
How to Rid Our Farms of Weeds

A. L. STONE



GOOD PLOWING NECESSARY TO ERADICATE WEEDS

The depth of the plowing should be regulated so as to turn the root stocks to the surface.

AGRICULTURAL EXPERIMENT STATION
OF THE UNIVERSITY OF WISCONSIN

MADISON, WISCONSIN

DIGEST

The loss from weeds is enormous; fully twenty-five per cent of the earning capacity of some farms in certain sections of this state is being lost. Millions of dollars can be saved annually by the use of a few simple methods of weed control. Pages 3 to 4

Successful destruction of weeds depends upon a knowledge of the life-periods and habits of the plant, and the application of this knowledge in the fight against them. Annual and biennial weeds may, for purposes of eradication, be treated alike. Page 5

Scattered weeds are best eradicated by cutting or pulling up by the roots while in full bloom. Where they occur in large patches cultivation, rotation of crops and chemical sprays should be employed. The main object is to prevent plants from going to seed. Pages 6 to 11

Perennial weeds offer the greatest resistance and require more thorough and persistent effort. Two of the most troublesome weeds in this state are Quack Grass and Canada Thistle. The former may be distinguished from other grasses if its characteristic features are known. Whatever method will destroy Quack Grass will also kill Canada Thistle or any other perennial weed. Pages 11 to 18

Fallowing or cultivation without a crop is the most certain method of eradication on large areas, and may be used to good advantage except on sandy soils and those continuously wet or very porous. Success depends upon the depth of plowing and frequent cultivation. The prevention of all leaf-growth in weeds means their certain death. Certain cropping systems will usually be successful with Quack Grass. Pages 18 to 22

Small areas may be freed of perennial weeds by covering with paper or by close cultivation. Page 22

Special methods for eradicating thistles that do not apply to Quack Grass are the growing of alfalfa, the seeding down of fields to perennial grasses, salting the plants, or applying gasoline or carbolic acid. Page 23

Concerted action is necessary. The most noxious weeds can be eradicated, and farmers should co-operate with each other, with the Legislature and the Experiment Station to rid this state of these enemies to profitable and pleasurable farming. Page 24

How to Rid Our Farms of Weeds

A. L. STONE

Taxes, of course, are inevitable, and by many often regarded as necessary evils. How many of us, though, fail to appreciate the tax which we voluntarily allow to be levied against us through unnecessary waste and readily preventable losses. But few appreciate how much of a tax noxious weeds take on many of our farms, nor how rapidly these pests are being spread over the state.

Occasional efforts to prevent their spread are worth but little. Constant unremitting attention until the complete destruction of all these pests is accomplished, is the only way to prevent these losses and insure success.

Our present weed laws are of but little value. The money spent on the annual mowing of vacant lots and roadsides is practically all wasted. To a certain extent the strict enforcement of the pure seed law will prevent the infestation of new areas, and something will be done by it in stimulating public interest in pure seed, free from weeds, etc., but before adequate and efficient legislation can be made to be of much interest there must be developed a united public opinion which will be willing to grapple with this evil in earnest. This is certainly a subject which might well concern our legislative bodies.

H. L. RUSSELL,
Director.

The annual losses caused by weeds on Wisconsin farms need more serious consideration than they have thus far been given. The Agronomy Department has accumulated considerable evidence which shows certain portions of the state to be infested with weeds to such an extent that it is very advisable to carry on a determined warfare to eradicate them. For many years those interested in scientific and permanent agriculture have thoughtfully considered the damage done by weeds and have

issued repeated warnings. But this work was confined almost entirely to preventive measures, and largely along the line of seed inspection for the purpose of insuring clean seed.

Farmers on virgin soils of the United States where weeds were not numerous were inclined to ridicule the idea that weeds could ever become seriously troublesome. The fears of the scientists however have been realized, and many farms in the United States have been abandoned because weeds multiplied and spread so rapidly that the farmers have become discouraged, and given up in despair. That such conditions as these exist even in Wisconsin may be surprising to many, yet such is the case, and noxious weeds are spreading here at a rate which has alarmed those who are acquainted with the seriousness of the situation. On many farms in this state fully 25 per cent of the crop-producing capacity has been destroyed by weeds. What this means to the owner of a 160 acre farm can be shown by a few figures. Twenty-five per cent of one hundred and sixty acres is forty acres. At thirty bushels per acre this area should produce twelve hundred bushels of barley. With barley at sixty cents per bushel the crop would be worth \$720. With land worth \$100 an acre, the farm would have a value of \$16,000. A loss of \$720 on an investment of \$16,000 is a loss of $4\frac{3}{4}\%$ —surely more than the average farmer can afford to bear.

Very good crops must be grown on the remainder of the farm if such a loss is to be overcome. The majority of farmers can not long make a profit under such conditions. Fortunately such conditions do not exist in all sections of the state and farmers of the portions which are not yet infested should take extreme care that weeds are eradicated before they spread. This circular is designed to arouse those interested in better farming to some concerted action for weed-control and eradication before conditions become more serious.

The successful eradication of weeds depends upon a knowledge of two important points. First, how long does the plant live? Second, how does it reproduce and spread?

LIFE PERIODS OF PLANTS

With respect to duration of life there are three classes of plants, viz.,

Annuals,

Biennials,
Perennials.

An annual comes up from a seed, bears flowers and seeds and later dies; all within one year.

A biennial grows from a seed but produces only leaves the first year. The root and sometimes the leaves live through the winter. The second year a flower stalk comes up, seeds are produced, and the plant dies.

