre. No wetting agent is necessary because the TCA is compounded with a wetting agent. No permanent injury should occur when the spray is applied properly.

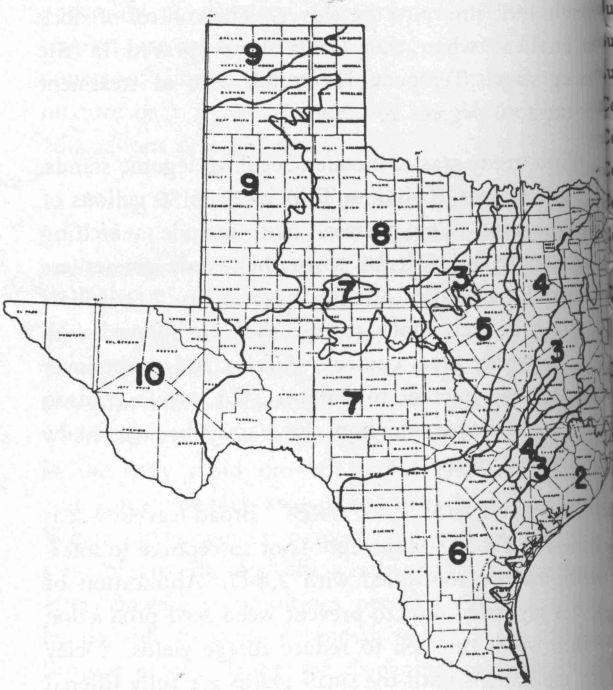
SPECIAL WEED CONTROL PROBLEMS. In some pastures serious annual, biennial and perennial weeds of both broad-leaved and grass types need attention. Many of these weeds, if allowed to produce seed, will create serious weed problems in succeeding seasons or in certain crops following the pasture in crop rotations. Some of the serious weeds and suggested methods for their control follow.

Curly dock, *Rumex* species, is a biennial weed that produces abundant seed crops. It should be treated in late fall and winter or in early spring. Spray applications *must* be made before this weed produces a seed stalk to control it effectively or to prevent seed production. Use ½ to ¾ pound of 2,4-D amine or low-volatile ester per acre in 10 to 25 gallons of water. Damage to white clover will be slight to none at the ½-pound rate. Use the ¾-pound rate if white clover is not to be protected. Do not use a wetting agent if white clover is present or is to be protected. Apply the spray at least once a year. If two applications per year are made, make one application in early spring and the second in late fall or early winter.

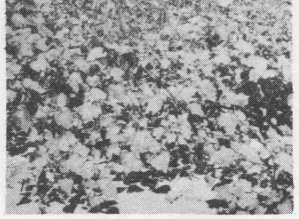
Sandburs in legumes may be controlled in the young stage as described under "seedling legume stands and seedling grass-legume mixtures" and under "established stands of perennial legumes." The only known practical control methods in stands of other grasses are cultivation and stimulation of the desirable grasses through proper management. Clean cultivation will be necessary for several seasons after seed production is stopped because new plants will grow several seasons from seed that do not germinate the first season after they are produced. Planting well-adapted grasses in a clean seedbed and then fertilizing and grazing them properly will help crowd out the sandburs. The best adapted introduced grasses will compete favorably with sandburs if given the chance.

Johnsongrass is a perennial grass that produces an abundance of seed that may cause problems in row crops following pastures in rotation. The grass is a valuable forage plant, and when it occurs in pastures it should be utilized as such. For this reason, chemical control is not suggested. Mowing will prevent seed production.

Figure 14. Vegetation areas in Texas.



BASKETFLOWER



COCKLEBUR

PINEWOODS CONEFLOWER

CROTON (GOATWEED)

TABLE 1. COMMON CULTIVATED PASTURE WEEDS IN TEXAS

Common name[1]	Botanical name[2]	Length of life[3]	Growing season[4]	Areas found[5]	Response to 2,4-D[6]	Control method[7]
GS:						
ter	Aster spp.	A & P	C & W	1-2-3-4-5-6-7-8-9-10	I-R	4-5
emone	Anemone spp.	P	C	1-2-3-4-5-6-7-8-9-10	I	4
straw	Galium spp.	A & P	W	1-2-3-4-5-6-7 10	I-R	4-5
erweed ee sneezewood)						
lderpod	Lesquerella spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	S-I	2-4
ldersenna	Colutea arborescens	P	W	1 3-4-5	I-R	5
t	Houstonia spp.	A & P	C & W	1-2-3-4-5-6-7-8-9-10	I-R	4-5
yweed inge sunflower)	Helianthus ciliaris	P	W	7-8-9-10	I	4
nweed	Gutierrezia spp.	A	W	2-3-4-5-6-7-8-9-10	I	2
lobur	Solanum rostratum	A	W	2-3-4-5-6-7-8-9-10	R	5
ettle	Cnidoscolus spp.	P	W	1-2-3-4-5-6-7	I-R	4-5
dleflower	Desmanthus spp.	P	W	1-2-3-4-5-6-7-8-9-10	I	4
lover, Calif.	Medicago hispida	A	C	2-3-4-5	S	1
lweed	Soliva spp.	A	C	1-2-3-4-5-6	I-R	4
sage	Franseria spp.	P & A	W	3-4-5-6-7-8-9-10	I	4
ercup	Ranunculus spp.	A	C & W	1-2-3-4-5-6-7 10	I-R	2
top	Kallstroemia spp.	A	W	3-4-5-6-7-8-9-10	S	1
omile, mayweed	Anthemis cotula	A	W	1 3-4-5	I-R	5
phorweed	Heterotheca subaxillaris	A	W	2-3-4-5-6-7-8-9	I	2
petweed	Mollugo spp.	A	W	1-2-3-4-5-6-7-8-9-10	I	2
rot (incl. wild southwestern)	Daucus spp.	A	C	1-2-3-4-5-6-7-8-9	R	5
taurea (starthistle, cl. basketflower d cornflower)	Centaurea spp.	A	W	2-3-4-5-6-7 10	I	2
ll-flower (incl. ligatorweed)	Alternanthera spp.	P	W	2-3-4-5-6-7 10	S-I	3-4

