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Weeds and Their Control

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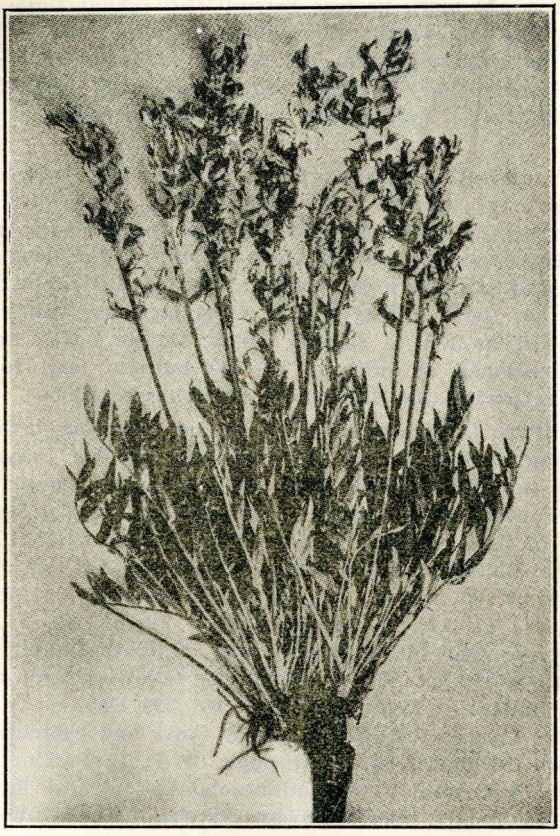

Loco Weed

Agronomy Department
AGRICULTURAL EXPERIMENT STATION
of the
SOUTH DAKOTA STATE COLLEGE OF
AGRICULTURE AND MECHANIC ARTS
Brookings

Foreword

The aim of this bulletin has been to include only the worst weeds which are more or less general throughout the state, but the writer has also added other facts of interest and value about weeds. The successful man or woman of today must know a great deal more than formerly about his or her occupation and about good living if more profit and enjoyment are to be obtained from life.

This bulletin contains more than a mere set of directions by which one may come to know and destroy some weeds. How weeds destroy the value of labor, of crops, of livestock, of farms, and of human health, are explained by the author who has had many years of experience as a farmer, teacher, and investigator. It is hoped that those having special weed problems which are not included will be led to further study of the books and other sources mentioned at the end of the bulletin, and to further inquiry directed to the Experiment Station specialists.

The writer is greatly indebted to the following investigators and publications: to Dr. C. O. Rosendahl of The University of Minnesota for unpublished data on hay fever plants; to Mr. Matthew Fowlds, Seed Analyst at Brookings, for suggestions on the scope of this bulletin; to Dr. E. A. Bessey of the Michigan Agricultural College and Experiment Station for the use of figures 1, 7, 8, 20, 22, 23, 25, 27, 28, 33, 34, 43, and 45, in addition to figures 9, 10, 11, 14, 16, 24, 29, 30, 31, 32, 35, 36, 37, 38, 39, 40, 41, 42, 44 and 46 previously used in South Dakota Bulletin No. 150, all by the late Dr. C. Beal. The following were also used from that bulletin: Figures 2 and 3 by Ada Hayden; Fig. 4, by J. T. Sarvis; figures 5, 6, 12, 15, 19 by Clark and Fletcher, loaned by the Iowa Geological Survey through Dr. L. H. Pammel; figures 13 and 21 by Oswald of the Minnesota Agricultural Experiment Station; and finally, figure 26 by Marsh of the United States Department of Agriculture. The use of figures 17 and 18 from Farmers' Bulletin 1058 of the U. S. Dept. of Agriculture, was obtained through the kindness of R. O. Bulger, State Leader of Barberry Eradication.

To Mrs. Dora P. Petry, the writer is indebted for much help of a typographical nature in keys and other parts of this bulletin.

ERRATA

Page 11 — omit last sentence on page.
Page 20, par. 2, line 13 — change "page 13" to "page 12."
Page 77 — exchange complete caption under picture with caption on page 81.
Page 81 — exchange complete caption under picture with caption on page 77.

INDEXED ENTS

Weeds and Their Control

E. J. PETRY, Consulting Botanist.

If the real damage done by weeds were appreciated greater effort would be made to destroy them. Good tests of this damage are seldom seen by farmers and others; hence few realize how great the losses are.

