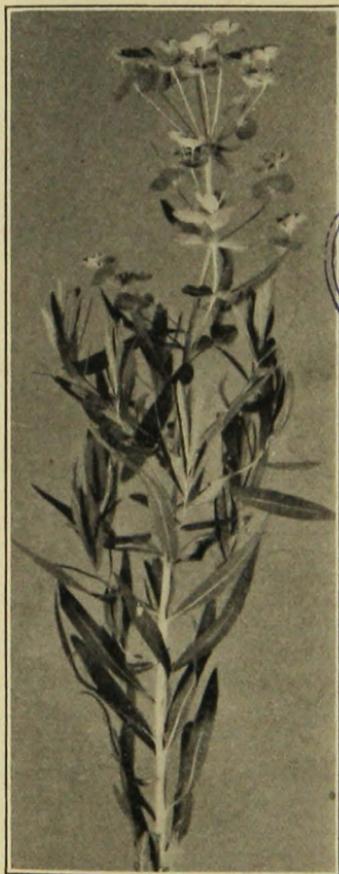


ERADICATING PERENNIAL WEEDS IN MINNESOTA



A.C. Army
Division of Agronomy
Agricultural Experiment
Station

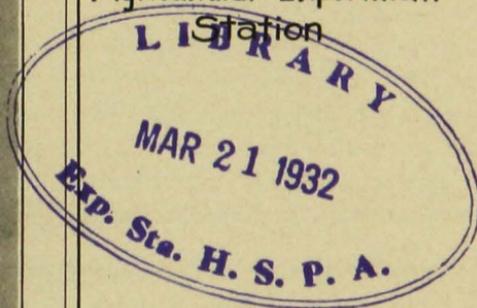


Fig. 1. Leafy Spurge

The group of flowers (umbel) at the top of the stem is characteristic of leafy spurge. The flowers in this group open first. Then other flowers develop progressively downward in the axil of each leaf. Ripe seeds often occur at the top before the flowers have appeared in the axils of the lower leaves. The flowers are lemon yellow in color, the leaves narrow and pointed.

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXTENSION DIVISION

Published in furtherance of Agricultural Extension, Act of May 8, 1914. F. W. Peck, Director, Agricultural Extension Division, Department of Agriculture, Co-operating with U. S. Department of Agriculture.

All of the worst eight perennial noxious weeds in cultivated lands and pastures in Minnesota spread by an underground system—either creeping roots or rhizomes. From early spring to late fall they continue to thicken up on areas already infested and to push out into adjacent new land. Each of the eight except Austrian field cress produces seed in abundance each year. All of these weeds except horse nettle are natives of Europe and were brought here in the form of seeds. They are still using this efficient means of travel. Fortunately, not all of these weeds are serious pests in every section of the state. For the benefit of those who have not seen them, a brief description of each is included. Descriptions of all except Austrian field cress are available in the book entitled "Manual of Weeds" by Ada Georgia.

Quack Grass

Quack grass is one of the earliest plants to resume growth in spring and it continues to grow until freezing weather in the fall. The slender jointed underground stems enable it to push out several feet into uninfested soil each year. Quack grass leaves are broad and dark bluish green. The seeds are borne in stiff, erect, beardless spikes, smaller than those of two-rowed barley, but somewhat similar in appearance. The seeds mature in the last part of June and the first part of July. Very immature seeds will germinate.

Canada Thistle

The new shoots of Canada thistle reach the surface of the soil in late April or early May. Occasionally a few of the plants live over winter with leaves in the rosette stage, just above the surface of the soil. The upper vertical roots extend to the surface from the horizontal creeping roots, which are usually from 8 to 16 inches below the surface, depending on the character of the soil. From the horizontal roots, numerous lower vertical roots penetrate from 8 to 12 feet into the soil. The plants grow to a height of from 2 to 6 feet and produce light purple flowers in the latter part of June and in July. Each seed has a parachute by means of which it is able to travel long distances in the wind. The seeds are also carried by moving water.

