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1964

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### Recommended Citation

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FS 181

CONTROL AND ELIMINATION OF

# Leafy Spurge

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## Leafy Spurge

Leafy Spurge<sup>1</sup> is a deep-rooted perennial weed that spreads by seeds and underground parts. It is one of the most serious weeds in South Dakota. It covers over 50,000 acres and causes 10 to 100% reduction in crop yield. The exact amount depends on the intensity of the stand and fertility and moisture conditions. It is more difficult to eliminate than Canada thistle, perennial sowthistle, field bindweed, and hoary cress, but not as tough as Russian knapweed.

The seeds are produced in 3-celled capsules which explode when ripe and spread the seeds 12 to 15 feet in each direction. The seeds are carried down draws by water and can be distributed by birds, animals, or man.

After the seed germinates, the plant develops rapidly. It consists of a shoot, transition zone, and primary vertical root. The primary vertical root produces lateral roots and feeder roots. The laterals grow horizontally and then turn downward to form secondary vertical roots which in turn produce lateral and feeder roots. Adventitious buds formed on any of these roots extend to form stems which develop into shoots above ground. A mature plant is illustrated in figure 1. Most mature leafy spurge plants have one main shoot and 8 or 10 shoots developed from buds on lateral roots.

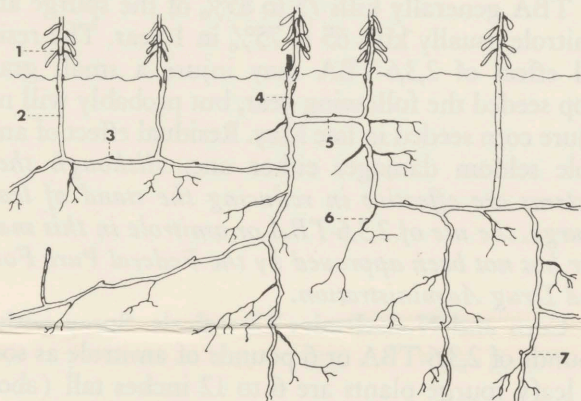


Figure 1. Diagram of a portion of a leafy spurge plant showing (1) shoot, (2) stem developed from bud on lateral root, (3) adventitious bud on lateral root, (4) primary vertical root, (5) lateral root, (6) feeder root, and (7) bud on vertical root 1½ feet below ground.

Adventitious buds are visible on the root of a 1-week-old seedling; but the bud of a 4-day-old seedling, grown under ideal conditions, is capable of producing a new shoot if the old shoot is removed. Buds are found on lateral roots less than 90 days after the seedling emerges. Crowns of buds, at or just below the soil line, are formed on the stems produced from lateral

roots and on the hypocotyl of the main axis of the plant. They produce new shoots if top growth is removed.

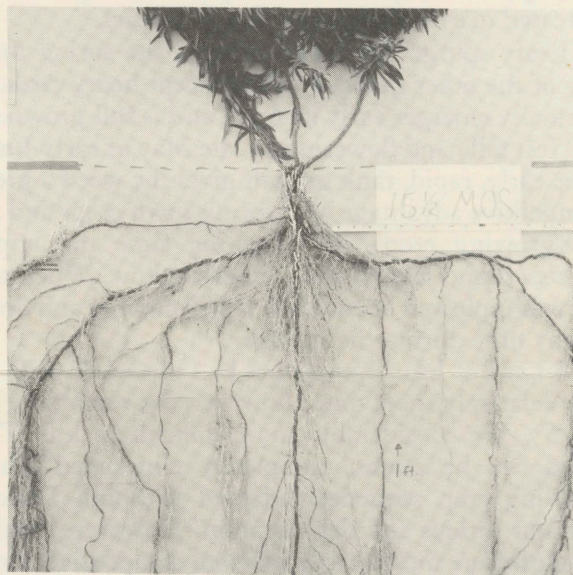


Figure 2. A 15½-month-old leafy spurge seedling showing shoot, primary vertical roots, lateral roots, secondary vertical roots, and feeder roots. Adventitious buds formed on the crown at soil level and on all vertical and lateral roots.

After 15½ months of growth one seedling (figure 2) produced a primary vertical root 5½ feet long with 276 buds (figure 3), 32 feet of lateral roots, and 70 feet of branch roots with a total of 1440 adventitious buds. Buds have been found on roots all the way down to a depth of 6 feet. In one case, these buds produced stems that grew through 2 feet of tamped soil in 12 months and through 3 feet of soil in 2 years.

