Control of Perennial Weeds in Oregon
I went by the field of the slothful,
And by the vineyard of the man void of understanding;
And, lo, it was all grown over with thorns,
And nettles had covered the face thereof,
And the stone wall thereof was broken down.

—Proverbs 24.
Control of Perennial Weeds in Oregon

By

E. R. Jackman, Lawrence Jenkins,
C. A. Henderson, W. A. Holt, and H. G. Avery

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Control of Perennial Weeds in Oregon

By

E. R. Jackman, Lawrence Jenkins, C. A. Henderson, W. A. Holt, and H. G. Avery*

Purpose of Bulletin

The perennial weed is an insidious enemy that like a bad habit seems harmless until so entrenched that casting out is difficult. The first few patches seem lacking in ambition and content with their lot. They grow for years more or less unnoticed. Then all at once the landowner is aware of other patches, becomes alarmed, looks around and discovers to his dismay that several fields are pretty well covered. When they reach this stage of almost complete possession of a field, control is expensive and may be beyond the means of the owner. As a result, on several thousand acres in Oregon, crop production has been abandoned and the weeds and the mortgage are the only growing things on the farm. Yet control is easy and costs little if undertaken when the first small patch appears.

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It is the purpose of this bulletin to discuss control measures and to suggest battle formations for community wars on weeds. Those who do not recognize their enemies on sight, and wish to be able to do so, may find pictures and descriptions of some of the worst of the perennials in separate leaflets, listed on page 71.

Although annual weeds do plenty of damage, no attempt is made here to discuss them. This bulletin is limited to perennial weeds.

**Extent of Weed Infestation in Oregon**

No weed census has been taken in Oregon, but it is estimated that white top, morning-glory, Canada thistle, Russian knapweed, and quackgrass occupy an area equal to 1\(\frac{1}{2}\) per cent of the plowable land of the state. If this estimate were correct, then 1\(\frac{1}{2}\) per cent of the pro-

Morning-glories around the buildings of an Oregon farm.

duction from the plowed lands is a heavy tax to pay for the doubtful pleasure of the company of these five weeds. If all other perennial weeds were added, such as St. Johnswort, fern, death-weed, and blackberry, the tax rapidly mounts to proportions large enough to attract wide attention.

**The Valuable Ounce of Prevention**

Many Oregon farms are free of the worst perennial weeds. The most fertile source of weed infestations is impure seed. For example, ryegrass is seeded at one time or another on most Western Oregon farms. One out of every five samples of ryegrass carries with it a menace in the form of

Buy pure seed.
Canada-thistle seeds. Buckhorn is present in most red-clover seed. And many farmers in the Columbia Basin have bought seed wheat containing some rough dark seeds and later blamed birds for starting morning-glories on their farms. Avoid seed bargains and have each lot tested before buying. The man who boasts of beating local seed prices by sending away for some cheap seed seldom boasts about the fine dodder or white top or Canada thistle he later finds in his fields.

There may be plenty of weed seed in relatively pure seed. Canada thistle has 395,000 seeds per pound. If one buys red-clover seed 99 per cent pure, he is getting seed considered to be up to the commercial standard for good red clover. But if all of the 1 per cent of impurity should happen to be Canada thistle, and he plants 11 pounds of seed per acre, he is seeding almost exactly one Canada thistle seed on each square foot of his land.

Farm machinery is the next culprit in spreading weeds. When one plows through a morning-glory patch with a moldboard plow, he might as well put in time deliberately transplanting the roots of that aggressive weed. Hayracks, hay balers, and threshing machines all carry weed seeds. Truck beds and hayracks should be cleaned well after work on a neighbor's farm where bad weeds are present. Wherever possible disk-type plows should replace moldboard plows on farms having weeds with spreading root stalks.
Wind and water do their part in spreading weeds, and there is not much that the individual can do about it. Irrigation water can be deweeded in part by destroying the weeds at reservoir sites and along the canals and ditches, but high water in the Willamette or Santiam is beyond treatment by the individual. Community action is necessary.

White top on a state highway. Grading such weed patches in highway maintenance work results in spread of weeds. If sides of highways were seeded to aggressive grasses, most of such sources of infestation would be eliminated.

Weeds may be spread in droppings from animals. It is a common thing to hide the weeds more or less by converting weed-infested land into pasture. The work horses, sheep, and dairy cows then eat the weed seeds and spread them to other fields. The seeds of many of the really bad weeds will germinate after passing through farm animals.

Weeds are also spread through hay and screenings. White top in Eastern Oregon was brought into the state in impure alfalfa seed, but it has moved around mainly in hay. In the Columbia Basin, morning-glory goes to market with the wheat, but comes back again as screenings.

As the easiest way to keep out of jail is to commit no crime, the easiest way to avoid weed trouble is to keep the weeds off the farm. If they do get on, destroy them before they gain a real foothold.

**Weed Control Methods**

So far, there is no royal way to weed control. The weeds stubbornly refuse to abdicate unless stern and unrelenting methods are applied. These methods are expensive in either time or money or both.
1. CONTROL WITH SALT

About 1915, growers in Eastern Oregon began to use salt for morning-glory control. As first applications were not effective, larger amounts were used until the practice became standardized at 1\(\frac{1}{2}\) pounds per square foot. This is at the rate of 32\(\frac{3}{4}\) tons per acre. If salt can be obtained for $15 per ton, the cost per acre is $490. In addition to the prohibitive cost, the land is useless for about fifteen years in Eastern Oregon. In Western Oregon this period of nonproductiveness would probably be shorter because of the leaching action of rain. Growers who used this method are reminded by other growers that the cost is too high, but they commonly retort that they spent the money on small patches and have no morning-glories, whereas the neighbors did not spend it and have weeds all over the ranches. Other chemicals are now known that will do the job for less money.

Salt Costs Money but Kills Weeds

"My idea of the morning-glory situation here is like this. We have fooled away some valuable time and now we must pay for it. About 15 years ago I killed my weeds with salt. Am not having much trouble with weeds now. "Lots of seed has been scattered by combines going from foul to clean fields without being cleaned, and I think something should be done about selling seed grain raised on weed-infested fields.

(Signed) J. A. GASKILL
Imbler (Union County)"

2. CONTROL WITH OILS

Many growers report that they have killed thistles and dandelions by cutting them off below the surface of the ground and pouring or squirting Diesel oil, kerosene, or gasoline on them. This method is possible only on very small patches and is not entirely effective.

Many of the railroad right-of-ways have been sprayed with oil and later burned to prevent weed-seed formation. In Klamath County this method has also been used on roads and ditch banks. Diesel oil kills the tops of weeds, and so is effective on annuals, but most states report poor results on deep-rooted perennials. It is usually sprayed on weeds at the rate of 300 gallons per acre. The cost for materials
is about $20 per acre. This method is adapted to the control of such annuals as puncture vine, star thistle, and dodder.

Work in 1936 in Klamath County indicates that if the oil is put on perennials at the rate of 6 gallons per square rod (960 gallons per acre) and applied at blooming time with a high-pressure spray outfit, it may kill the roots to a depth of two feet. The method needs further experimental work. The cost is not so great as with chlorates for white top and Russian knapweed, but the method has no advantage in price for the control of other weeds that do not require so much chlorate. Compared with chlorates, however, it reduces fire hazard and can be used in locations where chlorates are ineffective, such as on steep slopes. Repeat applications can be made in following years if the weeds are not killed. There has been no opportunity to observe the effect on the soil of repeated applications of oil. Apparently one application has no permanently bad effect. Recent experience in Wasco County indicates that oil kills most seeds that it touches, and can therefore be used for spraying partly or wholly ripe weed patches to prevent spread of seed.

3. CONTROL WITH ARSENIC

For many years various arsenic-bearing sprays have been used. These were put out for the most part under trade names and were sold by advertising often more ingenious than truthful. Farmers found it hard to keep up with such remedies because if they complained to the salesmen about ineffective results, the reply was, “But our
product is different this year and better.” Arsenic, as formerly used, was usually in the form of sodium arsenite. It killed the tops and occasionally killed the roots also, but results were erratic. Sodium arsenite, however, is a soil sterilent when enough of it is used. From

Spraying puncture vine with oil along highway in Malheur County. The dead vines were later burned. This method is cheap and effective for annual weeds like puncture vine. For perennial weeds the oil dosage must be increased to 6 gallons per square rod and results are not entirely sure.

3 to 5 pounds per square rod has often proved satisfactory. Railroads formerly used this spray in Oregon and many other states, and sodium arsenite weed killers are still on the market. The sprayed vegetation is extremely poisonous to animals and apparently attractive to them. Many farmers in this state have lost livestock in this manner. Recent work in California* has shown that arsenicals mixed with acid have a place as weed killers. The California workers say that if the spray is applied after dark in dry weather at a time when soil moisture is

practically depleted and plant growth has stopped, it is effective on some weeds, especially Russian knapweed and morning-glory. It has been ineffective on white top. To expect any degree of success with this method, it must be applied when there is a water deficiency in the plant, and at a time when there is a large area of leaf surface. There may be times during the early growth of the plant when it has a water deficiency but when the leaf surface will be so small that not enough arsenic will be taken into the root system. Since application must be made at a time when evaporation losses are at a minimum, spraying at night is necessary.

A weed-control method developed in California* and used with success in Malheur County as a clean-up for scattered plants is as follows: Fill a glass jar with a dilute acid arsenic mixture and into it force the tip of a weed stem or branch. This practice is not effective on all weeds, but in some cases the weeds will gradually absorb the poison and die. The jars of course should remain with the weed tips in them until the plants are dead.

At least one prepared acid arsenical is on the market.

As the cost of arsenic is only a fraction of the cost of chlorate, this method needs thorough trial in Oregon. Numerous early trials here were largely failures with only an occasional success, but since then Dr. A. S. Crafts in California has discovered that the arsenic solution mixed with acid is effective if conditions are right and he has apparently worked out what those conditions are.

For fifteen years or more dandelions have been killed on the Oregon State College lawns by spearing the crowns with a stick dipped into an arsenic solution.

4. CONTROL WITH CARBON BISULPHIDE

Carbon bisulphide has important advantages over other chemicals for weed control. When used under right conditions, it is swift and the surest in action of any chemical available. It not only kills weeds, but also dooms worms and bugs, and the soil is not injured in any way. Many testify that for a year or two the treated patch is more productive than the other land. This chemical is tedious to apply and the cost of application is about $150 an acre—about one dollar per square rod.

In spite of the high cost, the use of carbon bisulphide is increasing because of its positive killing action. It has not given satisfactory kills on dry soils or those containing excessive moisture. Results are erratic on soils with

gravel subsoil and on soils with a water table within 18 inches of the surface. Certain extra-heavy gumbo types of soil require heavier treating, and even then satisfactory kills cannot be guaranteed. In Eastern Oregon on nonirrigated land the weeds quickly exhaust the soil moisture in the spring, so that carbon bisulphide has proved most effective if used early in the spring. It is ideal for small weed patches on irrigated land, because there the moisture can be controlled and the chemical can be applied at any time during the summer. The chemical works so rapidly that complete kills have been obtained in six weeks after treating, and a crop has been grown on the land that season after the area was plowed and worked up well to allow the gas to evaporate. It is generally considered a better plan, however, to leave the treated area undisturbed for the one season for observation and to give seeds near the top of the ground an opportunity to germinate.

Before treating any area, all weeds should be cut below their crowns and the tops raked and destroyed. Holes six to eight inches deep and eighteen inches apart should then be punched in the ground in rows. There should be eighteen inches between rows, and the holes should be staggered with those in the adjoining row. This practice makes the holes opposite in every other row. The holes should be about \( \frac{3}{4} \) inch in diameter. The area for five feet outside the last plant in the patch should be treated. Two ounces of carbon bisulphide should be poured into each hole and the opening then closed by tamping. The material forms a gas about 2\( \frac{1}{2} \) times heavier than air and the gas settles down through the soil, killing almost all forms of plant and insect life as it goes.