Perennial Sow Thistle

In well established stands, the brittle yellowish white horizontal creeping roots of perennial sow thistle grow in the upper 2 to 4 inches of the soil. Patches of this weed growing on cultivated ground may increase from 6 to 8 feet in diameter in a single season. The vertical thickened roots are few in number. They reach to depths of from 5 to 10 feet and can establish new plants from a depth of from 16 to 20 inches below the surface. The appearance of

sow thistle plants is similar to those of wild lettuce. The rosettes of light green leaves appear above ground in late April or early May. At first they are usually tinged with purple. The thick sap is milk-white. The plants grow to a height of from 3 to 5 feet and begin flowering in June. The flowers resemble those of the dandelion but are very pale yellow. The seeds are carried in the wind by parachutes. Water does not wet the leaves easily. Most farm animals readily eat the stems and leaves of this weed.

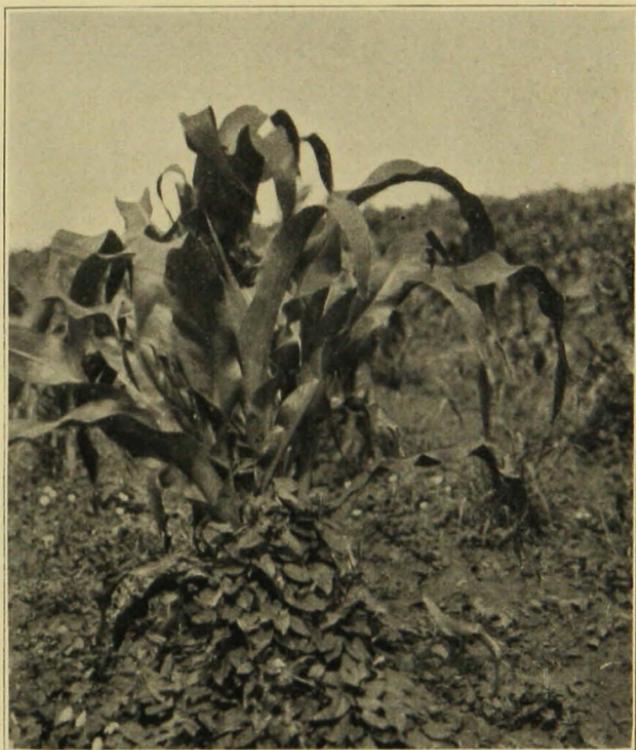


Fig. 2. What chance has this hill of corn to make good surrounded by field bindweed as it is? This is a common sight in corn fields infested with bindweed.

Field Bindweed

Field bindweed is commonly called creeping Jenny, and is also known as small-flowered morning glory. The slender horizontal creeping roots grow mostly in the upper 4 inches of the soil. From these horizontal roots the stems rise to the surface and very numerous yellowish white vertical roots penetrate into the subsoil to from 10 to 16 feet. The plants appear in the first half of May. The stems either run along the ground or use crop plants for support. The leaves of field bindweed are smaller, less pointed at the tips and of a deeper,

duller green and more leathery texture than those of common (hedge or great) bindweed. Flowering begins about the middle of June and continues through July and

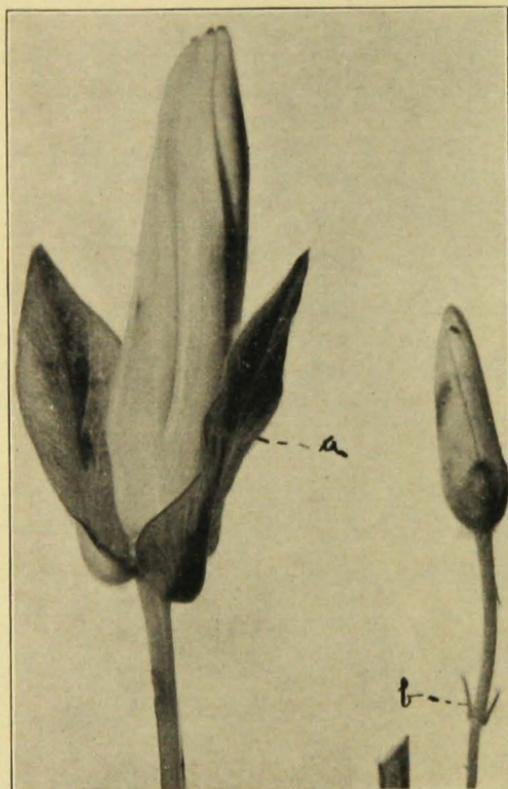


Fig. 3. Flower Buds of Common Bindweed, Left, and Field Bindweed, Right, Enlarged $2\frac{3}{4}$ Times Natural Size

Note, on the common bindweed, the two large leaf-like scales indicated at (a) attached just below the bud and partially surrounding it. On the field bindweed the pair of scales (b) are very small and are attached to the flower stem considerably below the bud. By observing the size and location of these scales the common and field bindweed may be definitely distinguished.