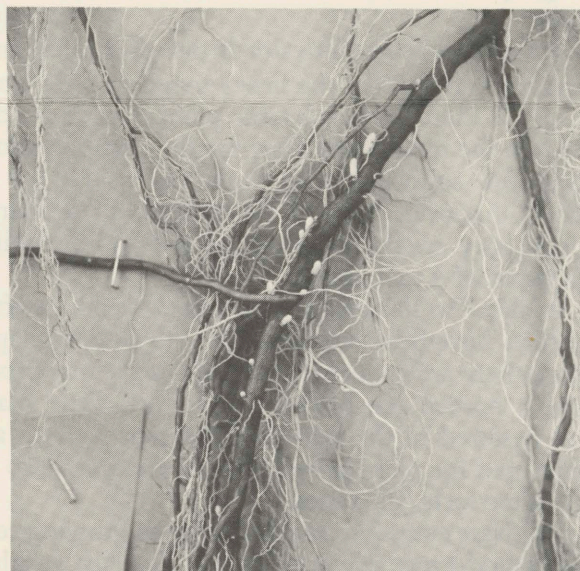


Figure 3. Adventitious roots on primary vertical root of 15½-month-old seedling shown in figure 2.

<sup>1</sup>*Euphorbia esula* L.

In one case extending over 4 years a seedling grown in a denuded area produced shoots that occupied an area 18 feet in diameter with lateral roots extending to 24 feet. Roots of mature plants reach a depth of 8 feet and probably more. In another case 7 plants increased to 872 plants in 3 years, while a patch of 7 square feet increased to over 2700 square feet in 5 years.

Leafy spurge develops earlier in the spring than any of the other noxious weeds except hoary cress. It normally emerges early in April and is full grown (1 to 3 feet tall) and flowering by late May or early June. This early, rapid, rank growth gives the weed a great competitive advantage over spring-sown crops and all low-growing crops. At flowering time the upper bracts (round leaves) are greenish-yellow. When top growth is plowed or cut back, it will emerge and flower any time during the summer.

Stands of leafy spurge can be reduced 75 to 90% in a relatively short time; however, the remaining 10 to 25% are considerably more difficult to kill. The weed can be almost completely eliminated while growing crop sequences adapted to South Dakota without serious soil deterioration. However, continuous pressure must be exerted from competitive crops, cultivation, or chemicals for a period of 3 to 5 years.

#### **REDUCE STANDS 75 TO 90%**

There are combinations of cultivation, cropping, and chemicals that reduce the stand of leafy spurge 75% or more in 1 year.

**Intensive Cultivation.** Cultivation, from immediately after small grain harvest until freezeup (Oct. 15), followed with a full year of intensive cultivation (May 15 to Oct. 15) the next year, will kill a high percentage of the weeds. Sometimes there will be stragglers to clean up the next year. In other cases a single year of cultivation will kill 85 to 90% of the weeds.

A duckfoot field cultivator is one of the few implements that will cut the heavy tough roots of leafy spurge. If there is considerable plant residue on the area, use the moldboard plow for the first operation. Equip the cultivator with wide sweeps (12 to 24 inches) that overlap 3 to 4 inches. Keep them sharp; be sure they are flat when in the soil and operating at a depth of 4 to 5 inches.

It takes 7 to 10 days for new shoots to emerge after the roots have been cut. Another 7 to 10 days elapse before there are enough leaves to produce more food than is needed for growth. Therefore, little plant food is stored in the roots and the root reserves are being used for plant growth for a period of 14 to 20 days after each cultivation.

Cultivate every 2 weeks during good growing conditions and every 3 weeks during dry, hot weather when plants are growing less rapidly. This generally means that cultivation should be done at 2-week in-

tervals during May, June, and July and 3-week intervals during August, September, and October.

**Cultivation and Summer Crops.** Close-drilled crops of sudangrass or buckwheat are more strongly competitive than most other crops. Cultivate three times before seeding the crop during late June. Harvest the crop, fall plow, and cultivate once or twice. This system reduces the stand of spurge about 70 to 80% in 1 year. Close-drilled soybeans and forage sorghum should be equal to buckwheat and sudangrass.