MON NAMES—The most generally accepted common names are listed in alphabetical order. Names following in parentheses other common names often used for the same plant; common names of other plants in the same genus; or, in a few cases they te whether the plants are annual or perennial when one common name is listed twice.

NICAL NAMES—The Latin name for the genus only is given in most cases, followed by "spp." which indicates that more than pecies is included in the group; when two Latin words are used, such as **Diodia teres,** only one species is included.

TH OF LIFE—"A" indicates that the plants referred to here are mostly annual, coming from seed, producing seed and dying in r or less; "P" indicates that the plants referred to here are mostly perennial, producing new growth at the beginning of each ng season from rootstocks or crowns. In a few cases, groups listed include both annuals and perennials.

WING SEASON—"W" indicates that the plants listed make most of their growth and bloom during the warm part of the year; "C" tes that most growth and flowering are during the cool season.

S FOUND—Numbers in this column refer to plant areas shown on the map, page 10, taken from Texas Agricultural Experiment n M.P. 240, prepared by F. W. Gould.

PONSE TO 2,4-D—"S" indicates that the plants are susceptible to and easily controlled with 2,4-D; "I" indicates that plant nse is intermediate between susceptible and resistant; "R" shows the plants resistant to the herbicide; and "S-I" or "I-R" tes a range of response, the plants being more susceptible when young or that the annuals are more susceptible than the nials.

TROL METHOD—Numbers in this column refer to the specific, numbered suggested methods of control listed on pages 15-16.

CURLY DOCK

ERYNGO
(STAR THISTLE)

GOATHEAD

ROSERING GAILLARDIA

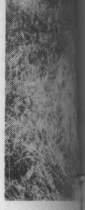


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TABLE 1. COMMON CULTIVATED PASTURE WEEDS IN TEXAS—(continued)

Common name[1]	Botanical name[2]	Length of life[3]	Growing season[4]	Areas found[5]	Response to 2,4-D[6]
Chickweed	Cerastium spp.	A & P	C	1-2-3-4-5 7 10	I-R
Clustervine, hairy	Jacquemontia tamnifolia	A	W	1-2-3-4-5	S
Cocklebur	Xanthium spp.	A	W	1-2-3-4-5-6-7-8-9-10	S
Coneflower	Rudbeckia spp.	P & A	W	1-2-3-4-5-6-7-8-9	I
Coreopsis	Coreopsis spp.	A & P	W	1-2-3-4-5-6-7 10	I
Corncockle	Agrostemma githago	A	W	2-3-4-5	I-R
Cottonflower, wooly	*Gossypianthus lanuginosus*	P	W	6-7-8-9	I-R
Croton (incl. goatweed)	Croton spp.	A & ?	W	1-2-3-4-5-6-7-8-9-10	I
Dalea	Dalea spp.	A & P	W	1-2-3-4-5-6-7 10	I
Datura (incl. jimsonweed)	Datura spp.	A	W	2-3-4-5-6-7-8-9-10	S
Dandelion	Taraxacum spp.	P	C	1 3-4-5 7-8-9	I
Deathcamas	Zygadenus spp.	P	C	3-4-5 7 10	R
Devilsclaws	Martynia spp.	A	W	1-2-3-4-5-6-7-8-9-10	I-R
Dichondra (ponyfoot)	Dichondra spp.	P	W	1-2-3-4-5 7 10	S-I
Dock (sorrel)	Rumex spp.	A	C & W	1-2-3-4-5-6-7-8-9-10	S
Dock (sorrel)	Rumex spp.	P	C & W	1-2-3-4-5-6-7-8-9-10	S-I
Dodder (lovevine)	Cuscuta spp.	A	W	1-2-3-4-5-6-7-8-9-10	I
Dogfennel eupatorium	Eupatorium capillifolium	P	W	1 3-4-5	I-R
Dwarf-dandelion	Krigia spp.	A & P	W	1-2 6	S
Englemanndaisy	Englemannia pinnatifida	P	W	3-4-5-6-7-8-9	I
Eupatorium (thoroughwort, boneset)	Eupatorium spp.	P	W	1-2-3-4-5-6-7-8-9-10	I-R
Euphorbia (spurge—for annuals see spurge)	Euphorbia spp.	P	W	1-2-3-4-5	I-R
Eryngo (Eryngium and starthistle)	Eryngium spp.	P	W	1-2-3-4-5-6-7-8-9-10	S
Eveningprimrose (sundrops)	Oenothera spp.	A & P	C & W	1-2-3-4-5-6-7-8-9-10	S
Filaree (alfileria, storksbill)	Erodium spp.	A	C	3-4-5-6-7-8-9-10	R
Fleabane	Erigeron spp.	P & A	W	1-2-3-4-5-6-7-8-9-10	S-I
Fogfruit (frogfruit)	Phyla spp.	P	W	2-3-4-5-6-7-8-9-10	S-I
Gaillardia (firewheel, Indian sunburst)	Gaillardia spp.	A	W	1-2-3-4-5-6-7-8-9-10	I
Gaura	Gaura spp.	P	W	1-2-3-4-5-6-7-8-9-10	I
Gayfeather	Liatris spp.	P	W	1-2-3-4-5-6-7-8-9	I
Geranium (cranesbill)	Geranium spp.	A	C	1-2-3-4-5-6-7-8-9	R
Gerardia	Gerardia spp.	P & A	W	1-2-3-4-5 7-8-9	R
Goathead (puncture-vine, heelbur)	Tribulus terrestris	A	W	1-2-3-4-5-6-7-8-9-10	S-I
Goatweed—see croton					
Goldaster	Chrysopsis spp.	P	W	1-2-3-4-5-6-7-8-9-10	R
Goldenrod	Solidago spp.	P	W	1-2-3-4-5-6-7-8-9-10	I
Greeneyes	Berlandiera spp.	P	W	1-2-3-4-5-6-7 10	S-I
Groovebur	Agrimonia spp.	P	W	1-2	R
Groundcherry	Physalis spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	R