Leafy Spurge

Leafy spurge forms large buds just below the surface of the soil in autumn and appears above ground as soon as the frost is out of the ground in the spring. The woody stems and narrow leaves resemble those of young willow shoots. The plants grow to a height of from 2 to 4 feet. The pale yellow flowers begin to appear in May and others continue to come on through July and August; in corn fields flowering continues well into September. Seeds in all

part of August. One to four flowers, commonly two, are borne on each flower stalk on which are bracts (leaves very much reduced in size) usually in pairs, about $\frac{3}{8}$ to $\frac{1}{2}$ inch below the flower. Common bindweed bears only one flower per flower stalk on which are two large leafy bracts at the base of the flower. The flowers are light pink, nearly white, as they open, and bleach to white. They measure up to $1\frac{1}{4}$ inches across. Some of the flowers of common bindweed may be pink with white stripes, but are usually white. They are both broader and deeper than the flowers of field bindweed. The brown to black pear-shaped rough seeds are produced in abundance. Do not sow seed or use straw that has seed of this weed. Animals do not eat this weed from choice.

stages of maturity, as well as flowers, appear on the same plants at one time. The seeds are similar in appearance to those of hemp. The horizontal roots grow to a depth of from 4 to 8 inches and the lower vertical roots penetrate into the subsoil from 8 to 10 feet. The new growth of the thickened roots is glistening white; the mature roots are brown and very woody. The plant has a thick milk-white sap. Ordinarily, farm animals will not eat this weed. (See cover page.)

Austrian Field Cress

Austrian field cress belongs to the mustard family and is similar to horseradish in appearance except that the leaves and flowers are smaller and the latter are pale yellow. The roots might easily be mistaken for those of horseradish. The horizontal thickened creeping roots are usually within 3 to 6 inches of the surface. From these the upper vertical roots grow to the surface and the lower ones penetrate into the subsoil from 6 to 10 feet. Most of the plants live over winter with the leaves lying flat on the surface of the ground in the rosette stage, and are ready to grow early in spring. The plants grow very rapidly, reaching the blooming stage during the latter part of May. No seeds have been observed, but under favorable conditions some may be produced. Animals do not eat the leaves and stems of this plant.

Oxeye Daisy

Oxeye daisy is a perennial weed in meadows, pastures, and waste places. It grows one to three feet tall and is little branched. Basal leaves have long petioles and deeply notched edges. Stem leaves are without petioles and are toothed. Flowers are white with bright yellow centers. The plants usually begin to bloom in May and continue throughout the summer. They spread by seeds and underground parts.

Horse Nettle

Only a few small spots of horse nettle (sand brier) are known in the state, but this plant has all the ear marks of being a very undesirable addition to our already too long list of perennial weeds. It grows on both cultivated land and waste areas. The plant belongs to the potato family, having flowers similar to those of the common potato. The stems and the veins of the leaves are sparsely armed with smooth yellow prickles. Fruits, about the size, shape, and color of those of the ground cherry but without husks, are borne in abundance. Each fruit contains a large number of seeds very similar to those of the tomato. The creeping roots grow mostly 6 to 10 inches deep, from which plants with definite tap roots arise. The tap roots penetrate to a depth of from 6 to 8 feet. This weed should not be confused with

the annual buffalo-bur, or prickly potato, whose fruits are spiny burs and whose stems are literally covered with yellow prickles.

PREVENTION AND CONTROL METHODS

Only by community effort is it possible to keep Canada thistle and sow thistle off farms. The seeds blow for miles. The other weeds usually get their start in one of the following ways.

1. Leafy spurge and Austrian field cress were brought in and sown in seed grain and clover and grass seed. Sow only seed that a laboratory test has shown to be free from noxious weed seeds.