Activated carbon bisulphide is recommended by the manufacturer for weed-killing purposes. It is the same as the carbon bisulphide used for fumigating grain except that it has 5 per cent of activating ingredients, added to prolong the chemical's effectiveness by retarding evaporation from the soil. This activating agent makes the chemical amber colored instead of colorless, as is ordinary carbon bisulphide. Both forms of the chemical have a strong, rotten-egg-like odor.

*Carbon bisulphide is a very inflammable liquid.* The vapors given off by the chemical are toxic and should not be inhaled. The liquid should never be poured inside a warehouse or other building.
Because of rapid evaporation from the top three or four inches of soil, the plants rooted close to the surface may not be killed. It is therefore a wise precaution, before treating the area, to cut all plant growth below the crowns and rake it from the plot. If any new shoots come up, they should be destroyed immediately. A light application of sodium chlorate generally will take care of these, or they may be killed by running a blade weeder two or three inches under the surface. If the soil is likely to crack or dry it is wise to rake the surface and form a mulch over the treated area.

Large scale equipment for treating weeds with carbon bisulphide.
Photograph by Courtesy of Wheeler, Reynolds, and Stauffer, San Francisco.

Much of the success with carbon bisulphide depends on tamping the holes properly. A 4”x4” rounded for a handle on one end and tapered on the other makes a satisfactory tamp. The holes should be closed by striking each side with the tamp. Additional earth should then be shoved into the depressions and tamped thoroughly. A metal tamp should never be used because a spark may result from striking some stones in the soil and the carbon bisulphide in that hole may be ignited.

The manufacturers of carbon bisulphide have developed a prod for punching holes and a funnel with a measuring cup attached with a 2½-foot pipe running from the funnel for measuring and applying the liquid. Several manufacturers have tried to develop inexpensive equipment that would be more satisfactory, but in the case of all tried to date more
time was required to treat an area with them than with the equipment mentioned. For large-scale applications, tractor-drawn equipment has been perfected that will apply the chemical at the rate of 2½ acres or more a day. With this implement the machinery does all of the work, but the cost is too great for any ordinary group of farmers. A county might consider the purchase or lease of such equipment.

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D. E. Alexander Shoots White Top With Carbon Bisulphide

"We use carbon bisulphide on white top on our ranch near Merrill, Oregon."

"We got about a 100% kill by shooting the ground at 18-inch intervals, 8 inches deep, and about 3 feet beyond the plant with 2-ounce shots. We found that the shooting was much more effective if we made it just ahead of irrigation."

"This past season a sick plant or two showed up the first of the season. We treated those individual plants, and they did not show up any more the remainder of the season. I believe that we have a 100% kill.

(Signed) D. E. Alexander
Napa, California"

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5. CONTROL WITH CHLORATES

Farmers and chemical companies have spent a great deal of money hunting for the ideal weed-killing chemical. So far, sodium chlorate has come closest to it; other forms of chlorate are on the market but are not so effective as sodium chlorate. Under most conditions the chlorates will positively kill the weeds if enough of the chemical is applied. The exceptions to this rule are listed on pages 18-19.

When the chlorates were first used, it was thought that the killing of the plants resulted only from absorption of the material by the leaves of the plants. Attention was therefore given to the relative effectiveness of various concentrations, the use of proper spray nozzles, and the time of application. In 1929, this view was modified in Oregon because:

a. Digging in numerous sprayed plots showed that the roots were usually dead only as deep as the moisture had penetrated.
b. Spraying just before a rain or before irrigating resulted in the killing of roots, whereas summer spraying without rain often killed no roots at the time. After the winter rains, root killing occurred.

c. Plots with the tops hoed off before spraying showed as good kills as adjacent plots with full foliage.

d. Sprays applied in the late fall after the tops were completely killed by frost gave as good results as earlier sprays.

e. Use of dry chlorate gave as good results as sprays.

These observations led to the opinion that most of the killing was due to contact of the chlorate with the roots of the plants. All of the chlorate work in Oregon since 1929 has been based upon that assumption.

County agents in both Eastern and Western Oregon placed numerous trial plots in 1930 and 1931, applying various amounts of both of the chlorates at all seasons and by all methods. This work showed:

a. The concentration of the spray is of little importance. In practice, one pound of chlorate to a gallon of water is easy to use and to remember, but where water is scarce, less water is just as effective.

b. Atlacide is not so effective as sodium chlorate. If three pounds of sodium chlorate are required per square rod, four pounds of Atlacide are needed.

c. Weeds unplowed for several years are much easier to kill than those that have been cultivated.

d. Weeds in grain stubble are easier to kill than undisturbed patches in summer fallow.

e. Applications of chlorates in the dust form are as effective as sprays. Fertilizer spreaders can be used for applying sodium chlorate, but Atlacide gathers moisture and does not flow freely through a spreader. Most of the fire hazard to the operator is eliminated by using dry chlorate, but it is more difficult to get an even coverage of the material over all of the ground. If the chlorate is applied dry, top growth should be removed and the material should be put on during or shortly before the rainy season.

f. In Eastern Oregon on nonirrigated land, the chlorates penetrate only as the winter moisture goes down. Accordingly, fall applications are best.

g. On irrigated land, penetration can be secured at any time by giving a light irrigation, provided it can be done in such a
way that the chemical will be washed down and not away. Time of application is of little importance if the treated area can be sprinkled or otherwise irrigated in a way to get the chemical down to the roots.

h. In the Willamette Valley, application may be made from August to March, but in general fall treatments are better except in locations where winter rains or a high water table during winter months may leach most of the material from the soil. In such places March is a better time. If spring applications are made in Western Oregon they should be in very early spring so that rainfall will be adequate to carry the material to the roots. Spring applications are advisable on all very porous soils in Western Oregon.

i. In the Coast counties, where winter rains are very heavy, early spring treatments have the best chance to succeed.

j. Treatment is very seldom uniform enough to kill every root. A check-up or repeat treatment should be given the following year to catch missed plants.

k. On old morning-glory patches the ground is likely to be full of seeds. When these begin to grow, they should be cultivated. Some farmers have reported failure from chlorates when the failure was due entirely to reinfestation from seeds.

l. There is a great deal of difference in results on different soils. One cannot say, for example, that 3 pounds of sodium chlorate per square rod will kill morning-glories or any other weed. On some soils it will require only 2 pounds, and on some 5 or 6 pounds. Local trial plots are necessary on each soil type. In general, 3 pounds of sodium chlorate or 4 pounds of Atlacide per square rod should be used on all weeds except white top. Work at the Federal Weed Control Experiment Station at Genesee, Idaho, indicates that the three species of weeds grouped under the name white top vary greatly in their resistance to chlorate. See the county agent and identify the variety before using chlorate on white top. In general, sandy soils or free working loams require less chlorates than heavy or sticky soils.

m. If not enough chlorate is used the first year, white top plants seem to acquire resistance or immunity to the poison. In cases in Baker, Union, and Wallowa counties, where only two or three pounds per square rod were applied to white
top, later applications totaling as high as 25 pounds per square rod failed to kill.

n. Any condition which weakens the weeds previous to treating will make the chemical more effective. This weakening may be due to such things as prolonged droughts, pasturing, competition from hardy crops such as rye, or a previous year of cultivation.

o. Occasionally individual plants or strains are more resistant to chlorates than the average. These may need extra heavy dosages.

Treating white top with carbon bisulphide in Baker County. Plots at right treated with sodium chlorate at different rates November 22, 1936.

Since the chlorates appear to do most of their work by coming into contact with the roots, any condition which prevents this will prevent success with this method. Some of these conditions are:

a. Steep slopes where rain washes the chemical down the hills. Highway shoulders and steep banks of irrigation ditches are poor locations for chlorate treatment.

b. Very gravelly subsoils where water washes the chemical away before it can act.

c. Overflow areas.

d. Seepy or swampy locations.
Peat soils or strawstack bottoms or other locations where organic matter is so abundant that the chlorates act on it and decompose before they have a chance to get into the soil.

Areas with a fluctuating high water table.

Soils with such hard surfaces that rains run off rather than into them.

Sodium chlorate alone will not burn, but when mixed with organic matter of almost any kind and allowed to dry, it becomes inflammable—almost explosive in some cases. Atlacide is sodium chlorate mixed with other chemicals for the purpose of reducing this fire hazard. But in extremely hot weather when humidity is very low, it may cause fires also. Both are very dangerous if mixed with sulphur. An orchard spray outfit that has been used for lime-sulphur spraying should not be used for applying chlorates.

There have been several fires in the state, and a few people have been badly burned. It is impossible to convey to anyone who has not seen it, the speed with which a chlorate fire burns. Many spray-rig operators get their shoes saturated with the chlorate. No fire can occur as long as the shoes are wet, but when they dry, they may ignite merely from friction while walking. So far as the writers know, no one has been able to remove his shoes in such cases quickly enough to avoid serious burns.

Spray-rig operators should wear rubber boots and slickers and should change clothes immediately after spraying. Even rubber boots should be washed thoroughly after every spray job.

Buckets or milk cans of water should be part of the equipment on every spray job. If one’s clothing starts to burn, injury may be prevented if someone has enough presence of mind to drench the flames with water. The quickest and most effective way to put out a fire around a spray rig is to turn the hose on the fire. The chemical cannot burn when in solution. A fire extinguisher should also be part of the equipment for use in case the spray machinery should start to burn when the engine is not running.

Spraying should always be done by two or more men. A single operator may become careless if he has no fire for a month or two and may allow clothes wet with spray to become dry. A lighted match or even friction from walking may result in enveloping him suddenly in flames. If he has a companion to dash water over him at once, results may not be serious, but if he is alone, he cannot ordinarily remove his clothes fast enough to prevent painful injury, or even death.
Such accidents are entirely unnecessary if the precautions given in this bulletin are observed, but many people become careless and take chances.

Do not smoke or light matches while wearing clothes used during spraying.

The use of dry sodium chlorate will do away with most of the risk, but not all of it. Postponing spraying until cool fall weather will also cut the fire hazards. The use of Atlacide instead of sodium chlorate may reduce fire danger, but does not eliminate it, especially in hot weather with very low humidity.

Chlorates should not be stored in buildings with wooden floors or in buildings with hay dust or other organic matter on the floors. Cans rust through quickly, allowing the chlorate to leak on to the floor. In measuring material from a can, some is usually spilled. This may work into a wooden floor or become mixed with hay dust and may remain there to cause the loss of farm buildings years later. For the same reason, the chlorates should not be measured out from truck beds or from automobiles. Store the cans away from farm buildings and open them on the ground.

Everything that has been said about the easy burning of clothes saturated with spray and allowed to dry applies with equal force to weed tops killed by chlorate spray. Such material is as dangerous to have around as gunpowder would be, sprinkled over the same area. Numerous fires have occurred in this state, and several buildings have been burned, because of summer spraying of weeds. Pieces of glass and tin cans, which concentrate the sun's rays, have set fire to several patches. Owners, eager to know the effect of the spray, have walked through dead patches, and fire has suddenly flared into existence around them, merely from friction between their shoes and the dead tops.

Of course, such burning has a drawback beyond the danger to people, buildings, and crops. If a weed patch burns after spraying, the work and expense are wasted. The chlorate remaining in the dead tops will wash down into the soil and be useful in root killing, but if it goes up in smoke, the spraying will do little if any good. To avoid this danger, stay out of sprayed areas or else spray late in the fall when weather is cool and moisture is in the air.
Because of this danger some may be frightened away from chlorates. The point to remember is that there is danger if handled improperly. They are no more dangerous than gasoline. Most people drive cars, but those are eliminated who peer into gasoline tanks by the light of a match.