A perennial is one the roots of which live on year after year unless killed in some way. Depending upon conditions, the plant may or may not produce seed every year.

METHODS OF REPRODUCING AND SPREADING

Plants reproduce themselves in various ways:—First, by seeds alone; Second, by roots alone; third, by seeds and roots both, and fourth by runners, suckers, etc.

Practically all annual plants reproduce themselves by seed only. Biennials, also, except for the one winter through which the roots live, reproduce themselves by seeds. Perennials may propagate by means of the roots only as does the Horse Radish which in many places is a bad weed. This plant was introduced into Wisconsin from a warmer country and while its roots live on for many years it produces no seed. Canada Thistles in many cases spread only by the roots and bear no seeds, while in other instances, where the conditions are favorable, a large amount of seed is produced.

The Wild Morning-glory when growing in cultivated ground often produces no seeds but spreads rapidly by its roots. There are other noxious weeds which reproduce and spread both by seed and root like the Ox-eye Daisy, the Snapdragon or Butter and Eggs, the Bouncing Bet, Perennial Sow Thistle, Quack Grass, and several more.

The importance of knowing the habits of any weed lies in applying this knowledge to the eradication of the plant. For instance, it would be useless to summer-fallow a field in order to kill an annual weed like the Wild Mustard which can be kept from spreading by any method that will prevent it from bearing seed. Whether the root is removed from the ground or not is of little consequence if no seeds are allowed to form.

On the other hand it would be equally unwise to attempt to

destroy Quack Grass by preventing it from bearing seed when, in many cases, it really spreads more rapidly by root stocks than by seed. Hence to intelligently eradicate any weed one must know its life period and its habit of growth.

METHODS FOR ERADICATING ANNUAL AND BIENNIAL WEEDS

For purposes of eradication the annual and biennial weeds may be treated alike. Both may be kept from spreading or reproducing themselves by preventing them from bearing seed.

MEANS OF CONTROL

ANNUALS AND BIENNIALS

1. *Cutting or pulling*
2. *Thorough tillage of cultivated crops*
3. *Rotation of crops*
4. *Spraying with chemicals*

PERENNIALS

1. *Summer fallowing*
2. *Partial summer fallowing and smother cropping*
3. *Thorough cultivation with crop*
4. *Smothering with tar paper, etc.*
5. *Application of salt brine, gasoline, etc.*

The important thing is to decide which is the best way to prevent the plants from bearing seed, and the way chosen will depend upon whether the plants are scattered or whether they are growing closely together in large patches or fields.

TREATMENT FOR SCATTERED PLANTS

Where annual or biennial plants are scattered there are two ways of killing them, either by pulling them up by the roots or by cutting them. When the plants are pulled up they may safely be dropped where pulled in the field if the seed-pods have not yet been formed. When the seed-pods are once formed, plants usually possess sufficient vitality to ripen the seeds even when they have been pulled up and thrown on the ground. In

such case the plants should be carried to some place where they may be burned.

If annuals are to be cut, this should be done if possible beneath the surface of the earth. Any other method is apt to leave one or two small branches on each plant and the entire food-supply furnished by the well-developed root is sent to these branches. They thus grow very rapidly and are practically certain to ripen their seeds unless cut a second time and even then the seed-pods will probably have formed and necessitate burning of the plants. A good tool for cutting scattered plants is the "spud" shown in Fig. 1.



FIGURE 1.
THE "SPUD"

METHODS FOR LARGE PATCHES OR FIELDS

Where annuals or biennials are growing in large patches or thickly infest whole fields, other methods than pulling and cutting must be used.

Cultivation. Careful and thorough preparation of the seed-bed for every crop is a great factor in the control of annual weeds. Fields which have been fall-plowed usually have a hard crust over them in the spring. The weed plantlets growing in the soil are not noticeable until cultivation breaks the crust and the white or pink stems of the young weed-plants are thrown up, sometimes by the thousand. Exposed to the sun and wind, they are practically all killed.

This same cultivation turns a new lot of seeds up to the surface to sprout, and within two or three days a new crop of weeds is growing. Another cultivation kills this crop; it would not require many such operations to practically free the crop-producing portion of the soil from weeds. The disk-harrow (Fig. 2) is an especially valuable tool for fitting fall-plowed land for

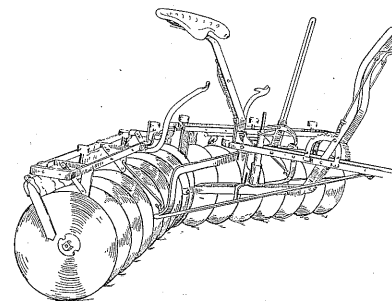


FIGURE 2.—DISK HARROW

A splendid tool to stir the winter packed soil thus exposing to the deadly work of wind and sun the young weed plants which start their growth with the first signs of spring.

a crop and killing the young weeds. Even after the crop is planted, the field should be harrowed whenever possible to kill whatever young weeds may have appeared. (See Fig. 3)

The value of such cultivation was shown in one instance where seven acres of a certain field were not harrowed. The weather later prevented further cultivation. On portions of the field which had been harrowed a two-hundred-bushel crop of potatoes was produced. On the unharrowed portion, the weeds took complete possession. They were so thick that the potatoes were choked out and no attempt was made to harvest a crop. Many farmers hesitate to drag corn, potatoes, or sugar

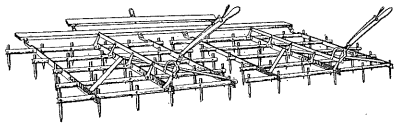


FIGURE 3.—THE SPIKE TOOTH "DRAG" OR SMOOTHING HARROW

An excellent tool for dragging out and killing young weeds in corn fields and elsewhere. It should follow the weeder shown in Figure 4.

beets early in the growing season, for fear of tearing out or covering up some of the young plants. If the dragging is done during the middle of the day or when the plants of corn or other crops are somewhat withered but little damage will be done. More weeds will be killed by one dragging while they are young and tender than by several cultivations when the plants have become larger and harder to kill.