TABLE 1. COMMON CULTIVATED PASTURE WEEDS IN TEXAS—(continued)

Common name[1]	Botanical name[2]	Length of life[3]	Growing season[4]	Areas found[5]	Response to 2,4-D[6]	Control method[7]
roundsel	Senecio spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	I	2-4
umweed	Grindelia spp.	P	W	2-3-4-5-6-7-8-9-10	S	3
dgehyssop	Gratiola spp.	A & P	W	1-2-3-4-5-6	R	5
liotrope	Heliotropium spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	S	1-3
nbit (deadnettle)	Lamium amplexicaule	A	C	1-2-3-4-5-6-7-8-9	S	1
arhound, common	Marrubium vulgare	P	C & W	3-4-5-6-7-8-9-10	I-R	4
rsemint (beebalm)	Monarda spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	S	1-3
rsenettle, Carolina (nightshade)	Solanum carolinense	P	W	1-2-3-4-5 7	R	4-5
acinthbean	Dolichos lablab	A	W	1-?	I	2
digo	Indigofera spp.	P	W	1-2-3-4-5-6-7 10	I	4
nweed	Vernonia spp.	P	W	1-2-3-4-5-6-7-8-9-10	I	4
perleaf (polyprim)	Polypremum procumbens	P	W	3-4-5-6-7		
tweed (smartweed)	Polygonum spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	I	2-4
hnia (false boneset)	Kuhnia spp.	P	W	3-4-5 7-8-9	I-R	4
mbsquarters (and ther goosefoots)	Chenopodium spp.	A	W	1-2-3-4-5-6-7-8-9-10	S-I	1-2
stdaisy	Chaetopappa spp.	A	W	1-2-3-4-5-6-7 10	I-R	2-5
ce (incl. prickly l.)	Lactuca spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	S-I	1-3
low	Malva spp.	A	W	1-2-3-4-5-6-7-8-9-10	I	2
shelder (sumpweed)	Iva spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	S	1
icanclover	Richardia spp.	A & P	W	1-2-3-4-5 8-9	S	1-3
icanweed (Japanese ur. birdeye, caperonia)	Caperonia palustris	A	W	2	S-I	1-2
thistle	Silybum marianum	A	C	? 3-4-5 ?	I	2
tvetch (loco)	Astragalus spp.	P & A	C	1-2-3-4-5-6-7-8-9-10	I	2-4
rweed	Asclepias spp.	P	W	1-2-3-4-5-6-7-8-9-10	I-R	4-5
rwort	Polygala spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	I	2-4
rningglory (annual)	Ipomea spp.	A	W	1-2-3-4-5-6-7 10	S	1
rningglory (perennial)	Ipomea spp.	P	W	1-2-3-4-5 10	S	3
stard (rape, cauliflower)	Brassica spp.	A	C	2-3-4-5-6-7	S	1
le (annual)	Urtica spp.	A	W	2-3-4-5-6-7 10	S	1
le (perennial)	Urtica spp.	P	W	1 3-4-5-6 8-9-10	S	3
tshade (incl. silverleaf)	Solanum spp.	P	W	1-2-3-4-5-6-7-8-9-10	S-I	4
on (garlic)	Allium spp.	P	C	1-2-3-4-5-6-7-8-9-10	I	4
lis (wood sorrel)	Oxalis spp.	A & P	C	1-2-3-4-5-6-7-8-9-10	R	5
yedaisy	Chrysanthemum leucanthemum	P	W	1 3-4-5	I-R	4-5
tbrush	Castilleja spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	I-R	4
henium (feverfew)	Parthenium spp.	A & P	W	1-2-3-4-5-6-7 10	I	2-4
idgepea	Cassia spp.	A	W	1-2-3-4-5-6-7	I	2
rillower	Stylosanthes spp.	P	W	1-2-3-4-5	I	4
stemon (beard-tongue)	Pentstemon spp.	P	C	1-2-3-4-5-6-7-8-9-10	R	5
nia, wild	Petunia parviflora	A	W	3-4-5-6-7 10	S	1
perweed	Lepidium spp.	A	C	1-2-3-4-5-6-7-8-9-10	S	1
weed (carelessweed)	Amaranthus spp.	A	W	1-2-3-4-5-6-7-8-9-10	S-I	1-2