Field tour in Deschutes County inspecting demonstration weed-control plots. Note orchard trees in background killed by use of chlorates near the trees.

It is not safe to use chlorate sprays in orchards, unless one does not care much about his trees anyhow. As the material is carried downward by rain, it kills all roots as it goes. Roots of a tree are just like weed roots to it. If chlorates are used on one side of a tree, the roots on that side may be killed without apparent damage to the top growth, but dead and rotting roots of course weaken the trees.

Where chlorates are used in ordinary amounts (three or four pounds per square rod) the soil is useless for lengths of time varying with the rainfall and soil texture. In the Columbia Basin, where rainfall varies from 10 to 14 inches, crops cannot be grown on the treated areas for about 6 years as a rule. In the lighter-rainfall areas, the time may be extended to 8 years. In Western Oregon the patches remain bare only 3 years or less, and under irrigation in well-drained soils the material may usually be worked out in 2 years. If chlorate-treated soil in humid districts is heavily manured, cropping is advanced 2 or 3 years.
If weed tops are sprayed, farm animals should not be turned into such fields without satisfying their appetites for salt. The dead tops have a marked salty taste, and animals may easily eat enough to kill them. If they are given plenty of salt for a few days before being turned into the fields, they will ordinarily pay very little attention to the sprayed areas.

Salt-hungry animals may eat sprayed weed tops and die.

Spraying wild morning-glory with sodium chlorate in a young orchard—a dangerous practice if the trees are valued.

The cost for chlorate applications will vary from $35 per acre to $125 per acre. Usual cost for most conditions is around $50 for materials alone. In addition, there is the loss of the use of the land for several years. It follows then that its use is impracticable on large acreages.

Chlorates can be recommended only for use in locations where cultivation is impossible or impracticable, such as:

a. Scattered, individual plants.
b. Fence rows.
c. Ditch banks.
d. Roadsides.
e. Pastures.
f. Forest lands.
g. Clean-up work after cultivation has killed most of the weeds.
h. Weed patches too small to cultivate.
i. Rocky land.
j. Stump or brush land.

Many people have used chlorates with notable success. Others think the method a bad joke. Common reasons for poor results are:

- a. Failure to treat outside the weed patch 5 feet all around. The weed patches send up new shoots outside the poisoned area, and the owners then have only a series of huge doughnut-shaped weed plots. (Treat morning-glory 10 feet outside the patch.)
- b. Inaccurate estimating of the area and the amount of chlorate.
- c. Irregular spreading of material.
- d. Failure to carry through by destroying seedlings and missed plants.
- e. Use of chlorates where conditions are wrong, such as on steep slopes, wet land, gravelly subsoil, etc.
- f. Treatment at the wrong time of year. (Chlorate on the surface of the soil decomposes and loses its effectiveness in a few months.)
- g. Attempts to economize on material.
6. CONTROL BY FLOODING

Flooding as a weed-control measure has been attempted by several Oregon farmers. It is successful if water is available and if the land is flat enough so that the weed-infested area can be covered completely by water and kept covered for two months. No experimental evidence is available showing the exact length of time required to kill the various weeds by this method. Probably the time differs on different soils. If there is rock or hardpan fairly close to the surface so that the water does not get away very fast, thus creating in effect an underground lake, it is likely that the method offers more hope

Spray Thistles After Cutting Grain

"Now this is the way I think is the most practical and surest way to kill Canadian Thistles. Sow your field in oats and vetch in the fall and cut your hay crop when ready the next summer. The thistles will then come up green and nothing else will volunteer and come up, so they will be easily found. Then spray them with sodium chlorate, 1 1/2 pounds to a gallon of water, about the 1st of September. Go over the field again in about four weeks and spray the ones that you missed or did not entirely kill and the ones that have come up since you sprayed, as there are always some that are just about to come through that you cannot see. Use the same strength spray as before.

"Go over the field again in four weeks. You may not find very many this time, but it is important that you get these few or they will soon be thick again. Do not plow or work through them after spraying, and do not work within ten feet of the patch sprayed. If you do, they will come up very thick around the edge with a kill in the center of the patch.

"It would be better if you want a 100% kill not to work the field the next spring and go over it a couple of times and look for ones that might come up.

"Do not try to spray thistles 4 to 6 feet tall; it takes entirely too much spray. Keep them small, 2 to 6 inches high, by cultivating or mowing them off.

(Signed) HARRY L. ROBINSON
Tigard (Washington County)"
Chlorate Plus Persistence for Morning-glory

"About 1926 I began using sodium chlorate as spray and continued until the fall of 1934. There were about 15 or 20 rather weak plants in '34 and less in '35. In fall of '35 disked and seeded the patch. It did not yield like the balance of the field, which was summer fallowed in the spring of '35, but no morning-glory showed during 1936.

"The small patches I covered with salt about 1924; killed the morning-glory, but nothing grows on the ground. Most of the year it looks like concrete pavement. I think with plenty of sodium and more persistence it can be controlled.

"I did not cultivate the ground in any way after 1919.

(Signed) E. P. MARSHALL
Pendleton (Umatilla County)"

Tillamook Water Commissioner Likes Chlorates

"We had many weeds including morning-glory, thistle, yellowweed, evergreen blackberries, dandelions, and other weeds whose names were unknown to us.

"These were growing in the yard where we keep our stock of water-main fittings and pipe. They were a great nuisance and we had lots of trouble with them until we sprayed them with sodium chlorate last summer. We only sprayed them once and they haven't sprouted any more.

"They seem to be entirely dead and if some more come in next spring we will give them another dose. We also sprayed grass and weeds which grew around the edge of our reservoir and had the same results.

"Everything dead and nothing has sprouted up as yet. It is the best stuff we have ever used.

(Signed) F. L. BECKEY
Tillamook (Tillamook County)"
for success than on soils with gravelly or otherwise open subsoils. It is likely that summer flooding is more effective than spring flooding. This is a smothering method, and if one lets the ponds go dry before the two-month period has passed, the plan will probably fail. The dike around the infested area should be high enough to hold about a foot of water. Care must be taken not to make the dikes from soil scraped from the weed patches.

**Flooding**

"I tried flooding for Canadian thistle and had quite good success where I could cover the plant, but I did not eradicate them because of some high ground around some stumps that were in the infested area."

"I cut the thistle quite close to the ground in August and completely submerged the plants. Where I was able to keep the plants covered for about three or four weeks, they were killed.

*(Signed) W. D. Collins
Bend (Deschutes County)*"
7. CONTROL BY COVERING WITH STRAW

Hundreds of Oregon farmers have tried to suppress their weeds, or at least hide them, by blowing the straw stack on them or by haul-
ing enough manure, earth, or other material to cover the patch. Theoretically, this should work on a small patch. Actually, there have been more failures than successes, but it works well with shallow-rooted perennials such as quackgrass. Failures have occurred where straw or other material was not placed far enough outside the edges of the patch; where not enough covering material was used; where the farmers gave up too soon; and, in the case of straw, where the straw was not kept wet in order to make it compact enough to have a smothering effect.

Killing deep-rooted weeds by this means depends on the generation of heat by decomposing material or on the material becoming compact enough to smother the weeds. Dry straw or earth has no effect on a really vigorous shoot of morning-glory or Canada thistle. It takes longer for the weed to reach the top, but apparently it doesn't weaken much. Manure will do the trick if kept moist enough to generate heat, which actually kills each crop of sprouts that comes up. As straw does not generate so much heat, a deeper cover is required, and it must be kept wet to make it compact. Straw should be piled 10 feet beyond the edges of the patch and should be at least 6 feet deep after settling. In the case of manure, 3 or 4 feet is usually enough. As the straw beneath rots away, reducing the depth of the cover, more

Jack Stump Covers His Thistles

"We have tried several different ways of controlling Canada thistles and have had good luck with all of them. Possibly the most satisfactory is the use of fresh horse manure, where the patches are small. The manure should be put on at least 2 feet deep and about 2 feet past the last thistle to allow for possible spread.

"This has always given 100% kill, but of course can only be used where very few plants appear.

(Signed) Jack Stump
Monmouth (Polk county)"
should be added to keep the pile 6 feet or more deep all the time. The straw should be saturated occasionally with water and should be left for three full years.

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**Gus Kraus Uses Clover Straw**

"I have, for years, fought Canada thistle with a degree of success such that I have lost much of my former fear of them. To eradicate a patch completely in the shortest possible length of time, it is important that the ground remain unplowed and not cultivated. I have found in every instance where the patch was not so large as to make the method impracticable, that covering them with clover straw early in May will eradicate them in a single season.

"I find that in a patch so covered, the only plants that survive are those that had a chance to follow a channel through the straw made by some rodent. These I have destroyed the following year by treating them individually with sodium chlorate spray.

(Signed) GUSTAV KRAUSE
Cornelius (Washington County)"

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**Manure on Quackgrass**

"My experience with control of quackgrass by manure is as follows:

"On small patches only is this practicable. Cover the plot with manure to a depth of at least a foot. Allow this to remain for at least 2 months or until the quackgrass begins to show leaves on top of the covering. Then set fire to the covering.

"I have found that by the time the quackgrass comes through the top of this covering the roots have lifted themselves both near and above the top of the ground. The burning then destroys all roots. I have tried this only on quackgrass and have effected a complete kill.

(Signed) J. O. HANSEN
Terrebonne (Deschutes County)"
8. CONTROL BY COVERING WITH PAPER

The roofing-paper or tar-paper method has been tried very often on small patches. There have been a great many different results—all bad. Sometimes animals step on the paper, and if the children play baseball near by, the center of the paper seemingly has a magic attraction for the ball. Anyhow, the paper usually is broken or rotted by the weather before the plants are dead. In other cases the paper is not spread far enough beyond the edges, or it is not lapped enough, or not sealed well on the laps, or the surface beneath is not leveled well, or wind blows the paper away. The percentage of failures with this method is so large that it cannot be recommended. Theoretically the method will be effective on small patches if all precautions are followed and if additional paper is put on whenever holes appear. One of the greatest difficulties is that the paper tends to rot during the winter so that recovering may be necessary the second spring. The paper should be left on for three years.

9. CONTROL BY PASTURING

Many people have tried to get out of the weed-growing class by pasturing their weeds. This method, of course, has a thousand variations, depending on climate, type of soil, kind of weed, and kind of livestock used. One of the commonest and most successful types of pasturing is practiced largely in the Coast counties and in Douglas County—goat pasturing. The goats clear land of brush and some

Hogs controlling morning-glory in Lake County. Hogs have rooted 2 feet down in places.
troublesome weeds. They eat St. Johnswort when it is young and reduce fern to some extent. Pasturing plus a sod-forming grass will keep fern under control.

Reports are frequent of killing morning-glories with hogs. It is rough on the hogs to keep them so hungry that they will work the ground over and over searching for the roots, but two seasons of such pasturing sometimes kill small patches. One man reports that he planted artichokes on his morning-glory land and that gave the hogs an added reason for rooting.

A good growth of knapweed in Morrow County. Later this patch was controlled by making a hog pasture of it.

Garden plots have a depressing and discouraging habit of changing into morning-glory patches, and some Oregon people have thereupon put chicken yards upon such ground. Chickens like the morning-glory leaves and keep them eaten down so that the roots may die in 4 or 5 years, provided poultry diseases and parasites do not get the chickens first. Continuous pasturing of chickens on the same land may be fatal to poultry profits.

Other, more extensive types of pasturing are frequent. The easiest thing to do with quackgrass is to pasture it, and it makes a great deal of very good pasture. But as weeds are weeds mostly because cattle do not like them as well as grass, this pasture method is more likely to reduce the spread of weeds than to kill them. Canada thistles are not eaten much unless stock get very hungry. One Wallowa County farmer sprayed his thistles with salt, and his hundred head of steers ate them with enthusiasm. He reports that he killed
a fine stand of thistles in two years by keeping them eaten to the ground in this way.