Besides killing the weeds cultivation ventilates and warms the soil, supplying much better conditions for germination of the seed and giving the crop a strong, vigorous start. It also encourages chemical action and provides the nitrifying and other bacteria with better conditions in which to work, and to render available a larger amount of plant food. Every good farmer has discovered this secret and no matter what the conditions are, insists on a careful preparation of his land for crops and plenty of the right kind of cultivation afterward. In fact many farmers even insist that Quack Grass and Canada Thistles are blessings in disguise because their presence necessitates more intensive preparation of the seed bed, and better and more frequent cultivation of the crop than is often otherwise given. The importance of careful cultivation both for weed eradication and its effect upon the soil and the crop cannot be over emphasized. This fact in a measure off-sets the expense incurred in the process of eradication. Where crops like corn and sugar

beets are drilled-in, killing the weeds in the rows, while they are small, is especially important. (The weeder shown in Fig. 4 serves this purpose well.) If allowed to grow to any height it is necessary to cover the weeds with dirt in an endeavor to kill them. This requires deep cultivation, and may cut off many of the roots of the corn, retarding its growth and lessening the yield. To offset this damage, it would be well to plant a little additional seed in the beginning.

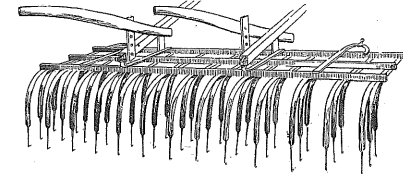


FIGURE 4.—THE "WEEDER"

A splendid tool for killing young weeds in any cultivated crop like corn, potatoes, or sugar beets, while too young for a spike tooth harrow to be effectively used.

Rotation of Crops. Perhaps one of the best means of successfully combatting weeds is by rotating the crops grown upon the infested fields.

A good rotation, especially for the dairy farmer, is one requiring four years and may include the following crops:

- First year—corn with clean cultivation;
- Second year—grain crop with clover (ten pounds), timothy (eight pounds);
- Third year—two crops of clover-hay;
- Fourth year—timothy meadow, or pasture.

For the second year of the rotation barley, oats, or spring wheat may be grown, as best suits the farmer's convenience. In the fourth year a crop of timothy hay may be cut or the field pastured, whichever plan best meets the needs on each particular farm. The sod should be manured and plowed in the fall and the field made ready for corn the succeeding spring. The degree of success obtained with this or any other rotation is largely dependent upon persistent cultivation of the corn or other cultivated crop.

Shorter rotations are not apt to be very satisfactory for weed-control, although in some cases and on some soils they serve the purpose admirably. Longer rotations, particularly those including alfalfa, would be even more satisfactory for the eradication of weeds. The establishment of a good crop-rotation on a field is usually a guarantee that annual or biennial weeds will be largely destroyed and that even the perennial weeds will be partially controlled. A few weeds can produce an enormous

quantity of seed. At this Station actual counts have shown that a well developed plant of Pigeon Grass will produce 142,000, Redroot or Rough Pigweed 330,000, Barnyard Grass 1,290,000, and the Tumble Weed 6,000,000 seeds. These are among the common weeds infesting cornfields and none of them should be allowed to go to seed, because one crop of weed-seeds will cause untold trouble.

In this rotation if the corn is kept clean and cut close to the ground the field can be left unplowed and the ground for the oats and grass seed be prepared by disking and harrowing thoroughly the next spring. The thorough and careful cultivation of the corn should have killed all the seeds and weeds in the crop-bearing surface of the soil so that the grain-crop following should be practically free from weeds. If the ground were plowed a new crop of weed-seeds would be turned up, to grow in the grain unless killed by thorough cultivation before the grain is sown. If properly carried out, this rotation will prevent the production of weed-seeds on the field for four years, as practically no weeds grow in the hay if a good stand is secured.

“Are four years of persistent work enough to kill all weeds?” They would be, were it not for the great length of time during which weed-seeds may lie dormant in the soil only to grow and reproduce their kind when turned to the surface. Instances are known of weed-seeds growing after having been buried for ten and even more than forty years! Hence the need of continued rotation.

Chemical spray checks. Another effective method with some weeds, notably the Wild Mustard, is to apply some sort of chemical spray. Various chemicals have been used with varying success. Iron sulphate and common salt have given good results and are comparatively cheap. The former can be bought for one dollar per hundred pounds; salt at half that price. A 20% solution of the iron sulphate or a 35% solution of the salt is effective and easily made by placing 100 pounds of the former or 125 pounds of the latter in a vinegar or kerosene barrel, filling with water and stirring until completely dissolved. It should be applied on a fair day after the dew is off, at the rate of one barrel to an acre. If rain falls within 24 hours, a second application may be needed. A sprayer throwing a fine mist that will settle gently upon the plant should be used.

Success depends upon reaching all portions of the plant with the spray. The one ordinarily used for potatoes throws too coarse a spray. The proper implement should develop a pressure of 100 pounds to the square inch. By using a sprayer with a 20 foot boom, a man with a good team can spray 20 acres a day, provided he has a helper to make the solution for him.