2. When hay, straw, or packing material is purchased, it is difficult to avoid bringing in the seeds of noxious weeds.

3. Threshing rigs and other farm implements often bring noxious weed seeds. Clean them before they come on the farm.

4. Watch the low places where water runs or stands occasionally. All these weeds except field cress are capable of producing seed in abundance. Prevent flowering and seed formation by mowing often. Field bindweed often grows prostrate on the ground and produces some seed even if mowed.

Complete Eradication

After perennial weeds have a good start in spring they store in their underground root systems reserve food for use in starting early the next year. If they are prevented from replenishing the supply of this material, they are forced to draw on what is left in these storage organs and eventually must die. This is the principle on which most of the successful methods of eradication are based. Just as a battery may be used too often to start the engine of a car and finally, if not recharged, becomes weak or dead, so clean tillage or frequent cutting lowers the reserve food in the underground parts of perennial weeds to the point where the plants are unable to produce more new stems and leaves and they die. Practically all of the perennial weeds in a patch of considerable size may be connected by the underground system. Therefore, food material gathered by green plants in one part of a patch may be passed on to others some distance away but probably not yet above ground. This emphasizes the necessity of seeing that all the weeds in a patch are treated.

Method of Attack Varies

The method of eradication to use depends on (1) the location, whether in cultivated land, pastures, or waste land; (2) the size of the area infested; (3) the kind of weed; and (4) to some extent on the type of farming followed. Some of the methods are effective

for all of the weeds on small or large areas; others are more limited in usefulness.

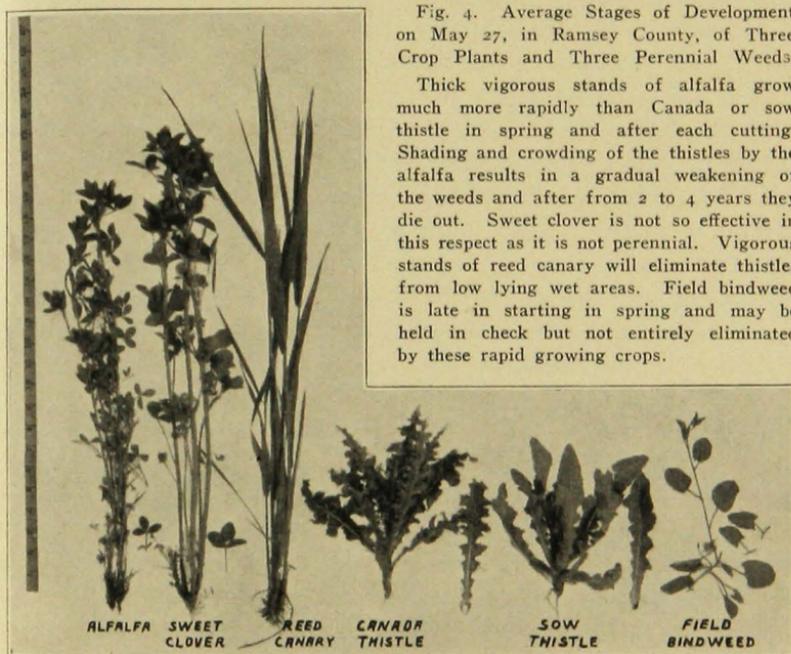
Methods for Small Areas

Chlorates Practical

The use of chlorates is practical and effective on small areas of all these weeds. Here the cost of using the chemical is usually less than digging the weeds out and, even if the small areas produce no crops for several years, the loss from that source is immaterial. In fact, there is considerable satisfaction in looking at bare spots that formerly grew vigorous stands of these weed pests. Before using chlorates, send for Circular 32, "Eradicating Perennial Weeds with Chlorates," in

Fig. 4. Average Stages of Development on May 27, in Ramsey County, of Three Crop Plants and Three Perennial Weeds.

Thick vigorous stands of alfalfa grow much more rapidly than Canada or sow thistle in spring and after each cutting. Shading and crowding of the thistles by the alfalfa results in a gradual weakening of the weeds and after from 2 to 4 years they die out. Sweet clover is not so effective in this respect as it is not perennial. Vigorous stands of reed canary will eliminate thistles from low lying wet areas. Field bindweed is late in starting in spring and may be held in check but not entirely eliminated by these rapid growing crops.



which the properties of chlorates and the necessary precautions in applying them are given in greater detail than is practical here.