SENETTLE

MILKWEED

SILVERLEAF NIGHTSHADE

PRICKLEPOPPY

RUSSIANTHISTLE

BITTER SNEEZEWEED (BITTERWEED)

SNOW-ON-THE-PRAIRIE

SUNFLOWER

TALL THISTLE

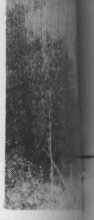


TABLE 1. COMMON CULTIVATED PASTURE WEEDS IN TEXAS—(continued)

Common name[1]	Botanical name[2]	Length of life[3]	Growing season[4]	Areas found[5]	Response to 2,4-D[6]
Plantain	Plantago spp.	A	W	1-2-3-4-5-6-7-8-9-10	S
Plantain, buckhorn	Plantago lanceolata	P	W	2	S
Pokeberry	Phytolacca spp.	P	W	1-2-3-4-5-6-7-8-9-10	I
Poorjo (buttonweed)	Diodia teres	A	W	1-2-3-4-5-6-7	S
Portulaca (purslane)	Portulaca spp.	A	W	1-2-3-4-5-6-7-8-9-10	S-I
Prairie-coneflower	Ratibida spp.	P	W	1-2-3-4-5-6-7-8-9-10	S
Pricklepoppy	Argemone spp.	A	W	2-3-4-5-6-7-8-9-10	I
Ragweed (incl. bloodweed)	Ambrosia spp.	A	W	1-2-3-4-5-6-7-8-9	S
Ragweed, western	Ambrosia psilostachya	P	W	1 3-4-5-6-7-8-9	S
Rosinweed (not incl. yankeeweed)	Silphium spp.	P	W	1-2-3-4-5 7-8-9	S-I
Ruellia	Ruellia spp.	P	W	1-2-3-4-5-6-7-8-9-10	I
Rush	Juncus spp.	P	W	1-2-3-4-5-6-7-8-9-10	S
Rushpea	Hoffmanseggia spp.	P	W	3-4-5-6-7-8-9-10	I
Russian knapweed	Centaurea repens	P	W	10	I-R
Russianthistle	Salsola pestifer	A	W	6-7-8-9-10	S-early I-R late
Scurfpea (incl. Indian breadroot and wild alfalfa)	Psoralea escuelenta	P	W	1-2-3-4-5-6-7-8-9-10	I
Sedge (incl. nutgrass)	Carex, Cyperus & other spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	R
Senna (sennabean)	Cassia spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	S
Sesbania (tall indigo, coffeebean)	Sesbania spp.	A	W	1-2-3-4-5-6	S
Sensitivebrier	Schrankia spp.	P	W	1-2-3-4-5-6-7-8-9-10	I
Shepherdspurse	Capsella bursa-pastoris	A	C	1 3-4-5-6-7	S-I
Sida	Sida spp.	A	W	1-2-3-4-5-6-7-8-9-10	I-R
Skullcap	Scutellaria spp.	P	W	1-2-3-4-5-6-7-8-9-10	I
Snakecotton	Froelichia spp.	A	W	1-2-3-4-5-6-7-8-9-10	I
Sneezeweed (bitterweed)	Helenium spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	S-I
Snow-on-the-mountain	Euphorbia marginata	A	W	3-4-5 7-8-9-10	I-R
Snow-on-the-prairie	Euphorbia bicolor	A	W	1-2-3-4-5-6	I-R
Sowthistle	Sonchus spp.	A	C	1-2-3-4-5-6-7-8-9-10	S-I
Spiderling	Boerhaavia spp.	A & P	W	2-3-4-5-6-7-8-9-10	I
Spiderwort	Tradescantia spp.	P	C	1-2-3-4-5-6-7-8-9-10	S
Spurge (euphorbia—incl. mat, spotted & other prostrate spurges)	Euphorbia spp.	A	W	1-2-3-4-5-6-7-8-9-10	S-I
Starwort (incl. chickweed s.)	Stellaria spp.	A	C	1-2-3-4-5-6-7 10	S-I
Stickseed (beggars-lice)	Lappula spp.	A	W	3-4-5-6-7-8-9-10	S
St. Johnswort	Hypericum spp.	A & P	C	1-2-3-4-5-6-7 10	R
Summercypress, belvedere	Kochia scoparia	A	W	3-4-5-6 8-9	S
Sunflower (annual)	Helianthus spp.	A	W	1-2-3-4-5-6-7-8-9-10	S-I
Sunflower (perennial)	Helianthus spp.	P	W	1-2-3-4-5-6-7-8-9-10	I
Tephrosia (devils shoestring)	Tephrosia spp.	P	W	1-2-3-4-5-6 8-9	I
Thistle	Cirsium spp.	P (or bienn)	W	1-2-3-4-5-6-7-8-9-10	S-I
Tickclover (ticktrefoil)	Desmodium spp.	P	W	1-2-3-4-5-6-7-8-9-10	R

TABLE 1. COMMON CULTIVATED PASTURE WEEDS IN TEXAS—(continued)