This method is advisable only where mustard is very thick. It will kill only the plants which are in the grain at the time of spraying and will have no effect whatever on the millions of seeds buried in the soil. Its effect therefore extends only to the year's crop. The spraying would need to be continued for several years or until the mustard plants would not be thick enough to make spraying profitable, when the remainder of the work would have to be done by hand.

Probably a much greater destruction of wild mustard would result from plowing and cultivating. Successive crops of seeds would be turned to the surface, sprout, and as rapidly as the young plants appear, they would be killed by cultivation. By continued repetition of this process, the crop-bearing surface of the soil could probably be freed from mustard in a single season.

METHODS OF ERADICATING PERENNIAL WEEDS

While there are many perennial weeds which are proving troublesome on Wisconsin farms, two are pre-eminently noxious, because of their peculiar nature and habits, viz., Quack Grass and Canada Thistles. Description of these weeds and the methods whereby they may be destroyed follow.

QUACK GRASS

Quack Grass grows to a height of from one to five feet, depending upon the fertility of the soil and the character of the season.

Its roots are fine and fibrous, like those of other grasses. It also has underground stems or root-stocks, which give this plant its noxious character. They must be killed to eradicate it. This is difficult to do, for they possess great vitality. They resemble roots and are sometimes mistaken for them. They look like other stems, except that the color is nearly white and the joints are much closer together, usually not more than an inch and a half apart and often less than that. At each joint new roots are thrown out and at many of them new stems start. In this way

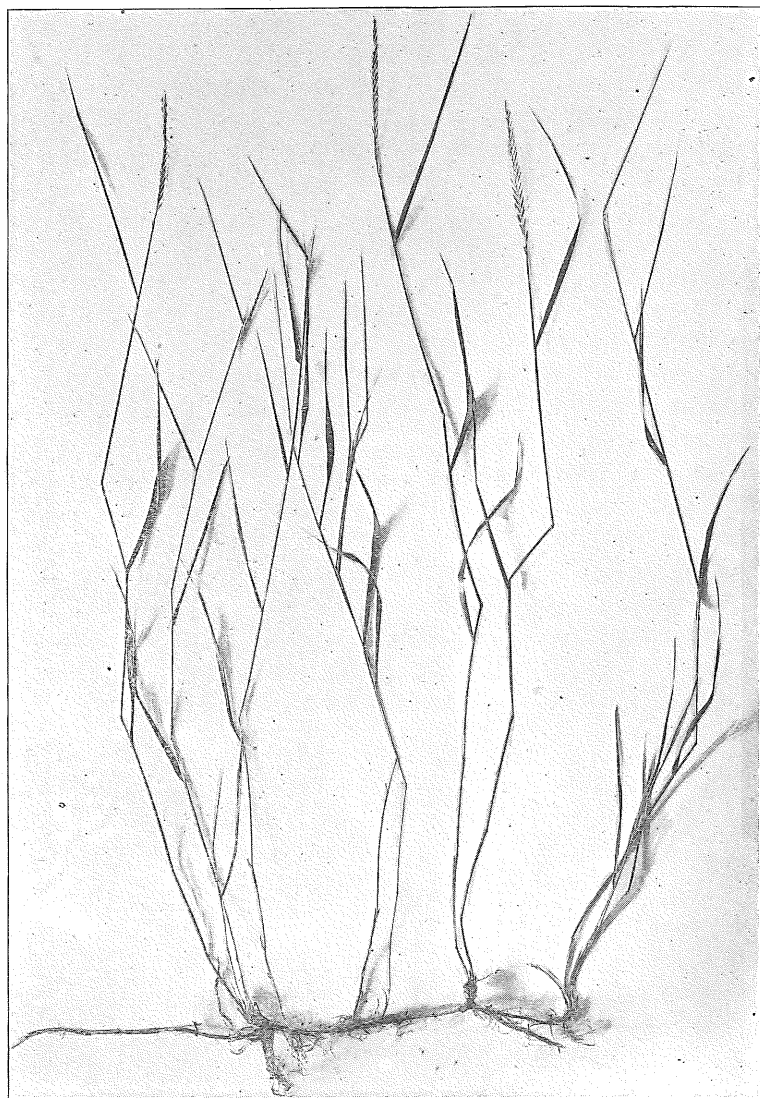


FIGURE 5.—A PERSISTENT TROUBLE MAKER

This shows the characteristic root growth of Quack Grass, one of the worst of all noxious weeds. When the main, underground rootstock is broken and spread over the field by farm implements a new plant springs up from each separate piece.

the grass spreads rapidly and a piece of the rootstock with one of these joints on it will produce a new plant, although it may be not over one-half inch long.

The leaves vary from three to twelve inches in length and

from one-fourth to one-half inch in width. They are rough to the touch on the upper side and smooth on the lower. The parts which clasp the stem (sheaths) are shorter than the distances between the joints (internodes).

The head is from three to eight inches long and from one-fourth to one-half inch wide. It is slender and at first glance much resembles English Rye Grass. The divisions of the head (spikelets) in Quack Grass are turned with the flat side to the stem (rachis), while in Rye Grass the edge of the spikelet faces the stem. When the heads first appear, they are narrow but grow wider as the plant approaches maturity.

The seed of Quack Grass is about one-half inch long and one-sixteenth of an inch wide, light brown or yellowish when ripe, and resembles the oat, except that it does not close up so much on the furrow side. At the larger end of the seed and in the furrow there is a club-shaped appendage (rachilla) about one-sixteenth of an inch long.