**Cultivation and Forage Crops.** Cultivate with a duckfoot cultivator every 2 weeks between May 15 and August 15. Seed brome grass at the rate of 12 pounds per acre or alfalfa at the rate of 8 pounds per acre. The stand of spurge is generally reduced 80 to 90% by this system.

**Grain and Nonspecific Chemicals.** Spray in the grain with one-third to one-half pound of 2, 4-D ester when the grain is in the 5-leaf stage to hold the weeds in check until after harvest. (This treatment did not injure Mo-0-205 or Garry oats, or wheat in several experiments and probably will not damage barley.) Spray 2 weeks after harvest with 5 pounds of 2, 3, 6-TBA (2½ gallons of Trysben 200 or Benzac 1281) per acre or 6 pounds of amitrole (12 pounds of Weedazol or Amino Triazole) per acre. Plow 10 days after spraying with 2,3,6-TBA or 15 days after spraying with amitrole.

TBA generally kills 75 to 85% of the spurge and amitrole usually kills 65 to 75% in 1 year. The residual effect of 2,3,6-TBA may injure a small grain crop seeded the following year, but probably will not injure corn seeded in late May. Residual effect of amitrole seldom damages either one. *Although these systems are effective in reducing the stand of leafy spurge, the use of 2,3,6-TBA or amitrole in this manner has not been approved by the Federal Pure Food and Drug Administration.*

**Corn and Nonspecific Chemicals.** Spray with 5 pounds of 2,3,6-TBA or 6 pounds of amitrole as soon as leafy spurge plants are 6 to 12 inches tall (about May 10). Plow 10 days later and plant an early corn hybrid. Spray the corn with one-third to one-half pound of 2,4-D ester per acre 1 week after the first cultivation. Cultivate two or three times after spraying.

The 2,3,6-TBA generally kills 80 to 90% of the leafy spurge, but it may damage the corn. There was no damage in seven research tests, but 90% of the corn was killed in one trial when there was no rainfall between spraying and plowing. Amitrole generally kills 70 to 80% of the spurge, but does not damage the corn. *The Federal Pure Food and Drug Administration has not approved the use of these chemicals in this manner.*

**Grazing.** Grazing sheep will considerably reduce

the stand of spurge. Start grazing during early spring so that they develop a taste for the weed. Rotate cattle ahead of the sheep if the sheep do not keep the grass grazed. Heavy grazing will eliminate as much as 75 to 85% of the spurge in 1 year. Intensive overgrazing is required to eliminate the remaining plants and sometimes does not do it.

#### REDUCE STANDS 10 TO 20%

Several combinations of crops, cultivation, and 2,4-D spraying reduce the stands of leafy spurge 10 to 20% in 1 year.

**Small Grain and 2,4-D.** Leafy spurge starts early in the spring and gets ahead of spring-seeded grain. Use one-third to one-half pound of 2,4-D ester per acre when the grain is in the 5-leaf stage to prevent the weed from going to seed and also weaken some plants. The small grain gets ahead of the weed and holds it in check until harvest. Cultivate three or four times after harvest to kill some of the weakened plants. Stands were reduced about 10% in experimental tests by plowing 2 weeks after harvest and cultivating three times during September and early October with a duckfoot cultivator. However, it is believed that a sharp 24- to 30-inch sweep cultivator would be effective on the weed and leave a stubble mulch on the soil surface. This system is useful when included in a rotation which also includes systems that materially reduce the stand.

Winter grain has some advantage over spring grain in that it keeps the soil covered over winter and starts growth earlier in the spring. However, early fall seeding prevents late cultivation.

**Bromegrass and 2,4-D.** Spray in the grass with 1 pound of 2,4-D ester during early June and again in late August. This system reduced the stand of leafy spurge 10 to 15% each year. Consequently, this system alone requires considerable time to reduce the stand of leafy spurge materially and seldom gives 100% elimination. However, it is useful as a follow-up to a system that includes a season of cultivation prior to seeding the grass. It is expected that other sod forming grasses would be as effective as bromegrass in areas where they are adapted.

#### PREVENT SPREADING

**Crops and 2,4-D.** Two sprayings with 2,4-D in small grain or corn do not reduce the stand of leafy spurge but do keep it from spreading to any great degree. Spray in either crop with one-half pound of 2,4-D ester per acre. Spray small grain stubble 2 or 3 weeks after harvest or spray corn with a high-clearance sprayer, equipped with drop nozzles after the corn has tasseled. Use 1 to 1½ pounds of 2,4-D ester per acre.