Common name[1]	Botanical name[2]	Length of life[3]	Growing season[4]	Areas found[5]	Response to 2,4-D[6]	Control method[7]
...dflax (incl. ...tter-and-eggs)	Linaria spp.	A	C	1-2-3-4-5-6-7-8-9-10	R	5
...mpetflower ...rumpetcreeper)	Tecoma stans	P	W	1-2-3-4-5	S	3-4
...blemustard & others	Sisymbrium spp.	A	W	3-4-5-6-7-8-9-10	S	1
...us-lookingglass	Specularia spp.	A	W	2-3-4-5-6-7-8-9	I	4
...rbena	Verbena spp.	P & A	W & C	1-2-3-4-5-6-7-8-9-10	S-I	1-3
...dindigo	Baptisia spp.	P	C	1-2-3-4-5	I	4
...olywhite	Hymenopappus spp.	P	W	1-2-3-4-5-6-7-8-9-10	I	4
...nkeeweed	Eupatorium compositifolium	P	W	1 3-4-5-6	I	4
...SSES:						
...ley, little	Hordeum pusillum	A	C	2-3-4-5 7-8-9	R	6
...nyardgrass (cockspur)	Echinochloa crusgalli	A	W	1-2-3-4-5-6-7-8-9-10	R	6
...rmudagrass	Cynodon dactylon	P	W	1-2-3-4-5-6-7-8-9-10	R	7
...me, annual (including ...hess or cheat and ...scuegrass)	Bromus spp.	A	C	1-2-3-4-5-6-7-8-9-10	R	6
...bgrass	Digitaria sanguinalis	A	W	1-2-3-4-5-6-7-8-9-10	R	6
...segrass (silver ...bgrass)	Elusine indica	A	W	1-2-3-4-5-6-7-8-9	R	6
...grass, silver	Aira caryophylla	A	W	1	R	6
...songrass	Sorghum halepense	P	W	1-2-3-4-5-6-7-8-9-10	R	7
...plerice	Echinochloa colonum	A	W	1-2-3-4-5-6-7-8-9-10	R	6
...dlegrass	Stipa spp.	P	C & W	1-2-3-4-5-6-7-8-9-10	R	6
...dbur (grassbur)	Cenchrus spp.	A	W	1-2-3-4-5-6-7-8-9-10	R	6
...algrass	Brachiaria spp.	A & P	W	1-2-3-4-5-6-7	R	6
...kgrass	Eragrostis cilianensis	A	W	1 3-4-5 7-8-9-10	R	6
...eawn	Aristida spp.	A & P	W	1-2-3-4-5-6-7-8-9-10	R	6
...dlegrass (winter ...entgrass)	Agrostis hiemalis	P	C & W	2-3-4-5-6 8-9-10	R	6
...dmillgrass, tumble	Chloris verticillata	A	W	1 3-4-5 7-8-9	R	6
...chgrass, common	Panicum capillare	A	C & W	1-2-3-4-5 8-9	R	6
...chgrass, fall	Leptoloma cognatum	P	W	2-3-4-5-6-7-8-9-10	R	6

Information on special spray mixtures and methods to use for treating scattered infestations of serious perennial weeds in pastures may be obtained from county agricultural agents.

SUGGESTED CHEMICAL CONTROLS

Broad-leaved weeds and weedy grasses listed in Table 1 are classified susceptible, intermediate and resistant from the standpoint of response to 2,4-D. The control methods suggested in the last column of Table 1 refer to the numbered statements listed below. The controls suggested in this section are for the control of specific weeds. Before making application of a chemical to control a specific weed, see the section, "controls for specific situations," Pages 8-10.

1. *Susceptible annual broad-leaved weeds.* Consistently good control may be obtained with 2,4-D at rates from ½ to ¾ pound per acre when the weeds are small. Use the lower rate with 2,4-D low-volatile esters.

2. *Intermediate annual broad-leaved weeds.* Control is possible with 2,4-D at rates from ¾ to 1 pound per acre. Make applications during the early rapid growth stage. Careful application is necessary to obtain good control. Repeat the application if regrowth occurs. Mow when necessary to prevent seed production.

3. *Susceptible biennial and perennial broad-leaved weeds.* Good control may be obtained with 2,4-D at rates of ½ to 1 pound per acre. Make applications when the weeds are in the early bud stage or early rapid growth stage. Repeat the application if regrowth occurs. One or more applications each season for several years may be required for good control. Mow as necessary to prevent seed production.

4. *Intermediate biennial and perennial broad-leaved weeds.* Control with 2,4-D is variable. Use the material at the rate of ¾ to 1 ½ pounds per acre during the early bud stage or during early rapid growth stage. Complete kill of roots with a single application seldom is obtained. The higher rate should not be used when temperatures are high and when plants are in the early, rapid growth stage because some injury to the grass may result. Weed seed production should be prevented by mowing when needed.

5. *Resistant annual, biennial and perennial broad-leaved weeds.* Control with 2,4-D at rates low enough to be safe for forage plants is not feasible. Use cultural methods, including mowing.

6. *Resistant annual weedy grasses.* Use 5 to 7 pounds of sodium TCA in 25 to 30 gallons of water per acre when these weedy annual grasses occur in established stands of perennial legumes, in established perennial grass pastures or in seedling legumes. Applications should be made when the weedy grasses are very small. Use 2 to 4 pounds of dalapon in 15 to 25 gallons of water per acre when these weedy grasses become a problem in established stands of annual or perennial legumes. The dalapon should be applied when the undesirable grasses are in the seedling stage. Follow herbicide container label instructions concerning residue tolerances.