The leaves and roots of Brome Grass are often mistaken for Quack Grass, and while the plants are young it is extremely difficult to distinguish them. The roots of Kentucky Blue Grass and Red Top are also mistaken for those of Quack Grass, principally because these grasses spread by rootstocks, similar to those of Quack Grass, except that they are much smaller. It is not possible to confuse these last named grasses with the Quack Grass after they are headed out, for all of them in general outline resemble oats, instead of rye or wheat, as is the case with Quack. The heads of different plants vary greatly in appearance. In some the flower covering (glume) bears only a sharp point at the end. In others the glume bears a distinct beard (awn) one-half an inch long. Some plants are light and some are dark green in color but in the general characteristics all are alike.

How it is spread. The whole plant grows rapidly and ripens its seed usually in July. Where growing in meadows, it may be gathered in the hay, whence it gets into the manure and so scattered broadcast over the farm.

If growing in grain it may be harvested and threshed with the grain, and if the grain is not graded with extreme care some of the Quack Grass seed will be sown on the fields the next year. If the hay or grain is sold on the market the seeds may be carried for long distances to establish patches of the grass on farms far removed from the place where the hay or

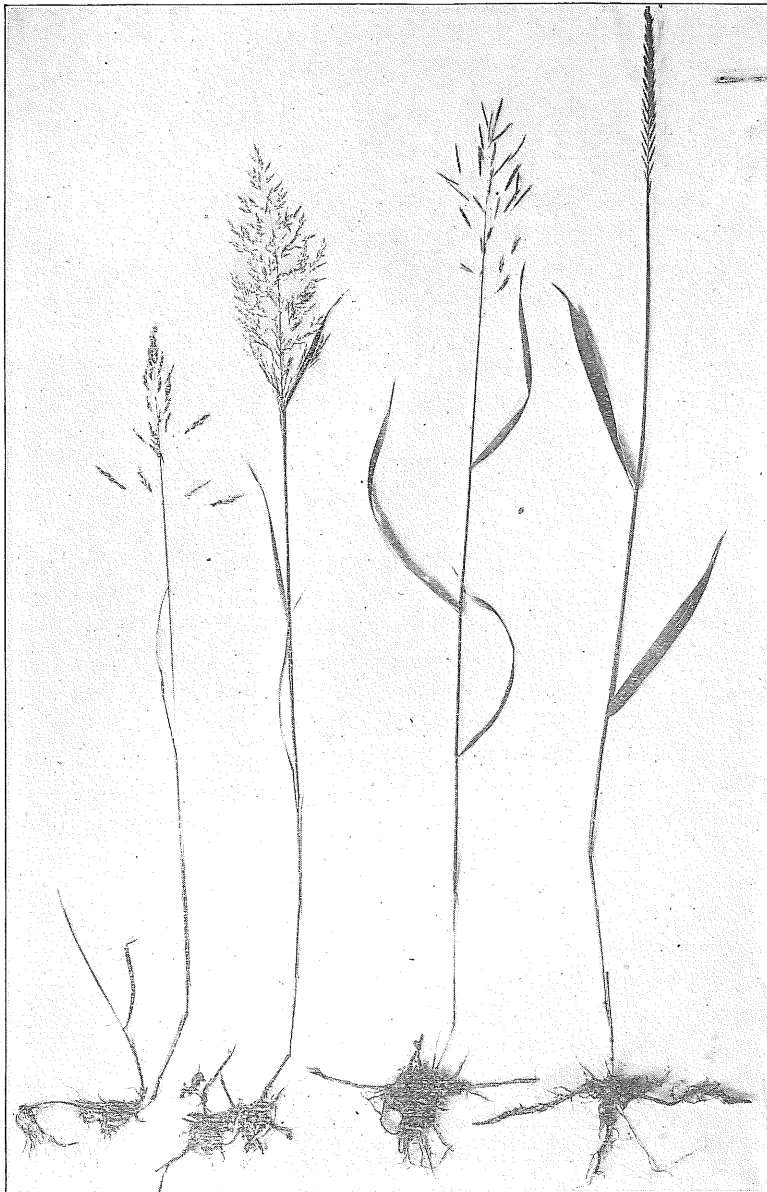


FIGURE 6.—THREE GOOD PLANTS IN BAD COMPANY

Before the heads are grown the roots of Kentucky Blue Grass, Red Top and Smooth Brome Grass are frequently mistaken for those of Quack Grass. The plants are shown above in the order given, with Quack Grass on the extreme right.

grain was produced. The seeds, and, in some cases rootstocks also may be carried from farm to farm by the spring floods or the seed may be blown from place to place by the wind. While Quack Grass may have some feeding value, it is not relished by stock so much as cultivated grasses are and its presence prevents the production of crops of much greater economic value and importance.

CANADA THISTLE

Like Quack Grass the Canada Thistle is a perennial plant. In height it ranges from one to three feet, depending on conditions. It is said to have received its name from the fact that it was found in the French settlements in Canada, although it was later introduced by the Dutch into New York and by the English into Vermont and New Hampshire. In England it is called "corn thistle," "green thistle" or "creeping thistle."