Two of the three common kinds of white top are not relished except when young by any kind of animals. Furthermore, that weed goes to seed early, at a time of the year when more palatable feed is abundant. If animals are kept on short pasture, they will eat these seeds and scatter the weed wherever they go. Pasturing is therefore more likely to spread white top than to stop it.

Sheep like many kinds of weeds. Buckhorn, for example, is seeded in many sheep pastures in Douglas and Coos counties. Morn-

Sheep Like Morning-glory

“We practice clean cultivation of orchards here, and I have one block of pear orchard that, over a period of years, has become completely covered with morning-glory. Cultivation in an orchard does nothing but improve the stand of morning-glory, so feeling sure that chemical applications would ruin the orchard, I was compelled to figure some other method of handling this problem.

“I placed a woven-wire fence around this orchard, turned a small bunch of Hampshire sheep in it, and find that the morning-glory is being killed out and the sheep do very well. They do not bark the trees and they keep the windfall fruit cleaned up, as well as the sucker growth from injured roots.

“I disk this orchard deep in the spring and loosen it up occasionally in the summer with a Kimball weeder, and the morning-glory never gets to vine out, as the sheep seem very partial to this young tender growth.

“Another small piece of morning-glory I made a hog lot of and kept hogs there 2 years. They went down about 2 feet after those morning-glory roots and it seems to have cleaned that piece as I have farmed it now for about 8 years.

“I have a field of about 5 acres that is full of morning-glory, and I am letting this field remain idle and pasturing sheep in it. I believe that after 3 years I will be able to get a stand of alfalfa there and in the meantime the sheep are paying a small profit.

(Signed) Roy Duvall
Mosier (Wasco County)”
ing-glory fields have been converted to sheep pastures all over the state.

All of the growers interviewed agreed that several years of pasturing made the weeds easier to kill either by chemicals or clean cultivation. The repeated damage to the tops probably reduces the root area and thereby diminishes the amount of stored food in the roots. If a grower has too many weeds to clean up in one year’s time and is starting on a conscientious weed-control program aimed at eventual elimination of the weeds from his farm, pasturing is one of the best ways to tie the weeds down and hold them until he can get around to more drastic measures. Weeds such as white top and Canada thistle, which bear seed in pastures, should be cut early enough and often enough to keep seed from forming. Some low-growing weeds such as morning-glories cannot be prevented from forming seeds by cutting, but fortunately the morning-glories do not produce much seed after a year or two of pasturing.

10. CONTROL BY SEEDING TO PERMANENT CROPS

Seeding to permanent crops works fairly well with some weeds. For example, alfalfa has greatly reduced the morning-glories in large fields in Union County and has crowded out nearly all of the Canada thistles on dozens of Willamette Valley and Wallowa County farms. Crested wheat grass is reported to be overcoming the morning-glories on several farms in arid parts of Washington. On the other hand,
quackgrass, which can be killed with comparative ease by cultivation, cannot be controlled either by grass or by alfalfa, nor can white top. But the alfalfa method is very hard on death-weed. Sod-forming grasses have controlled ferns and other weeds in many Coast Range pastures.

Alfalfa Plus Sheep Equals Weed Control

"Regarding the control of morning-glory on my property in Clark County, we did have a very heavy infestation and for a number of years, while growing annual crops in the infested district, we found it practically impossible to control them. However, after planting alfalfa and grazing the alfalfa with sheep both during the early growing season and after each cutting of hay, as well as late in the season, we found that the infestation of morning-glory has entirely disappeared.

"We noticed that the morning-glory plant was apparently quite palatable, but whether the heavy pasturing or the competition of the alfalfa combined with the pasturing was the cause of the eradication we are not prepared to say. However, it remains a fact that the infestation has entirely disappeared without any cultural or chemical efforts toward control.

(Signed) C. E. GRELLE
Portland (Multnomah County)"

Harry Ruhl Hogs Off Morning-glories

"We have made a 100% kill on morning-glory where we have confined hogs to a small lot continuously.

"Would not advise pasturing them in fields where there are patches as the hogs would root them and scatter them over a larger area.

"Where we killed them they have not showed up and it has been as long as 6 years past.

(Signed) HARRY RUHL
Alicel (Union County)"
Hogs Killed Thistles for H. W. Vogel

“Several years ago I had a small patch of Canada thistles near our barn. I fenced it hog-tight and turned in hogs and have not seen a thistle since in the lot.

(Signed) H. W. Vogel
Oretown (Tillamook County)”

Goats Kill Brush

“In the spring of 1935 I fenced in 81 acres of very bad brush land and put in 154 head of goats. By fall they killed nearly all the brush and the ground was just a dusty bed. I took the goats out on October 1. On October 15 started seeding it. On October 22 put goats back in to tramp grass seed into the ground and clean up the rest of the brush. Took goats out on November 25 and put them on another and larger piece of ground, brush land. I seeded about 10 to 12 pounds of grass seed to the acre and got a fine stand. Never grazed it the summer of 1936.

“In the fall of 1936 after the grass had gone to seed I put 100 sheep in the 81-acre pasture. They did fine and also tramped a lot of seed into the ground. The grass looks very well on it now, although we have had the worst winter in many years.

(Signed) R. H. Williams
Brookings (Curry County)”

The effectiveness of the treatment is due to different things. In the case of alfalfa on thistles, the weeds are susceptible to damage from frequent cutting. In fact, cases have been reported where thistles were killed by mowing them several times a year, even without the alfalfa. But frequent cutting has no bad effect on quackgrass. In the case of alfalfa on death-weed, the crop starts so much earlier than the weeds and recovers after cutting so much faster, that the weeds are...
shaded out. In the case of crested wheat grass, it is likely that the grass roots occupy the top foot of soil so thoroughly and start growth so early in the spring, that the grass can use the winter moisture more effectively than weeds. If alfalfa is used for this purpose, Grimm alfalfa should be used in Western Oregon and ladak alfalfa in Eastern Oregon. Both have a dense root system in the top foot of soil, and

Weeds find it hard to work their way into a good stand of crested wheat grass like the above field on the Mossie ranch in Umatilla County. Crested wheat grass competes successfully with morning-glory.

When Goats Came In, Evergreens Went Out

"Canadian thistle and evergreen blackberries are our worst pests. Angora goats have been our only way of controlling evergreens. We had an acre that was completely covered. We fenced it and put about six big wether goats on it and they killed the weeds completely.

(Signed) EVERETT A. SHIBLEY
Estacada (Clackamas County)"
both are longer lived than most strains of common. If crested wheat grass is used in Eastern Oregon, the Fairway strain is best. In Western Oregon highland bent grass is an aggressive sod-forming grass that will choke out many weeds.

If land is seeded to pasture it holds most of the perennial weeds in place, keeps them from spreading and kills some of them. White top cannot be controlled that way. Picture shows a ladino clover and grass pasture in Central Oregon.

Alfalfa Shades Out Morning-glory

"I bought 160 acres eight years ago, and I think it was the worst place in the Valley for morning-glory. Had trouble to get a stand of alfalfa. Had to seed twice but finally got a good stand. I raise 2 crops, some years 3 with no irrigation.

"The first year the morning-glory climbed up on the alfalfa, but after that they were not strong enough to climb. It has been in alfalfa for the past seven years and this past season was the best for hay. I am sure that it will eventually get them. It is hard to find a morning-glory plant now. I have more trouble with gophers than the morning-glory.

(Signed) N. K. West
La Grande (Union County)"
This system of control is adapted to use on large areas. Even if the weeds are not completely killed, their spread is checked, and the farm owner is given a breathing spell so that he can start on a clean cultivation or deferred-fallow campaign on a small acreage each year.

A good stand of alfalfa controls thistles and morning-glories and many other perennial weeds. It is ineffective against quackgrass, white top and knapweed.

Sod-Forming Grass Plus Sheep Beat the Weeds

"About 14 years ago we plowed a 20-acre field. We bought gray oats to sow. The man who raised the oats did not even know Canada thistles when he saw them, but he surely had them. Not suspecting anything wrong, we sowed that seed and surely had plenty of thistles. At least 3 acres of the 20 were a solid patch of them. We mowed them, but to no avail. They kept growing taller, and instead of threshing our crop we cut it into the soil. My son was disgusted with that kind of farming, got a job with a construction company, so I was left to do the best I could with my farm. That field was seeded to mesquite and redtop grass, used as pasture ever since, some 7 years. Thistles grew 4 to 6 feet tall; they were cut every year to keep them from going to seed. They kept getting
Sod-Forming Grass Plus Sheep Beat the Weeds—Continued

weaker for 3 or 4 years. Lately, there were not any to cut. Last summer, about a month before haying, I took the sheep out. Rains washed the sheep smell out of the grass, and it made a short but very good crop of hay, which was liked by the cows better than any other. There was not a trace of thistles or morning-glories to be found in that hay; evidently they are killed.

"I was not able to apply clean cultivation—a man past 70 is not as spry as one half that age. I tried chemicals, which proved too expensive. After one application, the thistles were somewhat thinned out, but the remaining ones grew more thrifty than before—an outlay of $25 and no results, except ruining a good pair of pants and shoes. To keep on tilling the field and raising crops would have meant two-thirds of the crop, possibly all of the straw, to be taken away from the farm, robbing just that much humus from the soil where it belongs, besides spreading and establishing those weeds worse than ever. With the method taken, I accomplished three points:

1. Killed the thistles, morning-glories, wild and evergreen blackberries, which were also plentiful seven years ago.
2. As a soil builder and conserver, my method could not be beat; I think future crops will prove this.
3. Soil erosion had set in, washing the best top soil into a nearby ditch, fertility going down toward the river; the grass sod stopped that very effectively.

"This plan or method no doubt is too slow for most farmers. I am well satisfied with results in my case.

(Signed) S. R. Nothinger
Sweet Home (Linn County)"

11. CONTROL BY CONTINUED CUTTING

The state is full of examples of weed killing by continued close cutting. Naturally, there is a wide range of reactions to this treatment on the part of the weeds. Some, such as fern, get discouraged easily and give up quickly. Others may survive the experience for three years or longer. Regular continued close mowing will eventually kill most of the perennial weeds that have a tall, upright growth, but those such as morning-glory, that grow close to the ground, will thrive under the treatment.
Cutting Fern

“I find that cutting the fern as soon as it is large enough to form heads, but before it has developed much foliage, is successful, and the fern dries up without covering the young grass too much. I follow this with another cutting in about a month. If it is a new field and has not been cut before, it usually takes a third cutting. If it had been cut the year before, two cuttings are usually enough to keep it down so that the grass has a chance to crowd it out.

“I like to cut the fern in wet weather as it does not heal over so quickly and gives a better kill. Two years' cutting will usually weaken the ferns so that the grass and stock keep it under control.

“I find this a very satisfactory method of controlling fern.

(Signed) RUDOLPH RUPRECHT
Toledo (Lincoln County)”

A Busy Hoe Will Kill Thistles

“In clearing my land I found a plot of Canada thistles, about 500 husky plants. Broke the ground and kept cultivated the first year. Second year after plowing as soon as these pests showed above the ground, I chopped them off quite deeply with the hoe. Kept this up weekly all spring, summer, and fall. The third year I found only two plants, and worked on them the same.

“Have not seen one in this plot for 2 years.

(Signed) J. R. SAMMONS
Oregon City (Clackamas county)”

12. CONTROL BY HOEING

Hoeing is adapted to small patches only, but it too has been effective on many, many farms. It depends more upon the persistence of the operator than upon any other one thing. Hoe and persevere.

Plants should be hoed as often as they appear. Such treatment will usually kill quackgrass and Canada thistle in one
year, but white top and morning-glory will probably require 2 or 3 years of work. Under Oregon conditions hoeing is necessary about 25 times during the first season and about 12 times the second year.