One objection to the use of chlorates is the fact that clothing wet with a chlorate solution is a fire hazard when dried. A spark is all that is necessary to start the fire, which usually bursts into violent flame. All danger from fire in farm buildings or injury by fire of those applying chlorates to weeds may be prevented by carefully observing a few simple precautions. **DO NOT SMOKE WHILE USING CHLORATES.** Either use rubber boots and a rubber coat to prevent wetting the clothing while spraying, or remove clothing wet by the spray before it becomes dry and soak it in cold water. Always keep the chlorate in the steel drums in

which it comes, take the drums to the field where it is to be used, unload, use what is needed, put covers on tight, brush off tops thoroly, and take back to a dry storage place out of reach of children. Handling in this way avoids all spilling on floors of buildings and wagon boxes where a chance spark may ignite it later. The use of Atlacide may lessen the fire hazard. **By no means does the use of this chemical eliminate the danger from fire.** All of the precautions necessary for the safe handling of sodium chlorate must be carefully observed in work with Atlacide.

Before chlorates are used in pastures, see that cattle have access to all the salt they want. If their craving for salt is satisfied, they will usually pay little or no attention to the chlorate. If one or more of the animals shows a liking for weeds sprayed with chlorate, that one should be removed from the pasture. No work has been done on the effect of chlorates on hogs or sheep. These animals should be taken out of pastures where chlorates are being used.

Dissolve the sodium chlorate at the rate of 1 pound to a gallon of water, or Atlacide at the rate of from $1\frac{1}{4}$ pounds per gallon, and stir until dissolved. Apply with a sprayer developing a pressure of from 125 to 150 pounds or more per square inch. Use a nozzle that throws a medium fine spray. It is best to apply part of the amount going one way and part going the other. This insures a more even distribution of the chemical.

Apply enough of the spray to wet thoroly all the leaves and stems. If this is done, the surface of the soil also will usually be wet lightly. The amount required per square rod of area to accomplish this varies with the amount of tops. Usually $1\frac{1}{2}$ to 2 gallons will be required per square rod of area. For leafy spurge, the first application should be at the rate of 4 pounds per square rod of area. The leaves of sow thistle and leafy spurge are not wet evenly by sprays unless a spreader is included in the solution. If only limited spraying is to be done the use of half an ounce of dissolved laundry soap per gallon of spray material is satisfactory. For more extensive work some commercial spreader will probably be more satisfactory. Chlorated weeds, except quack grass, are usually spindling in growth and yellowish green in color. Reapplications must be made, using the amount that appears to be necessary as often as the weeds begin to grow vigorously again. Once a month or six weeks is usually often enough. From 3 to 6 pounds of sodium chlorate per square rod of area in two or three applications is usually enough to kill the weeds, except leafy spurge, which may require as much as 7 to 10 pounds. If Atlacide is used, about one-fourth more per square rod of area is usually necessary to bring about the same results.

Applications made during July and early August are more effective than those made earlier, considering the amount of chemical necessary.

Cut the weeds close to the ground either at the appearance of the first buds or earlier, to prevent seed formation. Either apply the chlorate to the stubble immediately or let the weeds grow again to a height of 10 to 15 inches and then apply the chlorate. Letting the weeds grow up again brings the application nearer to July and August. Good results have been obtained in the eradication of quack grass and leafy spurge by making a first application of from 2 to 4 pounds per square rod, depending on the thickness of the stand, during the first week in November and following with another lighter application, if needed, as soon as the frost is out of the ground in the spring. Late fall and early spring applications are fairly satisfactory for the other weeds. Do not expect a complete killing from one application, even if it is exceptionally heavy. At least two applications are usually necessary.

Under no circumstances should the dry tops be burned off after the application of chlorates. If the tops are burned within a few weeks after the applications, the chlorate on the tops and the surface of the soil is destroyed and the work may need to be done again.

Common Salt Effective

For those who do not care to use chlorates, common salt applied in a layer from one-half to three-fourths of an inch thick with reapplications as needed may be used successfully on individual plants.