**Alfalfa.** A good stand of alfalfa or alfalfa-grass mixture also prevents the weed from spreading. However, the weed starts growth in the spring ahead of the crop, and alfalfa seldom reduces the stand. One year of alfalfa or alfalfa-grass mixture is useful as a follow-up of the system that includes a season of cultivation and a fall seeding of the crop.

#### 4-YEAR PROGRAMS

Nine of 32 combinations of crops, cultivation, and 2,4-D spraying that were tested are given in table 1. Several methods that did not give satisfactory results are shown to illustrate the need for a year-around program each year.

Treatments 3, 5, 7, 8, and 9 are the best combinations because they keep pressure on the weed all year each year. Although 2,4-D was used several times in each 4-year treatment, intensive cultivation was used whenever possible. It is more effective, especially when trying to eliminate strains of the weed that are resistant to 2,4-D.

#### NONSELECTIVE HERBICIDES

Numerous chemicals can be used to eliminate patches (weed nurseries) with one treatment. Apply the chemical to a band 6 or 8 feet wide around the outside of the patch to kill roots that extend beyond the patch. Seedling growth may appear after 2 or 3 years. These young plants can be eliminated with a 2,4-D application. Many new nonselective chemicals do not cause permanent injury to perennial grasses, but will prevent crop growth for 2 or more years.

The following chemicals generally give 95 to

Table 1. The Average Percentage of Leafy Spurge Killed in 4 Years

Treat. No.	First year		Second year		Third year		Fourth year	
	Treatment*	% kill	Treatment*	% kill	Treatment*	% kill	Treatment*	% kill
1.	Cult—alfalfa	82	Alfalfa	81	Alfalfa	82	Corn 1/3 lb. and 1 lb.	81
2.	Cult—alfalfa	82	Alfalfa	81	Wheat 1/2 lb. and cult	92	Corn 1/3 lb. and 1 lb.	92
3.	Cult—brome	82	Brome 1 lb. and 1 lb.	95	Brome 1 lb. and 1 lb.	98	Corn 1/3 lb. and 1 lb.	92
4.	Cult—brome	82	Brome 1 lb. and 1 lb.	95	Wheat 1/2 lb. and 1 lb.	96	Corn 1/3 lb. and 1 lb.	90
5.	Cult—brome	82	Brome 1 lb. and 1 lb.	95	Wheat 1/2 lb. and cult	95	Corn 1/3 lb. and 1 lb.	98
6.	Oats—brome—1/3 lb.	62	Brome 1 lb. and 1 lb.	24	Wheat 1/2 lb. and cult	31	Corn 1/3 lb. and 1 lb.	39
7.	Oats 1/3 lb., cult	68	Cult—sudan	91	Wheat 1/2 lb. and cult	94	Corn 1/3 lb. and 1 lb.	98
8.	Cult—sudan	79	Oats 1/3 lb., cult	96	Wheat 1/2 lb. and cult	98	Corn 1/3 lb. and 1 lb.	97
9.	Cult—sudan—rye	90	Rye 1/2 lb., cult	94	Wheat 1/2 lb. and cult	89	Corn 1/3 lb. and 1 lb.	94

\*"Lb." refers to pounds of 2,4-D ester applied per acre and "cult" to intensive cultivation.

100% elimination when applied at the rates designated below. Rates are given in pounds, pints, or fluid ounces of commercial product for each square rod in table 2. Use the higher rates for summer application for those chemicals indicating a range of treatment rate.

### PREVENT REINFESTATION

Once the old leafy spurge plants have been killed, the seeds in the soil will produce new plants for several years. Reinfestation can be prevented while using common crop rotations. The annual application of 2,4-D required to control annual broad-leaved weeds kill leafy spurge seedlings. Several 4-year rotations and the number of plants per square yard are given in table 3.

Treatments 2 and 4 were effective because 2,4-D was applied each year. Treatments 6 and 8 were not effective because 2,4-D damaged the alfalfa and sweet clover the first year. Subsequent treatments did not kill all the plants that became established the first year. It is probable that treatments 6 and 8

would have been much more effective if the legume had not been damaged the first year. Treatments 1, 3, 5, and 7 were not effective because no 2,4-D was used.