7. *Resistant perennial grasses.* The following treatments are suggested for use in controlling these grasses on cropland to be seeded to perennial legumes or grasses for seed production. For Bermudagrass use 10 pounds of dalapon in 40 to 50 gallons of water per acre. Apply the dalapon when the grass is growing and follow the application in 10 to 14 days with tillage. Some retreatment of scattered surviving plants will be necessary. Wait 5 to 7 weeks before planting treated areas. For spot treatment of scattered patches of Bermudagrass, use 1 pound of dalapon per 5 gallons of water and wet the leaves thoroughly. Pasture plants should not be sprayed with this mixture for it may injure them.

Johnsongrass should be treated when it is less than 8 inches high. Use 10 pounds of dalapon and 5 pounds of dry household detergent or 6 to 8 ounces of liq detergent in 100 gallons of water. When dalapon used, allow 5 to 7 weeks before planting treated are For a substitute control, use 1 quart of C-56 in 1 gallons of kerosene, or replace the C-56 with 1 quart selective dinitros. Additional information on control Johnsongrass is given in Texas Agricultural Experim Station Progress Reports 1955 and 1995.

SPRAYERS

TYPES OF SPRAYERS. Good weed sprayers f field use should be:

1. Well constructed for few maintenance problem
2. Easy to fill and clean.
3. Equipped with a pump of adequate capacity.
4. Easy to regulate.
5. Equipped with proper boom or nozzle to pro vide uniform coverage.

The boom and boomless sprayers, Figures 15 and 1 are in general use. Either type may be mounted direct on a tractor or trailer. Trailer-mounted units are mos desirable for larger acreages because larger tanks may b used that require less frequent filling. Tractor-mounte units generally are limited to about 100-gallon tan capacity. Trailer-mounted sprayers cost more and ar less maneuverable. Generally, spray volume output should be 10 to 25 gallons per acre for boom-type sprayers and 15 to 25 gallons per acre for the boomless type.

The advantages of boomless-type sprayers over boom-type sprayers are that they are:

1. Less expensive to build and maintain.
2. Usable in areas where brush and trees are too tall for use of the boom type.
3. More maneuverable around buildings, fences and roadways.
4. Adapted for use at greater speed.
5. Easier to mount or hitch, store and clean.

Disadvantages of the boomless-type sprayer as compared with the boom-type sprayer are:

1. They require a higher volume application of spray per acre for good coverage.
2. They give a poorer droplet distribution toward the edges of the spray swath, requiring that swaths overlap to avoid poor control. More accurate spray placement and more consistent weed kills are possible with the boom type.

3. The single nozzle is carried higher to allow swath width and the spray pattern is more subject to deformation by wind.

Boomless sprayers equipped with wide-swath nozzles are very effective when properly used, but their limitations should be observed carefully. Poor spray droplet distribution at the outer edges of the spray swath is one limitation that can be corrected to some extent by overlapping spray swaths several feet. Higher spray volume output will also help overcome this limitation by increasing droplet numbers at the outer edges of the swath. Avoid operation of boomless sprayers on windy days. Operating pressures for both boom and boomless sprayers should be between 20 and 40 pounds per square inch. Excessively high pressures result in too small droplets that are more subject to drifting.

Extension Service Plan No. 441 gives details on a boomless-type sprayer and is available from county agricultural agents. Row crop sprayers may be converted for spraying pastures by removing drop pipes and replacing all nozzles with proper size nozzles as given in Table 2.

PUMPS. The pump is the heart of the sprayer and should be selected to give the desired discharge at the right pressure with a reasonably long life. The nylon roller pump mounted on and driven directly by the tractor power takeoff has proved most satisfactory. Diaphram pumps are sometimes used. Pumps with good ball bearings and good seals may cost slightly more than some but will require less maintenance. Be sure the pump has sufficient capacity under the desired pressure for the largest gallonage that you might want to apply. A formula for figuring pump

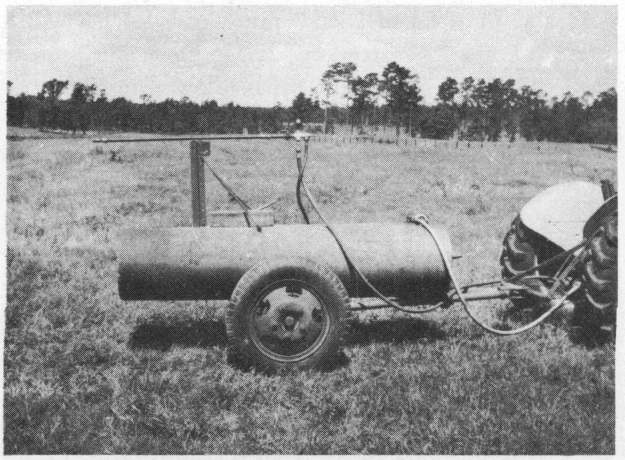


Figure 16. This shop-made boomless sprayer is satisfactory for most pasture spraying operations.

size in gallons per minute is: Gallons per minute $=$ $\frac{\text{Miles per hour x boom length x gallons per acre}}{495}$

For example: The discharge desired is 25 gallons per acre at 3 miles per hour with a 20-foot boom; g.p.m. $=\frac{3 \times 20 \times 25}{495} = 3.0$ g.p.m. This would be the minimum pump capacity for this rate of application for this sprayer at a given pressure. A pump with twice the capacity required should be obtained. Most power takeoff pumps are large enough to furnish the necessary volume and pressure.

PRESSURE REGULATORS AND GAUGES. A pressure regulator is necessary to maintain uniform pressure on the boom or on the wide-swath nozzle of the boomless sprayers. The regulator should be adjust-

Figure 15. A properly equipped boom-type sprayer gives the most accurate spray placement and consistent weed kills. (Photo courtesy of Century Engineering Corporation, Cedar Rapids, Iowa.)