13. CONTROL BY DIGGING OUT

Digging out is a good, old-fashioned remedy for small patches. The only investment required is a good spade or shovel plus a first-class pair of nonblistering hands mounted at the ends of double-action arms, and all surmounted by determination beyond the ordinary. Plenty of Oregon farmers have such equipment. The method will work with any perennial weed. Of course, it works best with weeds with a single root rather than with those having creeping lateral roots which form new plants at intervals. The digging should be at least 18 inches deep, and 36 inches is better. All roots found should be thrown out and dried or burned, and the digging should be repeated whenever a shoot shows above ground. One or two seasons of this will kill even white top. Digging out is particularly effective on evergreen blackberry.

Digging and Salting

"A few years ago I found a couple of places where Canada thistle had got started on my farm. I went down to my field equipped with a shovel, gunny sack, half a bucket of salt, and 2 gallons of crank-case oil. I laid the gunny sack on the ground and started digging for the thistle. Every white root I possibly could find I laid on the sack. I kept digging alongside the main root about 4 feet deep, till the root got as thin as a toothpick. Then I put some salt and oil in the bottom of the hole and filled it up again with dirt. I put a stake there to see if it would come up again but it didn't. "Every year I go over the land to look for a start of the thistle. I haven't found any since.

(Signed) Peter Vanaudenhaegen, Jr.
Forest Grove (Washington County)"

14. CONTROL BY CLEAN CULTIVATION

In clean cultivation lies the main hope for destroying weeds in large patches or when scattered over an entire field. Killing by this
method involves the known dependency between the roots and tops of plants. The tops need the roots to gather moisture and plant food for them. The roots serve as the gatherers of raw materials and need the tops to manufacture those materials into a finished food product that the roots can use. The roots are the mining crew, the tops the factory workers, and neither can function long without the other. In the case of some perennials with creeping roots, however, there is enough food stored underground to last the roots for two years or more without replenishing. This is particularly true of morning-glory and white top. In the case of quackgrass, this underground reserve is much less. Canada thistles are intermediate.

Hundreds of Oregon farmers have killed these weeds by cultivation. There is nothing mysterious about this method nor is it particularly difficult. It does require persistence. Many people have started cultivation with great energy in the spring only to see the flame of their enthusiasm smothered in the dust accompanying summer working of the soil.

There is some evidence to show that young weeds two or three inches high exhaust the roots instead of replenishing them. Experimental work on this is now going on in Oregon and other states. It is known that with morning-glories better results are obtained by delaying each cultivation for 8 to 12 days after emergence.

One year of clean cultivation will kill most of the varieties of perennial weeds. White top and morning-glory are exceptions. They need 2 years of effort and sometimes 3.

One type of blade weeder.
A number of different cultivation tools have been used with varying success. A spike-tooth harrow is of no value. The ordinary disk does not do very good work; it misses some plants and breaks all clods, leaving a fine dust mulch that may result in soil blowing or washing. The orchard cover-crop disk and the large “one way” disk are quite satisfactory. The spring-tooth harrow is only moderately effective. It is undesirable in that it spreads roots, and may require frequent dumping. As soon as the soil becomes dry, fine, and dusty the more vigorous shoots tend to slip between the teeth. The blade weeder has been used by many, but it has several bad features. Where the blades are dumped, there are skips and also piles of roots that grow. Unless the blades are kept very sharp, they tend to drag the tops underground instead of cutting them. Continuous use of the blade tends to pack the soil beneath it and force it closer to the surface with each succeeding cultivation. Replowing soon becomes necessary. A duck-foot with wide blades that overlap is satisfactory. The blades must be sharpened frequently. Another satisfactory implement is the rotary-rod weeder. Its revolving action tends to throw clods and tresh to the surface of the soil, thereby preventing erosion. As with a blade, the soil tends to become packed and makes each repeated working shallower. In all except very loose, sandy soils, it will be necessary to replow at least once during the season when the rod weeder is used. A few growers have made all of their cultivations with a plow. This system is more expensive than culti-vating with other implements, but it is more effective.

The cultivation method is essentially a starvation process. Plants with green leaves can get food only through the action of the leaves. Each shoot or sprout sent to the surface uses some of the food stored in the roots, and eventually the reserve food must become exhausted unless replenished by leaves. Deep cultivation is more effective than shallow and results in fewer cultivations because it naturally takes longer for a 6-inch sprout to reach the surface than for a 2-inch sprout to emerge. This is why the plow works well as a cultivation implement.

The clean cultivation method has its limitations, and one of the most important of these is that its use may be disastrous in a blow area. The continual working of the soil breaks the soil texture and produces a fine dust mulch to the depth of the cultivating. It is unsafe to use the plan on blow soils unless equipment is made which will cut
the roots so far under ground that the soil surface is left cloddy. If practiced on steep lands or soils inclined to wash or gully, fall planted crops should follow cultivation, and if necessary other precautions should be used, such as contour furrowing.

This cultivation method is naturally not feasible on very rocky land, in berry patches, on land that is too wet for cultivating part of the season, or in any fields that cannot be cultivated throughout. It is not too well adapted to working in orchards because of the dust. It cannot be used at all in a bearing orchard when props are necessary. If an orchard is clean cultivated for weed control, the weeds close to the tree trunks should be hoed even more frequently than the ground is cultivated.

The cost of cultivating depends on the weed involved, the rainfall, fertility of the soil, the implement used, and extent of infestation. A figure that will apply to average conditions is $12.00 per acre the first year and $6.00 per acre the second year in the case of weeds needing two years of work. This does not include loss of crop, taxes on land, etc. It is only the cost of the plowing and cultivating if the labor is hired. If the farm is small and the labor can be done by the owner without interfering with other farm labor, and if the work is done with horses, then of course the cash cost is very low. Clean cultivation or intensive summer fallow is tedious and exacting, but it has the merit that it positively will kill any perennial weed if the rules are followed exactly. Neither will it injure succeeding crops. It and the modification called “deferred fallow” are the only methods known that will kill all the weeds on large areas at a low cost per acre.

If clean cultivation is practiced to kill weeds, considerable time or cash expense, or both, go into the operation. It is only good sense to follow the job through. The cultivation for one or two years should be followed by a crop of corn, potatoes, sunflowers, beans, or other row crops if that is at all practicable. If it is not possible, as for example on a large wheat ranch, then whoever works that field in the future should carry with him a can of chlorate or salt for treatment of any plants that come up from seed.
Walker Franklin Cultivates for Thistle Control

"Most of our experience with Canada thistle has been on our upland fields, which are irrigated. It is no particular problem to eliminate the weed entirely in all the cultivated part of the ground. After growing several seasons' crops of barley and oats as a spring crop, we find that the thistles do spread and get to be a considerable pest.

"To get rid of them, we plow the ground during the spring plowing season and give it a thorough summer fallowing during the season, keeping the thistles below the surface by cultivating every week or even more often, if necessary, the first part of the season. In the latter part of the season they do not grow very fast and weeding can be done less frequently. Following the summer-fallow work we usually seed to fall wheat and get a rank growth the following year of wheat. Sowing the summer fallow has completely cleaned the thistles on those fields.

"On our subirrigated lands, we get the most out of our lands by pasturing and keeping the thistles mowed.

(Signed) G. W. Franklin
Enterprise (Wallowa County)"

W. R. Bailey Cultivates Early and Often

"When I bought my present farm 14 years ago it had on it one solid patch of morning-glory of about 10 acres in an old peach and cherry orchard and about a dozen smaller patches scattered over about 50 acres of orchard.

"On the 10-acre patch I decided 3 years ago to use cultivation. I came to this decision partly because of the cost of chlorate, partly because of the bad effects of a heavy application of chlorate to the soil and the increase in erosion which I have noticed on steep side-hills sprayed with chlorate, but mostly because in an old established patch which had been cultivated for years I knew that the ground was full of seed and that even if chlorate were applied it would require a good deal of cultivation to keep the seedlings down. I felt that I might just as well cultivate a little more frequently and more regularly and dispense with the spray."
W. R. Bailey Cultivates Early and Often—Continued

“In order to make a thorough job I pulled out what was left of the old orchard and cleared the patch entirely of trees. I think this has saved me about one-half of my work of cultivation since I do not have to work two directions to get a complete cultivation and have no trees to hoe around. I plowed the ground about 6 inches deep early in the spring using an Oliver breaking plow, which did a thorough job of turning under the trash. A little later I disked it thoroughly with a cover-crop disk and then started cultivation with tractor weeders. I first tried a goose-neck weeder having two revolving blades operating on a trip so that one blade is in the ground while the other hangs in the air jarring off the accumulated weeds. There was so much trash in the ground that this weeder was hard to operate and I switched to a 12-foot rod. I was going over this ground every fourth day and I soon found that the rotary rod kept packing the soil and running a little shallower each time over. I used the cover-crop disk to loosen up the soil every 3 or 4 weeks. Even then when the rod was running quite shallow I would have a little growth on the fourth day. About August I went back to the goose-neck and found that since much of the trash had rotted it worked as well as the rod and had the advantage of very little packing of the ground.

“I continued to use the goose-neck on this ground all summer and found that I could increase the interval between cultivations up to 7 days without any leaves showing above ground. The morning-glories on this plot were more than 90 per cent killed, but I continued cultivation the following year to hold down the seedlings and make sure the old roots were dead. Two years of cultivating got all of them.

“From this experience I can formulate three recommendations: (1) Use cultivation on large patches and make the cultivation regular, thorough and as deep as possible. (2) Use chlorate on small new patches and put on plenty. (3) Mark all patches with tall, strong stakes to prevent cultivation through them. With a good many hired men the stakes must be strong enough to stop a team or they will be run over.

(Signed) W. R. BAILEY
The Dalles (Wasco County)"
Cultivation OK in Marion County

“I have owned and operated this farm since 1917, and when I first took it over, there were fifteen or sixteen small patches of Canada thistles on this place. I made up my mind to get rid of them, but how? I finally staked off the patches and did not plow through them that fall because I was afraid I would drag the roots over the field. Then the next spring I plowed these patches separately and then worked them once a week all summer until late in the fall with a cultivator and Kimball. The results were very satisfactory.

(Signed) W. G. Roth
Salem (Marion County)”

Thistles and Quackgrass Were Killed

“I wish to report on my experience in killing Canada thistles by clean summer fallow on my home place, one-half mile northwest of Joseph, on land that is partly subirrigated. In 1933, we summer fallowed ten acres of land infested with quackgrass and Canada thistles.

“We plowed this in April and worked it continuously until about July 5. There was a period following for a month or six weeks that it was impossible to work it on account of the excessive moisture. Quackgrass showed up quite plainly during this period but the thistles were held down. After the ground became dry enough, we started cultivating again until the 4th of October, at which time we seeded this plot. Neither quackgrass nor thistles showed in any manner the next year in the crop of fall wheat. There was a 100% kill on that piece.

(Signed) Hugh Wilson
Enterprise (Wallowa County)”
Cultivation Liked in Hood River Valley

“I have not had complete success with chemicals on Canada thistles, but I have with cultivation. I use deep fall plowing and in the spring give the ground a thorough disk. After that I use Kimball or Acme harrow first thing Monday morning. I said Monday morning for it is absolutely necessary that the thistle be not allowed to come above ground and unless you set a certain time for a job of this kind, you will let it slip and your effort is wasted.

(Signed) J. P. THOMSEN
Hood River (Hood River County)"

H. H. Hawley Cultivates on Crooked River

“I have in my fields white top, knapweed and morning-glory. The last, I believe, is the worst one of the three. “They are in alfalfa fields where the soil is very deep and irrigated. My method is cultivation. I plow the ground often enough to keep it loose to quite a depth, then use a bar or blade cultivator between plowings. The cultivation should be often enough so the weeds will never get above the ground, which is very often. It will take at least 2 years to do the job. But it can be done and must be done if we are to survive in a weed-infested area.