Spade and Hoe Still Good

Two other methods are open to those who do not wish to use chemicals in destroying small areas of these weeds. If infected spots are small and not too numerous, begin by removing all plant parts to the depth of the spade. After this, hoe or cut out promptly with the spade all plants as soon as they show above the ground. On larger spots use thoro shallow hoeing every week or ten days throughout the season. If the work is neglected at any time and the weeds are allowed to make considerable growth, the advantage gained by previous work is largely lost.

Mulch Paper Gives Results

Before applying mulch paper, tar paper, or roofing felt, all tops of the plants and other rubbish must be removed so that the surface of the ground is clean for at least 10 feet beyond even the smallest weed plants. Level the ground with a garden rake so the paper will fit down tight. Then apply the paper or roofing felt to the entire area, lapping it at least four inches at all joints and weighting it with stones or soil. This method is not practical in pastures.

Some of the perennial weeds will grow up through a layer of straw 2 or 3 feet deep. Even if the straw is put on 3 or 4 feet thick, some of the plants usually grow up near the edges and eradication is

not complete. It is not good practice to pile manure on spots infested with these perennial weeds. Some of the underground parts of the weeds may grow up into the manure and will be carried to other parts of the field when the manure is spread.

Methods for Large Areas

Frequent Tillage and Competing Crops

The cost of the chlorates and the loss of crop on entire fields for at least a year following the treatments makes the chemical method impractical at the present time on large areas in Minnesota. Intelligent use of clean tillage and of crops that offer real competition to the weeds, or a combination of these two methods, have been used successfully to bring about complete eradication. The tillage ordinarily given to crops in a good rotation is not enough to eradicate perennial weeds after they have become established. Early fall plowing of fields that have produced grain is an aid in controlling all weeds.

Cultivating often enough to prevent any leaves from showing above ground is just as effective on large as on small areas. With no leaves exposed to the light, the weeds are compelled to draw on the reserve materials in the underground parts to make new growth. When this supply gets too low, the weeds die.

Bare Fallow Sometimes Necessary

Bare fallow for one entire season may be necessary where there are many weeds. Usually it is best to start by thoro plowing at a depth of about 4 inches during the first part of July or in early August. Weeds that bloom earlier than this must be cut to prevent seed formation. Unless the tops can be plowed under completely, it is best to mow the weeds before plowing. After plowing the aim should be (1) either to keep the underground parts below the surface and to cut with a sharp disk or duckfoot cultivator all new stems as they approach the surface, in this way lowering the reserves in the underground parts; or (2) to drag the underground parts to the surface to dry. The first method is usually the best. If, after a month or two, the disk or duckfoot cultivator will not cut all the new stems as they grow to the surface, replot slightly deeper than before, and continue cultivation as needed to keep all weeds from showing green until freezing time. Be careful not to puddle the soil by cultivating when too wet. Prolonged tillage, even if carried out carefully, is likely to lower the productivity of some soils.

Fallow and Competing Crops

As fallow need not begin until early July, it is possible, by planning ahead, to remove such early maturing crops as winter rye, winter wheat,

red clover, or sweet clover, or to use the land for pasture to that time before beginning the clean cultivation. This removes one of the most serious objections to the clean culture or fallow method—that of loss of a crop. There is an advantage in getting the crop off the land promptly so that the fallow can be started by July 15. The fallow should be continued (1) to September 15, when winter rye or winter wheat may be sown and after the harvest the next year the fallow repeated; or (2) to freezing time and continuing it the following spring.

The next spring, if winter wheat or rye was not planted, cultivation should be started early and given as needed to keep all weeds from showing green above ground. If, by corn planting time, the **eradication of the weeds is nearly complete**, this crop may be checked in and the few remaining weeds killed during the summer. If the weed grows in hills of corn, remove corn and all unless the weeds can be removed easily without injuring the corn. It is better to have less corn than to let some of the weeds grow. If, by corn planting time, the eradication is not **practically complete**, the tillage can be continued to the first part of July, when either buckwheat or millet may be sown. When planted at the proper time, these crops grow rapidly, shade the weeds during the brief time they occupy the ground, and produce some return from the land. They do not smother the weeds as is often thought. The cultivation preceding and following buckwheat and millet is mainly responsible for killing the weeds.