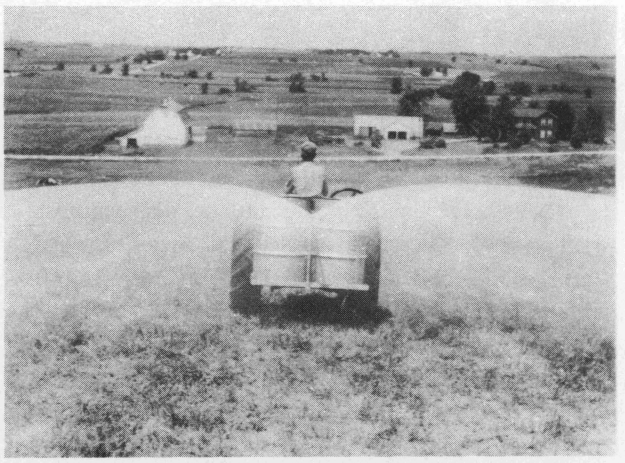


Figure 17. Boomless-type sprayers using a single wide-swath nozzle are more maneuverable, faster and easier to clean and store than the boom-type. (Photo courtesy of Century Engineering Corporation.)

able and of the ball check spring-loaded type with a pressure capacity exceeding 100 pounds per square inch. This type will allow bypass flow from the pressure side of the pump to return to the tank. Pressure regulators are necessary on positive displacement pumps to take care of the flow when flow to the boom is cut off. Pressure gauges are essential on properly rigged sprayers. The gauge tells the operator whether the pumping system is operating properly, and it is necessary for use in calibrating sprayers by the nozzle manufacturer's tables.

BOOMS. Black or galvanized pipe and light seamless tubing ¾ inch in diameter may be used for the boom. Booms should be well supported, easily adjustable for different spraying heights and hinged or attached so they will fold back when they strike an object.

NOZZLES. Nozzles with ¼ inch and ¾ inch pipe size couplings are available. Flat fan-type nozzles generally are used for herbicide application. This type gives a more uniform spray pattern and will function at lower pressures than the cone type. The nozzle body should contain an orifice tip and strainer. The sizes listed in Table 2 will be sufficient for most pasture weed control applications. Manufacturer's recommendations concerning nozzle spacing on booms, spraying height and nozzle fan angle should be followed closely. Tables 2 and 3 list several nozzle types for boom and boomless sprayers, along with spacing, operating pressures, speed of travel and gallonage per acre.

AGITATORS. Hydraulic agitation maintained by the excess spray mixture that is bypassed to flow back to the tank will be sufficient for maintaining proper mixture for most herbicide formulations used for application in pastures and meadows.

STRAINERS AND VALVES. Strainers save time for the operator and allow uniform spray patterns. Strainers are necessary for the collection of rust and undissolved materials to prevent nozzle clogging and to prevent wear on the pump and nozzle openings. A strainer with the approximate mesh size of window screen should be used on the tank opening. A strainer with a 50 to 80-mesh screen should be used in the suction line between the tank and pump. A third strainer located between the pressure regulator and boom is optional, but contributes much to more uniform, trouble-free spraying. Use nozzle strainers with check valves to prevent dripping and siphoning of spray material from the spray tank when the machine is left standing. A quick shut-off valve between the spray tank and the regulator should be used on both types of sprayers to avoid wasting spray and to prevent siphoning on the boomless type when the rig is stopped. The nozzle strainers generally are furnished on all sprayers except on the boomless type using the wide-swath nozzles, which should be 50 to 100 mesh, depending on nozzle orifice size.

SPRAYER CALIBRATION. A sprayer must be calibrated properly so that the discharge rate is known. Size of nozzle, operating pressure, forward speed and nozzle spacing on the boom affect the volume that a sprayer will discharge. Variation in any of these factors may change the rate of application to the extent that poor weed control is obtained or that the crop is damaged.

Three methods may be used to determine the output of a sprayer in gallons per acre. The first method is by use of nozzle manufacturer's tables which give gallons per acre subject to nozzle size, pressure and forward speed. Tables 2 and 3 list nozzle sizes which are suitable for most pasture and meadow spraying operations. When nozzle manufacturer's tables are used for determining sprayer output, the sprayer should be calibrated at least once each season by one of the following methods.

The second method of calibrating a sprayer is by operating it over a measured distance of 200 feet and calculating the amount discharged on a per-acre basis. Put enough water into the sprayer to fill the system. Operate the sprayer until the water is sprayed out uniformly. Stop the pump and drain out any water remaining in the tank. Then put a measured quantity of water into the sprayer. Operate the sprayer over the measured 200-foot run at the desired speed. Stop the sprayer, drain and measure the remaining water. Subtract this amount from the original measured amount placed in the sprayer. The gallons-per-acre output can be calculated by inserting the figure for the amount sprayed in a 200-foot run in the following formula:

$$\text{Gallons per acre} = \frac{(\text{gallons sprayed per 200 ft.})\,(217.8)}{\text{boom length or spray swath width}}$$

Example: 2 ¼ gallons are sprayed in a 200-foot run from a 30-foot boom (or from a wide-swath nozzle on a boomless sprayer that covers a 30-foot swath).

$$\frac{2.25 \times 217.8}{30} = \frac{490}{30} = 16.33 \text{ gallons per acre}$$

The third method of calibrating a boom or boomless-type sprayer is by operating it over a measured distance

TABLE 2. FOR BOOM-TYPE SPRAYERS.