(Signed) H. H. HAWLEY
Post (Crook County)"

Thistles Are Like Whales

“The Canada thistle is like a whale. He’s got to come up for air once in a while. We’ve found we can drive him off if we don’t allow him to come up.

(Signed) E. O. LYON
Scio (Linn County)”
Cultivation Practical and Successful

"Canada thistles are the only weeds that we have had to contend with, and my method in clear fields has been clean cultivation, starting the work in the fall as soon as the crop is off and working it as long as the ground can be worked in the fall, then starting in the spring as soon as the ground is dry enough, and working it by alternating with the plow and disk every ten days or two weeks for the full season. When using a tractor plow, it may be plowed each two weeks without the use of a disk.

"This plan certainly kills the thistles for me.

(Signed) A. F. Eyman
Canby (Clackamas County)"

Cultivate White Top for Two Years

"We plowed 40 acres of white top May 16, 1936, 5 inches deep, and took a spring-tooth and cultivated the roots out on top, raked them up and burned them. In July we plowed the second time 10 inches deep and cultivated once a week until late fall, about 20 times in all.

"In the spring of '37 we started on April 10 and cultivated once a week until November. I think we will get almost a 100% kill. We used a CC Orchard Cultivator equipped with duckfeet, 8 feet wide for the most part. I would recommend 6 head of horses or a tractor. We used 4 head of horses a part of the time, 6 part of the time, but when the dust gets deep and hot weather came, we used 8 head of horses and cultivated as deep as 15 inches; I believe the deep cultivation is the most effective. The cost of cultivation will run around $1 per acre for each cultivation. The main thing to keep in mind is to keep all plants under ground. They must not be left more than 4 or 5 days at one time without stirring the soil.

(Signed) C. E. Charles
Vale (Malheur County)"
15. CONTROL BY DEFERRED FALLOW

This method has various names. In the Columbia Basin it is sometimes called the Spokane system; in other states it is called "fallow-smother crop," etc. When attacking weeds in this way, a crop of winter wheat or winter rye in Eastern Oregon, or vetch in Western Oregon, should be seeded heavily on the weedy field, using from 50 to 100 per cent more seed than is customary. The following spring this crop should be cut for hay or turned under as green manure. If cut for hay, it should be cut rather early—in the milk stage. The field should then be plowed at once, preferably 12 inches deep, and left rough until weeds appear, when it should be worked down and during the remainder of the season all weed growth prevented by cultivation. It is a good plan to rake off and burn the roots if dense enough to warrant it. The land should be fall-seeded to the same crop again and the procedure repeated the next year.

The advantages of this treatment are that the number of cultivations can be reduced so greatly that the extra costs are very small—not more than a third of the clean-cultivation costs; and if the crop is cut for hay, there is income from the field. Two or three years of this will usually kill any of the perennials. If a few scattering plants come up, they may be killed by chlorates or by acid arsenical, using the can or jar method mentioned on page 12. It is best to follow with a cultivated crop if practicable in order to detect these stragglers.

This method works better in the longer-season parts of the state than it does in the high-elevation counties, but it is practicable in higher counties on quackgrass and Canada thistle, though not on white top.

White top is likely to thrive with the treatment because it blooms so early that it has completed its life cycle by the time the hay is cut.

This method has not been tried as yet in the Columbia Basin so far as the writers know, but it offers real hope on morning-glories because it eliminates the thing which helps the morning-glories so much—the summer fallow. Morning-glories are a more serious pest in summer-fallow areas than anywhere else because the year of fallow regularly renews their energy and encourages the roots to spread into the moist soil surrounding the patches. Deferred fallow is especially effective with quackgrass and Canada bluegrass. Even one season will result in killing these in most parts of the state. Canada thistle is sometimes killed in one year. Morning-glory is never killed out in one year; it may require three years or more.
Rye for this purpose is more effective than wheat. Hairy vetch and common vetch are equally effective in Western Oregon. If grain is used instead of vetch, winter barley is better than wheat in Western Oregon. Winter barley cannot be trusted to survive in Eastern Oregon.

The reverse of this method is not at all satisfactory in Oregon; that is, early fallow followed by a crop of late-planted millet, Sudan grass, or sorghum. The weeds do not seem to be injured by fallow in the cool spring months. Apparently two cultivations during the heat of August are more effective than half a dozen workings in the spring.

Deferred fallow owes its effectiveness to the following:

a. Most weeds use root reserves up to blooming time and then rapidly rebuild them if not disturbed. Therefore, late plowing and working attacks the weeds at a time when they have

An Experimenter is Practical and Successful

"About these morning-glories—under our conditions you either have to fight them or just move off and let them have the place.

"We have one experimental plot that was completely covered with a uniform stand of wild morning-glory, and by plowing it in July when it was hot, and working it with a rod weeder, almost once a week during the growing season, we kept the morning-glory below the ground.

"Ground worked in this way gets a fine dust mulch on it, and will all blow away over here, so to keep our soil we seeded it down to winter wheat. The following season we cut the wheat for hay about the time the morning-glory was ready to bloom (June 15), plowed the ground, and again worked it about each week with the rod weeder, and did not let the morning-glory get above ground.

"This process has killed the morning-glory. We have had this experimental plot back into our regular rotation program, and there has not been any morning-glory on it for the past two years.

(Signed) D. E. RICHARDS
Superintendent, Eastern Oregon Livestock Experiment Station, Union (Union County)"
less storage material in the roots than at any other season of the year.

b. If a hay crop is removed, moisture and plant food are also removed, making new root formation more difficult.

c. Tall, rank-growing crops that start growth early in the spring, such as rye and vetch, tend to get ahead of the weeds. This is why winter rye often makes a fair crop in a weed patch that completely overwhelms spring wheat. Winter rye is more effective than winter wheat because it is earlier, and where winter barley will grow it is better than wheat. Most of the perennial weeds start growth rather late, and they are at a disadvantage with a rank-growing fall-seeded crop. The shade and the crowding-out effect weaken them to some extent before the plowing.

The deferred-fallow system is ideal as a method for starting alfalfa or grass on weedy ground. The one season of fallowing during the hot months usually weakens the roots near the surface sufficiently so that a stand of legumes or grass can be obtained. The fact that a crop is harvested the same season is a strong point in favor of this method of weed killing. Danger from wind erosion is less with the deferred-fallow method than with season-long cultivation.

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George Kahl Check Rows Corn and Hoes Thistles

"For 10 years we tried unsuccessfully to eradicate Canada thistles from a certain field. It was a 9-acre field with 13 thistle patches, the largest one 60 by 80 corn hills. Finally we planted it to corn for two successive years. Each year as soon as the thistles began to grow after corn planting, we marked these spots. At the corner of each thistle patch we placed a tall pole, taller than the corn would grow. Then each week during the growing season these places were hoed.

"We think it is important to hoe THOROUGHLY and to check row the corn. We finished this method four years ago and have seen no more thistles there.

(Signed) GEORGE W. KAHL
Oregon City (Clackamas County)"
16. CONTROL BY INTERTILLED CROPS

Many perennial weeds can be killed by producing crops like corn that need frequent cultivation in the early spring. By the time cultivation is stopped, the surface of the soil on nonirrigated farms is dry, and the crop shades the ground. A few seasons of nearly any cultivated crop will rid a field of quackgrass, and even Canada thistle fades out. Of course, weaker-growing perennials like fern succumb comparatively quickly. Sunflowers are the best for this purpose of any

Sunflowers and corn are best.

“Hoe and Persevere” Says J. P. Jungwirth

“Canadian thistle we can easily exterminate in the open fields, and best results are obtained by planting the field, where you wish to kill the thistle, to corn.

“Our way is, after the corn is up large enough to cultivate the first time, we follow with the hoe and hoe them every week. We set aside Monday for that job of hoeing the thistle regardless. It is a discouraging job the first two or three times, as they are quite thrifty at that time. From then on they keep getting less. About the 7th and 8th times, which means 7th and 8th weeks, they get very small and few, so we take a row at a time. We hardly find any more thistles after the 9th time over. This is our surest method.

(Signed) J. P. JUNGWIRTH
Newberg (Yamhill County)”

Cultivate and Hoe and Goodbye Thistles

“There was a very good stand of Canada thistle on this place when I bought it, but by keeping the affected areas in cultivated crops and by diligent application of cultivator and hoe, I have gotten rid of them.

(Signed) GEORGE W. EMKEN
Brownsmead (Clatsop County)”
crop grown in Oregon. They are so vigorous that they furnish tougher competition than any other plant. Corn is second best. It should be check rowed.

**Frequent Cultivations Have Killed Morning-glory**

"In my truck garden, under irrigation, it is not difficult to eradicate the pest. I try to grow an early crop such as lettuce, spinach, or cabbage—something that can stand close and frequent cultivation and that is a rapid grower requiring only a short period to mature.

"After the first crop I plow deep and till soil well, keeping weeds down until I am ready to plant a second similar crop. An Acme or Kimball orchard harrow does a quick job and is thorough for frequent cultivation between plantings.

"Plow the field again after second crop and continue cultivation. It's a tough weed that can stand that sort of treatment more than 2 or 3 years. When only a few sprouts show up, take a shovel and dig the roots up.

(Signed) Wendell Bartholomew

Eugene (Lane County)"

Raise corn, then hoe and persevere for weed control.
17. COMBINATIONS OF CONTROL METHODS

It is likely that any well-organized attack on weeds will not only include several methods, but will combine several of those described above. Some possible combinations include:

a. **Carbon bisulphide plus arsenic, oil, chlorate, or salt.** The carbon bisulphide sometimes misses a few plants near the surface, and it is never effective against seedlings which come up after the treatment.

b. **Deferred fallow plus alfalfa or grass.** A season of deferred fallow will usually weaken the perennial weeds enough so that stands of grass or alfalfa may be obtained.

c. **Pasture plus mowing.** Some erect weeds like Canada thistle can be killed in time by frequent mowing, which is out of the question on cultivated land. Mowing becomes possible if the land is put to pasture.

d. **Permanent crops plus chlorate.** Chlorate-treated plots should not be disturbed for two or three years except to kill any seedlings that appear. A field dotted with numerous treated areas is difficult to work unless the plowing and other operations extend through these patches. The problem may be solved by planting to grass or alfalfa.
e. Deferred fallow plus chlorates. Two years of deferred fallow will usually kill most of the weeds. The few remaining can be treated individually with chlorates.

f. Deferred fallow or clean cultivation followed by intertilled crops. The cultivated crops will give the operator a chance to detect stragglers, and the spring cultivation itself will kill seedlings and stray plants that have already been weakened by the previous fallow.

g. Continuous fallow one season plus deferred fallow the next. Clean cultivate all of one year, plant rye or other crop that fall, cut for hay early, and practice clean fallow the remainder of the season.

h. Digging or hoeing plus chlorates or salt. Kill most of the weeds by one or two seasons of work; kill stragglers by use of the chemicals.

Comment

"I wish Mussolini or Hitler had these weed infested farms under their control. It wouldn't be long before these weeds were no more.

"If we ever want to save Malheur County from being overrun with noxious weeds, large amounts of money have to be expended and drastic regulations covering the use of land have to be enacted into law.

"I am fully aware of the need of Government, State, and County cooperation with the landowner. The privileges of democracy have been accepted (private ownership), but the responsibilities are willfully neglected.