The Canada Thistle does not have rootstocks like the Quack Grass, but has true

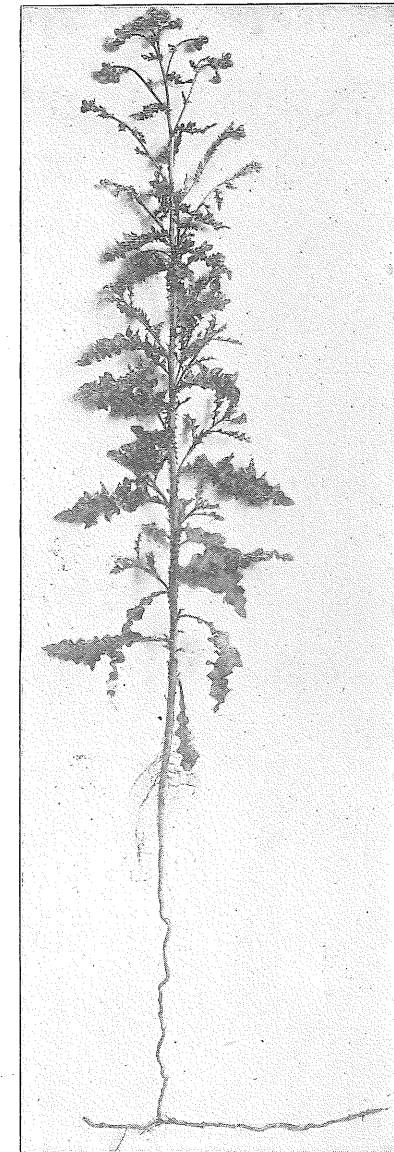


FIGURE 7.—A TYPICAL CANADA THISTLE PLANT

This shows the long stem root and the horizontal underground root. Note the slender leaves and flower branches as compared with the Bull Thistle shown in Figure 8.



FIGURE 8.—THE ORDINARY BULL THISTLE

This plant is frequently taken for its relative, the Canada Thistle. Note the heavy main stem, the thick leaves and large tuft of surface roots with a single tapering tap-root.

more than three-quarters of an inch in diameter and bears few spines. It separates into several branches near the top, each branch bearing a flower.

roots, the parts of which are capable of producing plants. There are tufts of rootlets at intervals on the horizontal root. These roots are about a quarter of an inch in diameter, almost white in color and it is from these that new plants are thrown up at intervals as they extend their length through the soil.

When undisturbed by cultivation the roots are apt to lie near the surface, but go deeper in cultivated soil and where it is particularly loose and porous may be found at a depth of three feet. The roots are very hardy and by means of the sharp growing points will sometimes send shoots up through two or three feet of hard packed clay soil. When the plant begins its growth in the spring, a rosette of leaves is formed close to the ground from the center of which a flower stalk is sent up.

The stem is rather slender, somewhat irregular in shape, seldom

The leaves are bright green in color, smooth on the upper face and rough or hairy beneath. The lower leaves are from three to eight inches long and from one to one and one-half inches wide and the edges are curled or wavy. The edges are cut or divided and bear a large number of sharp stiff spines, which on the mature plant are yellow or almost white in color. The leaves are easily distinguished from those of the common or Bull Thistle, the leaves of which are very rough on both surfaces and bear a large number of spines of varying lengths.

The heads are purple, about an inch long, three quarters of an inch in diameter and bear no spines but simply stiff scales

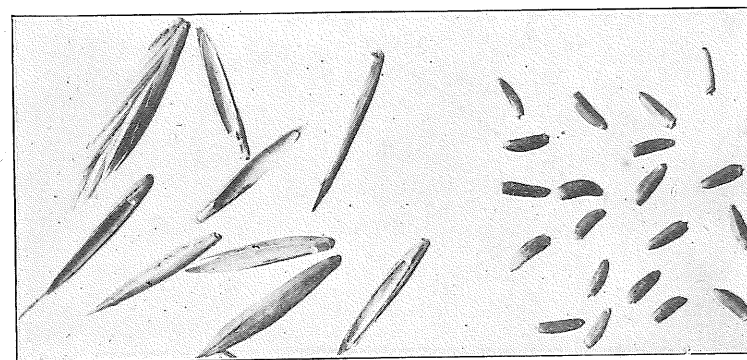


FIGURE 9.—QUACK GRASS AND CANADA THISTLE SEED

Spikelets and seeds of Quack Grass at left. Seeds of Canada Thistle at the right. Note that some of the Quack Grass seeds have awns and some do not.

or bracts. They differ from the heads of the Bull Thistle which are often two inches or more long and an inch in diameter and covered with sharp, stiff spines.

The seeds are smooth, brown, about an eighth of an inch long, and larger at one end than the other. The larger end bears a shallow depression or cup, from which projects a sharp point. Once seen and known the seed will not be forgotten. Every seed bears a tuft of downy hairs, called a "pappus," by the aid of which it may be carried a mile or more during the high winds preceding some of our summer storms.

The seeds may be carried from place to place by water in the shape of spring floods, creeks, rivers, irrigation and drainage canals. They may also be shipped in hay or grain, but the most prolific source of introduction is through grass and clover seeds. For this reason all grass and clover seed should be carefully ex-

amined before sowing to make sure that it contains no Canada Thistle seed.

Habits. Canada Thistles seldom bear seed in cultivated fields but in clover or grass fields, in pastures, groves or fence rows where they may develop undisturbed for a time, seed is often produced abundantly. Whenever seed is produced on plants growing in cultivated fields only a few of the heads on each plant bear seed, the rest being sterile.

While Canada Thistles produce more or less seed, yet the increase of these pests is due largely to the roots which spread out rapidly in all directions and are transplanted in widely different portions of the farm by the plow, drag, and cultivator.