Capacities are given in gallons per acre at various rig speeds and liquid pressures based on concentrated 2,4-D and water solutions at 70 degrees F., nozzles spaced 20 inches apart on the boom and a spraying height of 20 to 22 inches.

Nozzle No.	Liquid pressure in p.s.i.*	Gallons per acre				
		2 m.p.h.**	3 m.p.h.	4 m.p.h.	5 m.p.h.	7.5 m.p.h.
1/4T65015	20	15.7	10.5	7.8	6.3	4.3
1/4TT65015	25	17.5	11.7	8.8	7.1	4.7
100-mesh	30	19.2	12.9	9.7	7.7	5.2
screen	35	20.7	13.9	10.4	8.3	5.6
	40	22.2	14.9	11.1	8.9	6.0
	50	24.8	16.7	12.4	10.0	6.7
1/4T6503	20	31.5	20.9	15.7	12.6	8.4
1/4TT6503	25	35.1	23.4	17.6	14.1	9.4
50-mesh	30	38.4	25.8	19.3	15.4	10.3
screen	35	41.6	27.8	20.8	16.6	11.1
	40	44.5	29.6	22.2	17.8	11.8
	50	49.8	33.2	24.9	19.9	13.2

*p.s.i. = Pounds per square inch
**m.p.h. = Miles per hour

Information in this table courtesy of Spraying System Co., Bellwood, Illinois.

TABLE 3. WIDE-SWATH NOZZLES FOR BOOMLESS-TYPE SPRAYERS.

Tabulation is based on spraying water at a temperature of 70 degrees F. and coverages are based on rig being in motion at speeds listed with nozzle 36 inches above ground level.

Wide-swath Nozzle No.	Liquid pressure in p.s.i.*	Capacity in g.p.m.**	Coverage in feet	Gallons per acre			
				2 m.p.h.***	3 m.p.h.	4 m.p.h.	5 m.p.h.
Single							
1/4 KLC-18	10	1.8	18	25	16.5	12.4	9.9
	20	2.5	20	31	21	15.5	12.4
	30	3.1	21	37	24	18.3	14.2
	40	3.6	22	41	27	20	16.2
Single							
42A	30		40		13.9	10.4	8.3
	40		40.5		15.9	11.9	9.5
	60		41		19.2	14.4	11.5
Boom jet	20	6.1	47	32	21	16.1	12.8
3030-3/4-2TOC20	30	7.5	50	37	25	18.5	14.7
3430-3/4-2TOC20	40	8.6	52	41	27	20	16.4
Cluster							
333	30		40		13.9	10.4	8.3
	40		40.5		15.9	11.9	9.5
	60		41		19.2	14.4	11.5

*p.s.i. = Pounds per square inch
**g.p.m. = Gallons per minute
***m.p.h. = Miles per hour

Information in this table courtesy of Spraying System Co., Bellwood, Illinois, and Century Engineering Corp., Cedar Rapids, Iowa.

nd calculating the amount discharged on a per-acre basis.

1. Measure the length of the boom in feet or measure swath width for boomless sprayers.

2. Divide the length of the boom or spray swath width into 43,560. This will give you the number of feet you will travel to cover one acre. For example, if the boom length or swath width is 20 feet, then:

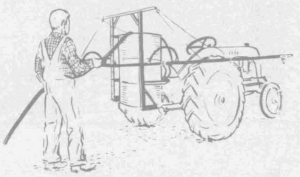
$$\frac{43{,}560}{20} = 2178 = \text{number of feet you will have to travel to cover one acre.}$$

3. Measure off the number of feet you need to travel.

4. Fill the sprayer tank full of water and spray the distance you have measured at a speed which can be maintained in the field.

5. Refill the tank, measuring the amount of water required. The number of gallons required to fill the tank is the number of gallons this particular sprayer is applying per acre.

6. Then, for example, if the sprayer is discharg 25 gallons per acre and you want to apply 1 quart chemical per acre, add 1 quart of chemical for e 25 gallons of water to be placed in the sprayer tank.



Care of Sprayers

The sprayer should be cleaned thoroughly after each spraying operation since many herbicides are corrosive, causing scale to form, in addition to damaging parts of the pump, pressure regulator and nozzles.

When 2,4-D esters or oil soluble materials have been used:

1. Rinse the sprayer system with kerosene.

2. Put in 1 to 2 pounds of washing soda to 30 gallons of water or 1 quart of household ammonia per 30 gallons of water.

3. Allow this to remain in the sprayer for several minutes. Then start the sprayer and circulate it through the system.

4. Drain the sprayer.

5. Rinse the sprayer again with water and drain.

When 2,4-D amines or other water soluble salts have been used:

1. Rinse the sprayer system with either 1 to 2 pounds of washing soda or 1 quart of household ammonia in 30 gallons of water. Allow the solution to stand in the sprayer for several minutes; start the pump and circulate it through the system. Then drain the sprayer.

2. Rinse the sprayer system with 6 to 8 ounces of liquid detergent in 30 gallons of water and drain.

3. Rinse the sprayer system with water and drain.

To prevent rust or corrosion, flush the sprayer system by pumping through it a solution of automobile radiator rust inhibitor in water (½ cup per gallon of water) and drain. Kerosene or fuel oil will not prevent rust or corrosion.

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