(Signed) P. Tensen
Ontario (Malheur County)"

Suggestions for a County Weed-Control Program

The Linn County farm woman spoke truly who said in a meeting, "Weeds aren't so much a pest as they are a state of mind. If everyone in a community hates thistles, that community won't have any, but if people just take 'em as a matter of course, like death and taxes, then there will be plenty of thistles." The first thing to do then in organizing a weed war is to get the people behind it.
In order to organize this most effective of weapons—public opinion—it is necessary to have an organization reaching into every community. Several Oregon counties have this in the form of county weed councils. These councils draw their membership from:

1. County Court
2. Agricultural Conservation Association
3. Federal agencies
   a. Soil Conservation Service
   b. CCC camps
   c. Forest Service
   d. Department of Interior
      Indian Service
      Taylor Grazing Act Administration
      Reclamation Service
      National parks
4. State agencies
   a. Highway engineers
   b. Administrators of state lands
   c. County planning board
5. Farm organizations
   a. Grange
   b. Farmers Union
   c. Farm Bureau
   d. Eastern Oregon Wheat League
   e. Livestock associations
   f. Community clubs
6. Extension Service
   a. County agent
   b. 4-H Club agent
7. Schools
   a. County school superintendent
   b. Smith-Hughes agricultural teachers
8. Large land-holding corporations
   a. Railroads
   b. Federal Land banks
c. Joint Stock Land banks
d. Irrigation districts
e. Military road land-grant companies
f. Irrigation and drainage districts

9. Financial organizations
   a. Banks
   b. Mortgage companies
   c. Insurance companies

10. City governments

    The county court may well see that membership embraces every
    community. If some communities have no representation on the coun-
    cil, prominent farmers should be appointed and asked to serve.

    Each organization represented on the council should then be
    assigned a certain piece of work and should agree to carry out a prac-
    tical program. Some of the things that the various organizations could
    do are listed below. This is not intended as a complete list but every-
    thing suggested has been done with success at some point in the state.

ACTION BY COUNTY COURTS

1. PURCHASE OF CHEMICAL. In several counties the courts have
   facilitated the work by buying chemical in large lots and selling it at
cost to farmers. People are more likely to use the chemical if purchase is made easy in this way.

2. PURCHASE OF DUSTING AND SPRAYING EQUIPMENT. Here again if spraying or dusting is made easy by access to equipment, more people will practice weed-control measures. Some counties have furnished equipment free to those who would use it; others have made small charges to cover depreciation. Still others have furnished a man to go with the equipment to insure that it be used properly. In such cases the county usually pays for the man and the equipment, and the farmer pays for the material. About half of the Eastern Oregon counties have followed this procedure. A man trained to do this work will accomplish far more than a dozen untrained men.

Spraying Russian knapweed with county-owned spray truck in Baker County.

3. PROCLAIM COUNTY OR COMMUNITY WEED-CONTROL DISTRICTS. (Described later under the head of the Oregon Weed Law).

4. TREAT WEEDS ON ROADSIDES AND OTHER COUNTY-OWNED LAND.

5. IN THE EARLY STAGES OF INFESTATION OF VERY SERIOUS WEEDS, ASSUME ENTIRE COST OF ERADICATION. For example, two counties have very small plots of leafy spurge. These counties might well pay for the destruction of the patches while they are still small. Several counties have only a few square rods of white top.
6. Assume part of the cost of weed eradication in the case of weeds that occupy only relatively small areas. For example, Union County had only about 100 acres of white top, but did not want even that much, so offered to pay half the cost to any farmer who would cultivate his white top according to formulated rules. Many accepted, and that weed has nearly disappeared from the county.

7. Seed down roadsides to aggressive permanent crops such as crested wheat grass in Eastern Oregon and Astoria or Highland bent-grass in Western Oregon.

It must be recognized, of course, that most of the foregoing things cost money. The justification for this sort of expenditure is in the fact that if unmolested, weeds will spread to other lands and eventually reduce the tax-paying base.

**ACTION BY AGRICULTURAL CONSERVATION ASSOCIATIONS**

In 1936 and 1937, payments under AAA have been available to those farmers who cultivated noxious weeds or sprayed with chlorates, provided of course the farm had a large enough soil-building allowance. In 1936 more than 3,000 acres were treated, and in 1937 more than 9,000 acres were clean cultivated in Oregon. Association officers could very well encourage a wider use of this provision.

**ACTION BY FEDERAL AGENCIES**

1. **Soil Conservation Service.** This branch of the United States Department of Agriculture is naturally more or less weed-minded. Its staff members encourage cooperators to seed weedy fields to grass or legumes, point out control measures, see that no seed used by their organization contains seeds of unwanted weeds, and exercise some supervision over seed bought by cooperators.

2. **C.C.C.** In Malheur County the CCC camps assigned to the Reclamation Service have spent a large amount of time and money in controlling noxious weeds. In some other counties there has been similar, but less extensive cooperation. It has included work on roadsides, ditches, reservoir sites, and privately owned lands.

3. **National Forests.** All of the Forest Service employees are eager to help in such programs. In the past most of their work has been directed toward control of poisonous weeds, but as weed programs become more advanced in the counties, it is probable that this organization can be counted upon for help in all possible ways.

4. **Indian and National Park Services.** These organizations have not been called upon in this state except in Umatilla County,
where morning-glory is bad on Indian land rented to white farmers. In this case rental charges are reduced to those renters who engage in weed-control measures.

Road on ditch bank in Klamath County treated with chlorates for white top. Roadways such as this give crews access to weed patches along canals.

5. RECLAMATION SERVICE. The Reclamation Service has been very alert to weed damage and has helped materially, especially in Malheur and Klamath counties. Its cooperation can doubtless be ob-

Spraying a ditch bank in Klamath County. The United States Reclamation Service cooperates in such work.
tained to the fullest extent. All main canals should have roadways along them to give access to weed patches and the slopes of new canals and drain ditches should be seeded to permanent crops such as blue-grass or crested wheat grass.

6. TAYLOR GRAZING ACT ADMINISTRATION. Objectionable perennial weeds in the main are not common on the public domain now under the Taylor Grazing Act. Some white top is becoming established on this land, but the public domain land in this state is too dry for the weeds that bother most on cultivated lands. Some grazing lands have poisonous weeds that may require attention eventually.

ACTION BY STATE AGENCIES

1. STATE HIGHWAY DEPARTMENT. The State Highway Department is awake to the menace of weeds. In counties where individuals combat weeds effectively, the department may be expected to cooperate fully. This organization is experimenting with the seeding of perennial grasses and legumes on newly graded places in order to prevent the encroachment of weeds. This is an excellent plan and deserves state-wide use. Grading practices and shape of borrow pits at the sides of highways may need changing to facilitate planting to grass.

White top along state highway in Jefferson County. This has been spread by grading operations.

2. STATE-OWNED LANDS. Lands are owned by the state (there may be others not listed) and administered by the following agencies:
   Penitentiary
   Hospitals and schools
Fish and Game Commission
State Board of Forestry
State Board of Higher Education
State Highway Commission
State Land Board
Veterans State Aid Commission

The State Land Board has an attorney in each county, and in all counties where ownings of state land are considerable, the local administrator should be a member of the Weed Council. Under the new weed law state agencies are required to cooperate when weed districts are organized.

3. COUNTY PLANNING BOARDS. These organizations may function in helping to outline long-time weed projects, particularly in helping to organize WPA weed projects or other enterprises calling for expenditure of public funds.

Weed mounts as prepared by the State College Extension Service.
ACTION BY FARM ORGANIZATIONS

There are many types of farm organizations that should be, and are, in fact, taking a leading part in weed-control work. The Eastern Oregon Wheat League and the Grange have been most active to date. Some of the things that such organizations can do are listed below.

1. Make weed surveys in all organized communities.
2. Make weed maps.
3. Each year hold one or more educational meetings devoted solely to weeds.
5. Arrange for trials of various control methods.
7. Aid in obtaining additional legislation if needed.
8. Raise money for county contests of various kinds, such as best weed collections by 4-H Club members, most outstanding work on weed control by any farmer, etc.
9. See that the new weed law is explained to all people who operate farm machinery that moves from place to place, such as threshing machines.
10. Appoint local leaders for weed-control programs.

ACTION BY STATE COLLEGE EXTENSION SERVICE

An educational campaign by the State College Extension Service should include frequent letters to local leaders, stories in local and state papers, help in arranging weed discussions at meetings of farm organizations, preparation and distribution of bulletins, preparation of slides or films on weed-control methods, preparation of weed mounts and displays, investigation of failures and successes in weed control all over the state, and publicity on the findings. Unless local people are enthusiastic workers on the weed-control train, the county agricultural agent can do nothing, but he can aid materially in firing and furnishing the steam if others provide fuel.

ACTION BY SCHOOLS

The rural schools can see that each boy and girl knows the principal damaging weeds of the county. This can be done through weed collections and contests in gathering and naming weed specimens. Some Smith-Hughes classes in agriculture have adopted weed-control projects and have prepared weed maps and weed surveys of the communities. Some classes prepare weed mounts and give discussions on weed control before the various farm organizations.
ACTION BY LAND-HOLDING CORPORATIONS

One of the very serious hindrances to effective weed control is the tenant-landlord situation. Tenants hesitate to spend large sums of money in killing weeds when the advantage of the work may go to another. This is especially true if the farm involved is for sale. Corporations owning such lands could help if each would adopt a definite policy toward weed control. We suggest the following as having some possibilities:

1. Give long-time rental contracts with options to buy at a set figure, to tenants who do satisfactory jobs.
2. Allow a stated amount in rent reduction for each acre of weeds destroyed.
3. If chemicals are used, pay part of cost.
4. Have as part of rental contract the agreement to keep infested fields seeded to permanent crops.
5. If the landowner furnishes seed, he should pay particular attention to getting seed free of seed of bothersome weeds.

**ACTION BY FINANCIAL ORGANIZATIONS**

Weedy land has a tendency to revert to the one holding the mortgage. In spite of all the dramas showing the greedy mortgage owner thrusting the poor old man out into the snow, it is safe to say that the average corporation or individual does not want to foreclose. Most of these concerns become landowners against their will and contrary to their intent when the loans were made.

Such situations may be avoided in part by refusing to lend money on weed-infested land. Many money-lending organizations are now following this policy. But if the bank or loan agency already has the farm, perhaps some of the actions outlined in preceding paragraphs are open to them.

**ACTION BY CITY GOVERNMENTS**

The new weed law provides that municipalities must control noxious weeds on lands owned by them within weed-control districts. Therefore representatives of all city governments should have a place on the weed council, learn the sentiment of the people, and be ready to combat any weed infestations within the city limits.

**Objectives of the Weed-Control Program**

The foregoing suggests battle formations and organization behind the lines. The actual attack may combine one or all of the following:

1. Location and mapping of all perennial noxious weed patches.
2. Immediate eradication of all perennial weeds that are found only in small areas within the county.
3. Gradual elimination of weeds that have so firm a foothold that immediate destruction is too expensive. This campaign might include:

   a. Sign virtually every land owner to a voluntary weed-control contract by which he would agree to keep weeds from forming seed and would further agree to undertake complete destruction, a few acres at a time.
b. Clean-up weeds, one small community at a time, starting with communities where infestation is small.

c. In cases of overflow land or irrigated land, start clean-up at head of water supply and work down.

d. Seed down large patches to grass or legumes so that cultivation will not spread the weeds. In each case of weeds that will go to seed in pasture or hay, the owner will usually agree to prevent seed formation by early cutting.

e. The weed council or the county court should appoint non-paid weed supervisors for each small community. These should be men who are particularly interested in weed control. Each supervisor should have no more than fifteen farms. These supervisors have no legal authority, of course, but past experience has shown that they usually accomplish as much as officers of the law.

4. Whenever weed districts are organized, on either a community or county-wide basis, there should be a county weed supervisor with assistants if necessary. These men will be officers with power to enforce the state weed law. It is always better to use patience and tact than to use law, but occasionally the latter is the only weapon that commands respect. Paid supervisors should not supplant the nonpaid men mentioned in (e) above.

5. Roadsides, both county and state, should eventually be seeded to permanent aggressive grasses in which weeds will not thrive. In Eastern Oregon crested wheat grass is good on dry lands and Kentucky bluegrass or smooth brome grass is satisfactory for irrigated or subirrigated areas. In Western Oregon highland bent-grass and Astoria bent are examples of such grasses.