METHODS OF ERADICATION

Many methods have been devised and advocated for the eradication of Quack Grass and Canada Thistles. The success of any method depends very largely upon soil and weather conditions and a method which has proven entirely successful under one set of conditions has frequently failed when used under somewhat different circumstances. Quack Grass is more persistent and more difficult to eradicate than the Canada Thistle, hence any method which will eradicate Quack Grass will surely destroy Canada Thistles or any other perennial weed.

Some methods may be used effectively and economically on small patches, but will prove too costly for large areas. The method should be wisely selected and suited to the circumstances.

METHODS FOR LARGE AREAS

Following or Cultivation Without a Crop. This method is successful except on sandy soils which leach badly, soils that are continuously wet, or are so porous that the horizontal roots are too deep to be reached with the plow. No crop can be grown while this treatment is being given. Then the field should be plowed as soon as possible after the crop has been removed, but should not be plowed while so dry that the soil turns up in large lumps, making it difficult to work. The depth of the plowing is very important as the success of the method practically depends upon it.

First ascertain the depth at which the horizontal roots or rootstocks are growing, and regulate the depth of the plowing so as to turn them to the surface (See Fig. 10). In meadows, or pastures, or any other place where the plants are not cultivated or otherwise distributed the rootstocks of Quack Grass will be found usually within two or three inches of the surface. In cultivated ground they grow deeper, in some cases below the usual plow line.

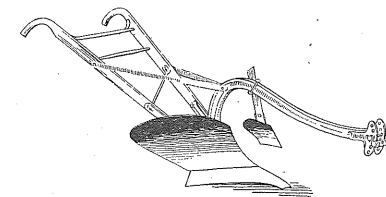


FIGURE 10.—PLOW FOR KILLING WEEDS

The style of plow to be used in plowing grain or corn fields. It will turn the roots well up on the surface and cover all litter which might hinder the necessary cultivation.

After plowing, the field should be cultivated often enough to prevent all leaf growth, for every time the leaves get above the surface they supply the root with food and thus prolong its life. Hence the cultivation must be done before the leaves appear above the ground. The plant breathes through its leaves and if its breathing apparatus is destroyed, it dies for lack of air. The succeeding spring the ground should be plowed again just deep enough to turn to the surface any roots which the cultivator may have failed to reach the preceding autumn.

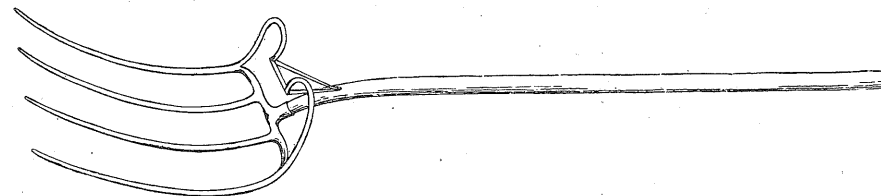


FIGURE 11.—THE BARLEY FORK

An excellent tool to pick up dead roots of weeds which have been killed by cultivation.

The object of the cultivation is to drag all the roots to the surface where the wind and sunshine will dry them out and kill them. In a damp season the roots should be removed from the field by use of a horse rake and a big fork (shown in Fig. 11). A spring-tooth harrow (See Fig. 12) or some other good digging-tool is preferable to a disk-harrow. The latter cuts up the roots into small pieces; it requires more work to get them all to the surface where they will be killed, and a single portion of a Quack Grass rootstock bearing a joint will start a new plant even

though it is only one-half inch long. It has been shown that a piece of Canada Thistle root a quarter of an inch long will often produce a new plant, so it is unwise to cut them up with a disk harrow. The field should be plowed at varying depths at least three times more during the season, to make sure that all roots are brought to the surface and killed. The cultivator should be kept going during the time between plowings to prevent all leaf growth.

In case there is any doubt about the complete eradication of the weeds, corn planted in checkrows to allow of cultivation both ways should follow the summer-fallow. Close watch should be kept of the field and if any weeds appear they can be removed by hoeing. It is not probable that any weeds will survive the preceding treatment but it is well to be certain.

This fallowing method is more certain to result in complete eradication than any other which has been tried. It gets rid of the weeds with one year's work. The thorough cultivation of

the soil puts it into splendid condition, a much larger crop will be obtained the following year than possible had the weeds remained, and the field will continue to bear good crops after the weeds have been eliminated. The dead rootstocks of the Quack Grass will be converted into humus and so increase the water-holding capacity of the soil. For these

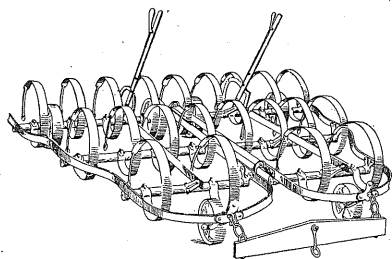


FIGURE 12.—THE SPRING TOOTH HARROW

One of the very best tools to drag the roots of Canada Thistles and other noxious weeds to the surface of the soil where sun and wind can kill them.

reasons it is as economical a method as one which allows the production of crops but extends the treatment through several years.

VARIATIONS OF THE FALLOW METHOD

Cultivating with a Crop. Where the Quack Grass or Thistles are to be removed while a crop is being raised plowing should begin the preceding summer or autumn, the earlier the better. This should be followed by careful cultivation until the ground freezes up. The next spring plowing should begin as soon as

soil conditions permit and be repeated at intervals of four weeks until the first of July.