### REDUCE STANDS IN SHELTERBELTS

Use AMS as suggested in table 2 to drastically reduce stands of leafy spurge growing in tree plantings. None of the other chemicals listed in table 2 should be applied closer to a tree than the "drip line."

To reduce stands 10 to 25% in 1 year, use 1½ lbs. 2,4-D acid equivalent per acre twice each season (early June and late August). Use very low volatile formulations of 2,4-D such as an emulsifiable acid formulation or an oil soluble amine formulation (Brand names "Weedone 638," "Emulsamine 3E," or "Dacamine.") To reduce stands 25 to 50% in one year, use Amitrole-T (brand names "Cytrol" or "Amitrol T") at 6 lbs. active ingredient per acre. Do not allow spray drift to contact leaves of trees; it will cause injury.

Table 2. Amount of Nonselective Herbicide Required to Kill Leafy Spurge

Chemical	Amount per square rod	Cost per square rod*	Amount per acre	Cost per acre
AMS (1) .....	4-6 lb.	\$1.44-2.52	—	—
"Altacide" .....	6-8 lb.	1.10-1.85	—	—
Sodium chlorate .....	5 lb.	0.87	—	—
2,3,6-TBA (2) .....	½ pt.	0.63	20 lb. (20 gal.)	\$100.00
Fenac (3) .....	½ pt.	0.52	15 lb. (10 gal.)	\$82.50
Borate-TBA Mixture (4) .....	1½ lb.	0.87	—	—
CBMM (5) .....	6-8 lb.	1.60-2.56	—	—
Picloram (6) .....	¼ fl. oz.	0.25	2 lb. (1 gal.)	\$40.00
TBP-2,4-D Mixture (7) .....	6½ fl. oz.	0.50	16 lb. (8 gal.)	\$80.00

\*Approximate retail cost of chemical for 1 square rod at lower rates for areas 10 to 15 square rods in size. Cost decreases for large areas and varies somewhat with local situations.

- (1) Brand Name "Ammate X"
- (2) Brand Names "Benzac 1281", "Trysben 200" (approved for use on noncropland—do not graze within 1 year).
- (3) Brand Name "Fenac" (Do not use treated forage for feed)
- (4) Brand Names "Benzabor", "Amoco Noxious Weed Killer", and "Coop-TBA Granules"
- (5) Brand Name "Chlorea"
- (6) Brand Name "Tordon 22K" (approved for use on noncropland only)
- (7) Brand Names "Tritac D", "Amoco Noxious Weed Killer D", and "TBP Liquid Weed Killer"

Table 3. The Average Number of Leafy Spurge Plants per Square Yard That Reinfested an Area After the Weed Had Been Eliminated

First year		Second year		Third year		Fourth year	
Treatment*	Plants per sq. yd.	Treatment*	Plants per sq. yd.	Treatment*	Plants per sq. yd.	Treatment*	Plants per sq. yd.
1. Oats .....	0.6	Oats .....	0.6	Wheat .....	1.8	Corn .....	3.8
2. Oats ¼ lb. ....	0.7	Oats ⅓ lb. ....	0	Wheat ½ lb. ....	0.3	Corn ⅓ lb. ....	0
3. Oats .....	0.6	Corn .....	0.3	Wheat .....	0	Corn .....	1.4
4. Oats ⅓ lb. ....	0.7	Corn ⅓ lb. ....	0	Wheat ½ lb. ....	0.3	Corn ⅓ lb. ....	0.1
5. Oats-alfalfa .....	0.6	Alfalfa .....	0.4	Wheat .....	2.0	Corn .....	4.3
6. Oats-alfalfa ¼ lb. ....	1.9	Alfalfa .....	1.0	Wheat ½ lb. ....	0.6	Corn ⅓ lb. ....	1.9
7. Oats-Sweet clover .....	0.6	Sweet clover .....	1.5	Wheat .....	1.5	Corn .....	4.7
8. Oats-Sweet clover ¼ lb. ....	1.9	Sweet clover .....	1.0	Wheat ½ lb. ....	1.4	Corn ⅓ lb. ....	1.6

\*2,4-D amine applied at ¼-pound rate, but 2,4-D ester applied at ⅓- and ½-pound rates.

Published and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914, by the Cooperative Extension Service of South Dakota State University, Brookings, John T. Stone, Director, U. S. Department of Agriculture cooperating.

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