The general plan outlined above would result in a quick clean-up of most of the perennial weeds in more than half of the Oregon counties, and in every county it would result in helping the situation. In most cases the most menacing weeds can be eradicated, but there are a few counties where certain weeds already exist so universally that any attempt at immediate county-wide control would be far too expensive to be borne. Even in these counties other weeds are only in the early stages of spread and could be stopped at once.
A Digest of the Oregon Weed Law

(As Revised by the Legislature in 1937)

1. Weeds are a public menace and their control is a public problem to be solved by the combined forces of individual, county, state, and nation.

2. Counties and state shall be responsible for control of weeds on land owned by them.

3. For the biennium 1937-1938 there is appropriated $15,000 for weed-control work by the State Department of Agriculture; not more than 10 per cent of this may be expended in any one county.

4. County courts may declare counties or parts of counties as weed-control districts for control or for eradication of such weeds as they designate as noxious. If the court does not take such action, then a petition bearing at least 7 names of farm owners, and constituting a majority of the landowners within the proposed district, may be presented asking that such action be taken. The court must then act in accordance with the petition. A weed inspector must then be appointed. He has authority to inspect farms and order the weeds destroyed or kept from producing seeds in accordance with the terms of the order creating the districts. Failure to comply with the supervisor’s orders may result in fines for each offense varying from $10 to $100.

5. Within the boundary of a district the State Highway Commission, the county court, reclamation districts, and municipalities are bound to obey the law, just as farmers are.
6. In cases of total refusal to destroy the weeds or to prevent seed formation, the weed inspector may perform the work and charge it against the land as taxes. If, however, by that time the weeds have already formed seeds, the county court shall request the State Department of Agriculture to quarantine such land and prevent the movement of livestock or crops from the place except under conditions specified in the quarantine order.

7. If weed districts are proclaimed, county courts are required to levy a tax and create a fund to be known as the weed-control fund, to be used for the control of weeds on county roads and public lands, and for cooperation with individuals in the control of weeds.

8. Weed districts may be terminated by the court after a hearing, or by petition of a majority of the landowners.

9. Threshing machines, hay-racks, hay-bailers, and other farm machinery shall not be moved from any farm until such implements are thoroughly cleaned.

10. No hay or straw containing seeds of noxious weeds may be moved to noninfested farms.

11. Owners of threshing machines, clover-hullers, hay-balers, seed-cleaning and seed-treating machines, must display on some part of the equipment copies of the sections of the law dealing with farm machinery. (Points 9, 10, and 11 of this outline.)

Showing the effect of morning-glories in a field of Baby Lima Beans in Malheur County.
A Digest of the Oregon Seed Law

(As Enacted by the Legislature in 1937)

1. All seeds and mixtures of seeds except grains sold or offered for sale must be labeled in accordance with definite labeling requirements. This applies equally to seeds sold from farmer to farmer and sold from dealer to farmer.

2.* If noxious weed seeds are present, it must be so stated on the label, and only specified amounts are permissible at all. For example, seed containing more than 9 seeds per pound of Canada thistle may not be offered for sale. Seed containing any of the seeds of white top, leafy spurge, or Russian knapweed may not be offered for sale or sold.

3. All screenings removed from seeds must be destroyed or de-vitalized if they contain seeds of noxious weeds. This does not apply to grain screenings.

4. A limited number of free seed tests is provided for farmers for seed intended for use only on their own farms. When the seed is for sale, tests must be paid for. All money collected by the seed laboratory must be used solely for seed-testing work, and fees shall be sufficiently high to cover expenses.

5. Certification work on all kinds of seeds, tubers, and plants is vested in the State College. Certification fees are limited in use to certification work. No person may use the terms “certified” or “registered” relative to any seed unless such seed has been in fact certified or registered.

6. The Director of the State Department of Agriculture is authorized to enforce the Act and is given access to warehouses, stores, storage places, etc., wherever seeds may be.

7. The State Department of Agriculture may seize seed offered for sale in violation of the act and hold it until the Act is complied with. If the Act is not complied with, such seed may be destroyed under regulations protecting the rights of the owner.

8. Seed entering the state from outside sources may be held or destroyed if in violation of the Act.

*Noxious weeds: The white tops, Lepidium draba, Lepidium repens, and Hymenophysa pubescens; Russian knapweed, Centaurea picris; all dodders, Cuscuta, spp.; quackgrass, Agropyron repens; wild morning-glory or bindweed, Convolvulus arvensis; Canada thistle, Cirsium arvense; blue flowering lettuce, Lactuca pulchella; death-weed or sumpweed, Iva axillaris; Johnson-grass, Sorghum halepense; leafy spurge, Euphorbia esula; Austrian field cress, radicula austriaca; perennial sow thistle, Sonchus arvensis; puncture vine, Tribulus terrestris; yellow toadflax, Linaria vulgaris; alkali mallow, Sida hederacea; corn cockle, Agrostemma Githago; Australian burnweed or fireweed, Erechtites prenanthoides; the star-thistles, Centaurea melitensis, solstitialis and iberica; St. Johnswort or goatweed, Hypericum perforatum; wild garlic, Allium vineale; oxeye daisy, Chrysanthemum Leucanthemum; cow cockle, Vaccaria pyramidalis; buckhorn plantain, Plantago lanceolata.
9. All seed dealers must be licensed. This includes any person (or any corporation) who sells seeds he did not raise himself. Retailers of packet seeds only are exempted if the company that put up the packets is licensed. The license is $2.50 per year, and receipts from this source are to be used for carrying out the provisions of the Act.

10. Licenses may be suspended or revoked for persistent and willful violation of the act.

11. Violations are punishable by fines of from $10 to $100 for each offense.

12. An annual appropriation of $6,000 is to be divided, $2,500 to the State Department of Agriculture for enforcement, and $3,500 to the Agricultural Experiment Station to pay for authorized free tests. All money from fines is to go to the State Department of Agriculture to be used exclusively in the regulatory work imposed on the department.

Acknowledgments

The authors thank Professor G. R. Hyslop, In Charge of the Division of Plant Industries, for his aid in preparing the bulletin. Dr. D. D. Hill, Professor of Farm Crops, and L. E. Harris, Assistant Agronomist, who read and corrected the manuscript. County Agricultural Agents who made many good suggestions were R. G. Larson of Malheur County, R. W. McKennon of Gilliam, Wray Lawrence of Wasco, O. S. Fletcher of Lane, and William Cyrus of Washington County. Many other county agents gave pictures and information and dozens of farmers generously contributed their experiences.
Leaflets Are Available Describing Individual Weeds

Leaflets have been prepared, each one picturing and describing some particular perennial weed. Listed below are the weeds, covered by this series of leaflets. Anyone wanting only the morning-glory leaflet, for example, is asked to request that one only.

It is likely that additional weeds will be pictured and described in future years, so that after the year 1938 the following list may not be complete.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
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<tbody>
<tr>
<td>Bladder Campion</td>
<td>Silene latifolia</td>
</tr>
<tr>
<td>Blue Flowering Lettuce</td>
<td>Lactuca pulchella</td>
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<tr>
<td>Broad-leaved Dock</td>
<td>Rumex obtusifolius</td>
</tr>
<tr>
<td>Broad-leaved Plantain</td>
<td>Plantago major</td>
</tr>
<tr>
<td>Buckhorn</td>
<td>Plantago lanceolata</td>
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<tr>
<td>Canada Thistle</td>
<td>Cirsiuns arvense</td>
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<tr>
<td>Chicory</td>
<td>Cichorium Intybus</td>
</tr>
<tr>
<td>Curly Dock</td>
<td>Rumex crispus</td>
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<tr>
<td>Dandelion</td>
<td>Tarasacum officinale</td>
</tr>
<tr>
<td>Death Camas</td>
<td>Zygadenus venenosus</td>
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<tr>
<td>Death-weed</td>
<td>Iva axillaris</td>
</tr>
<tr>
<td>Evergreen Blackberry</td>
<td>Rubus laciniatus</td>
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<tr>
<td>False Dandelion</td>
<td>Hyphochaeris radicata</td>
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<tr>
<td>Fern</td>
<td>Pteridium aquilinum var. pubescens</td>
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<tr>
<td>Field Chickweed</td>
<td>Cerastium arvense</td>
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<tr>
<td>Gorse</td>
<td>Ulex europaeus</td>
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<tr>
<td>Heal-All</td>
<td>Prunella vulgaris</td>
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<tr>
<td>Hedge Bindweed</td>
<td>Convolvulus sepium</td>
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<tr>
<td>Himalaya Blackberry</td>
<td>Rubus procerus</td>
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<tr>
<td>Horsetail Rush</td>
<td>Equisetum arvense</td>
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<tr>
<td>Johnson Grass</td>
<td>Sorghum halepense</td>
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<tr>
<td>Larkspur</td>
<td>Delphinium Andersonii</td>
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<tr>
<td>Larkspur</td>
<td>Delphinium Mensiesii</td>
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<tr>
<td>Leafy Spurge</td>
<td>Euphorbia esula</td>
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<tr>
<td>Morning-glory</td>
<td>Convolvulus arvensis</td>
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<tr>
<td>Mouse-ear Chickweed</td>
<td>Cerastium vulgatum</td>
</tr>
<tr>
<td>Myrtle</td>
<td>Vinca minor</td>
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<tr>
<td>Nettle</td>
<td>Urtica Lyallii</td>
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<tr>
<td>Oxeye Daisy</td>
<td>Chrysanthemum Leucanthemum var. pinnatisifidum</td>
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<tr>
<td>Perennial Ground Cherry</td>
<td>Physalis lanceolata</td>
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<tr>
<td>Perennial Peppergrass</td>
<td>Lepidium latifolium</td>
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<tr>
<td>Poison Oak</td>
<td>Rhus diversiloba</td>
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<tr>
<td>Quackgrass</td>
<td>Agropyron repens</td>
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<tr>
<td>Russian Knapweed</td>
<td>Centaurea picris</td>
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<tr>
<td>St. Johnswort</td>
<td>Hypericum perforatum</td>
</tr>
<tr>
<td>Salt Grass</td>
<td>Distichlis spicata</td>
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<tr>
<td>Plant Name</td>
<td>Scientific Name</td>
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</tr>
<tr>
<td>Scotch Broom</td>
<td>Cytisus scoparius</td>
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<tr>
<td>Sheep Sorrel</td>
<td>Rumex Acetosella</td>
</tr>
<tr>
<td>Shoe-string weed</td>
<td>Psoralea lanceolata</td>
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<tr>
<td>Sweet Brier</td>
<td>Rosa rubiginosa</td>
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<tr>
<td>Tansy</td>
<td>Tanacetum vulgare</td>
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<tr>
<td>Tansy Ragwort</td>
<td>Senecio Jakobaea</td>
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<tr>
<td>Tuber Oatgrass</td>
<td>Arrhenatherum elatius var. bulbosum</td>
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<tr>
<td>Water Hemlock</td>
<td>Cicuta Douglasii</td>
</tr>
<tr>
<td>White Top</td>
<td>Lepidium repens</td>
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<tr>
<td>White Top</td>
<td>Lepidium draba</td>
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<tr>
<td>White Top</td>
<td>Hymenophysa pubescens</td>
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<tr>
<td>Whorled Milkweed</td>
<td>Asclepias mexicana</td>
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<tr>
<td>Wild Onion</td>
<td>Allium ampelotens</td>
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<tr>
<td>Yellow Nut Grass</td>
<td>Cyperus esculentus</td>
</tr>
<tr>
<td>Yellow Toadflax</td>
<td>Linaria vulgaris</td>
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</tbody>
</table>

To obtain additional copies of this bulletin or copies of any of the leaflets on weeds in the list above, write to Extension Service, Oregon State College, Corvallis, Oregon.