Between plowings thorough cultivation should be practiced. On the date mentioned the seed-bed should be carefully prepared and the land sown to millet or buckwheat at the rate of three pecks per acre in either case. The previous treatment will have so weakened the weeds that the millet or buckwheat will be well established before the weeds recover sufficiently to begin growth.



FIGURE 13.—HEMP IS A SUCCESSFUL SMOTHER CROP

This picture, taken on the state prison farm at Waupun, shows what little chance the most hardy and persistent weeds have to obtain air and light when hemp gets a good start.

Hemp is another crop which has lately been introduced into Wisconsin, and which has already shown its value as a smother crop for weeds. It requires a very fertile soil for best results, but will do well on all but our more sandy soils. The preparatory treatment of an infested field should include the application of twenty loads of barnyard manure per acre followed by the partial fallow as outlined for use with the millet and buckwheat. Hemp must be sown by May 10th in Wisconsin, hence not much spring cultivation other than a careful preparation of

the seed bed can be given. Sow the hemp with a broadcast seeder or grain drill at the rate of one bushel of seed per acre. Experiments conducted by C. P. Norgord of this station show that success is practically sure on fertile soils but cannot be expected on poor soils or on badly infested fields where insufficient preparatory work has been done. All of these crops grow rapidly and provide a dense shade which smothers the weeds.

This means is almost sure death to Canada Thistles, but often fails with Quack Grass and must be adopted advisedly. If followed by plowing again in the fall after the crop is removed and by thorough cultivation the succeeding spring, all weeds will probably be killed. This method allows the production of a crop during the process of weed eradication, but it is not so certain of success.

METHODS FOR SMALL AREAS

Covering with Paper. Quack Grass and Canada Thistles in patches not over two rods square can sometimes be economically killed by cutting the weeds close to the ground just when in bloom and covering with tar or some other heavy building paper. The strips of paper must overlap sufficiently to prevent the plants from coming up between the strips and should also extend far enough beyond the edges of the patch so that no plants can reach the air and sunlight.

The paper should be weighted down with earth or stone to hold it in place. If the surface is nearly level it would be better to use planks or fence rails to hold the paper in place because the earth is apt to retain moisture and cause the paper to rot.

This method can only be used successfully on fairly level ground where the paper can be held close to the surface. In a dry season 60 days is usually sufficient to destroy the weeds, but it is best to leave the paper on until time to plow in the fall. Should any plants survive this treatment they will be so weakened as to be easily killed the succeeding season.

Close Cultivation. Where it is not possible to use the foregoing method either because of unevenness of ground or for any other reason, close cultivation may be practiced. The patch should receive the same thorough cultivation as recommended for large areas, except that much of the work may be done with a hoe.

METHODS FOR CANADA THISTLES BUT NOT FOR QUACK GRASS

Growing Alfalfa. Canada Thistles have been completely eradicated where good stands of alfalfa were secured and maintained for three years or more. To secure this result the ground should be heavily manured and plowed as early in the summer or fall as possible and cultivated as already described, continuing the cultivation until early June, when the seedbed should be carefully prepared and alfalfa sown at the rate of 25 pounds per acre.

The preceding treatment will have weakened the weeds. The manure will give the alfalfa a good start and provide a rapid growth so that the alfalfa will soon shade the ground sufficiently to prevent the thistles from growing. This method was tried by several members of the Wisconsin Experiment Association who claim that it is a complete success.

The Sod Method. The same results as above noted can sometimes be secured by manuring heavily and seeding down thickly to perennial grasses, such as Kentucky Blue Grass, Red Top, English Rye Grass, etc., but the stand must be almost perfect and the land allowed to remain in grass for a series of years.

Salting the Plant. Cut off the Canada Thistle while in bloom just beneath the surface of the earth and apply a large handful of salt, or better yet, a half pint of stiff salt brine where the thistle is cut off.

Occasionally this treatment needs to be repeated, but usually one application is sufficient. This method is especially effective when stock is pastured on the field, for in their efforts to get the salt they help to destroy the thistles.

Gasoline for Thistles. Gasoline may be substituted for salt and applied in the same way. Carbolic acid may also be used, but must be handled with care. Neither of these is practicable, except for scattered plants or with very small patches, as the material is too costly.



FIGURE 14

Weed cut off just below surface and salt placed in a funnel shaped hole made with hoe or other tool. The salt dissolves when wet by rains making a brine which kills the root.

FARMERS SHOULD ACT AT ONCE

Farmers cannot afford to ignore the danger from the encroachment of these various weeds; yet there is a lamentable lack of concerted action to get rid of these enemies of crop production. Land in this state is too high-priced for owners to permit twenty-five per cent of its producing power to be destroyed by weeds. It is time that those interested in agriculture realized the situation. The legislature has named a certain number of weeds which must be kept from seeding. They are Quack Grass, Canada Thistle, Burdock, White or Oxeye Daisy, Snapdragon or Butter and Eggs, Cocklebur, Perennial Sow Thistle, Sour Dock, Yellow Dock, Wild Mustard, Wild Parsnip, and Russian Thistle.

There are laws on our statute books to compel the cutting of these weeds before seed is produced, but to prevent seeding is not sufficient. Steps must be taken to rid the soil of the roots as well as of the seed, if complete freedom is to be obtained. Cooperation between farmers in the same locality and between farmers, the Experiment Station, and the Legislature, is necessary before satisfactory results will be secured. The fact that the *most noxious weeds can be eradicated* should be emphasized and active efforts put forth to prevent these pests from taking possession of Wisconsin farms. Only by continuing the fight to the end with method and thoroughness can ultimate freedom from noxious weeds be attained.