If a repetition of the treatment is necessary, plow the ground as soon as the buckwheat or millet is removed and continue the tillage throughout the fall and the next spring up to corn planting time. Decide then whether to grow corn or to continue the tillage to July and plant buckwheat or millet again.

Alfalfa Method of Eradication

Alfalfa Eliminates Thistles

Wherever thick vigorous stands of alfalfa can be obtained and kept for three or four years, Canada thistle and perennial sow thistle can be completely eliminated. The success of this method depends on the fact that vigorous alfalfa starts earlier in spring and recovers more quickly after each cutting than either of the thistles. It shades them and, with the cutting two to three times each season, prevents them from storing adequate reserve food in their underground parts. In two to three years they die out. Quack grass and leafy spurge start as early in spring as alfalfa and make as rapid growth. **These two weeds definitely can not be eradicated by growing alfalfa.** Austrian field cress makes rapid growth early in spring and therefore probably can not be eliminated by growing alfalfa. Field bindweed lives in

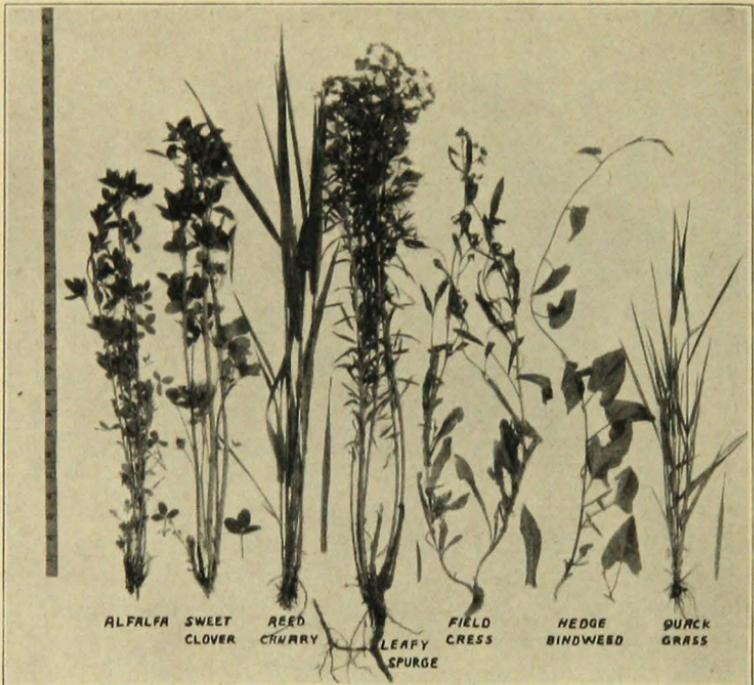


Fig. 5. Average Stages of Development on May 27, 1931, in Ramsey County, of Three Crop Plants and Four Perennial Weeds.

Leafy spurge starts earlier in spring, grows more rapidly, and blooms earlier than alfalfa or sweet clover. Austrian field cress overwinters with leaves above the ground, grows rapidly, and is about through flowering before alfalfa begins to bloom. Quack grass overwinters with leaves above ground and grows about as rapidly as the crop plants. Both leafy spurge and quack grass can hold their own in vigorous stands of alfalfa and sweet clover; probably field cress also. While hedge bindweed, common morning glory, starts later than alfalfa or sweet clover, it grows very rapidly. It may be controlled but not eliminated by growing these crops.

the shade of other plants and has a very extensive and vigorous root system. Vigorous alfalfa will hold in check but seldom eliminate it.

Alfalfa seedlings are small for some time and can not compete successfully with the more sturdy perennial weeds. Land infested with these weeds needs thoro and repeated tillage to kill the weeds to the point where thick even stands of alfalfa may be obtained.

Cutting Effective in Pastures

Unless chlorates are used in pastures, the cutting treatment can be used to weaken and finally kill thistles and other weeds except quack grass. The first cutting should be made as the plants begin to produce buds or earlier. Cutting off with a hoe all plants too small to be cut by the scythe helps to weaken them. Additional cuttings at or below the surface of the soil of all weeds during the following months and usually during the next year or two are necessary to bring about complete eradication.