For the state and nation, the losses run into unbelievable millions of dollars each year. Average losses for the following crops in the United States have been reported as follows:* Corn 10 per cent, hay 10 per cent, potatoes 8 per cent, spring grains 12 to 15 per cent, winter grains 7 per cent pasture 20 to 25 per cent. But these are far too low for many states, including South Dakota. Such amounts saved annually would make a difference between profit and loss, between success and failure, on many farms. These estimates are in general far too low for the reason that the damage by plant and animal parasites, harbored by these weeds, is estimated as insect and fungous losses; animals lost or stunted by poisonous weeds are not included. Nor do these figures represent dockage losses on milk and its products, on grain, wool, and grades of livestock.

Many cases are known where the loss of over 50 percent of the annual production of whole farms was due to weeds which could have been completely controlled with little more labor than was actually but improperly spent.

The experience of careful observers has shown that in single fields, the damage may be small in some instances, while in many cases it may mean a total loss. It has meant the loss of the right to certify seed or, in some cases, has brought on a costly law suit. In foods and feeds, weeds and weed seeds have caused unsalability of dairy products, human sickness, and many deaths. Much livestock is lost or stunted each year in this way. The pollen from about half of our weeds causes many cases of hay fever. Far more than the loss of time and labor on a field has resulted from the neglect of weeds.

Is a weed a plant which does not have pretty flowers, or is it always a plant out of place? Are weeds plants without use to man and growing where they are not wanted? A weed, according to the best authorities, is a plant which interferes directly or indirectly with the growth or value of similar plants which are used by man for food, for ornament, or for protection.

* Mostly averages by H. R. Cates (p. 3 Separate) Yearbook of U. S. Dept. Agri. 1917.

"Similar plants" here means plants of like classification or relationship and of like general bodily structure. This definition leaves out the poetic idea of wild and unsightly plants without pretty flowers, but it includes intruders in lawns, vines, and trees. It also includes parasitic flowering plants in trees, bushes, and herbs such as mistletoes, dodders, and broom rapes, and it indirectly includes ditch weeds and plants of idle fields, of fence rows, of roadsides, and of rights-of-way, because these sooner or later interfere with the useful groups mentioned before. Fungi which cause plant diseases are not included because they are not similar plants. Poisonous plants are not always included, for the same reason that many poisonous medicinal plants, and the wild plants of the prairie, of forests, hills, rivers, and lakes, are not included.

WEEDS CAN BE CONTROLLED

Weeds, just as human diseases, were, until recently, looked upon as a punishment by Providence and therefore impossible of control. Several great authorities still consider weeds a discipline for farmers and horticulturists. Good farming and scientific experiments have led to a better view which shows that the farmer must recognize each kind of weed and then apply the most economical method of avoiding the loss which that weed can cause.

This does not always mean the absolute extermination of a particular kind of weed, but rather a condition in which it no longer causes any loss of time or farm values.

DAMAGE DONE BY WEEDS

The causes of the great losses from weeds in the approximate order of their importance are as follows:

1. They rob other plants of water in the soil.
2. They rob other plants of soil foods.
3. They cause dockage of grains, wool, and livestock at markets, due to lower grading. This is due to the presence of weed seeds in grain, to burs in wool and hair, and to improperly nourished or poisoned livestock.
4. Because they grow faster than small cultivated plants, they often shade and smother them, destroying quality or size or both.
5. They hasten rotting of railroad ties and lumber, which the farmer and general public must pay for indirectly.
6. They harbor fungi, like rusts and smuts, which reduce the yield of crops or spoil the appearance of ornamentals, and in some cases even cause the leaves of trees to drop in mid-summer.
7. They harbor animal parasites not otherwise present, such as plant lice, leaf hoppers, thread or pin worms, worm-

like larvae of insects, beetles, and many others, which not only eat the plant or suck its juices out, but often infect it with a fungous or mosaic disease.

8. In rainy seasons especially, weeds prevent the proper curing of hay, and may later cause mold which is unhealthful to livestock.

9. They require a change of crop rotation in some cases, which causes a loss of time and income.

10. Their general bad appearance on a farm greatly lowers the value in the case of noxious weeds such as quack grass, Canada thistle, and field sow thistle. Such farms have been abandoned in numbers.

11. Bad flavors in milk, butter, and cheese are the result, in most cases, of feeding on strong weeds like ragweed, dandelion, wild onion, and wild garlic. In most markets, these have little or no value.

12 Hay fever, more or less severe, is caused by about half of the weeds described in this bulletin and by many others of this state. This loss is hard to estimate, especially by those who have never suffered the handicap of this disease.

13. The damage wrought by poison ivy and nettles are hard to estimate, but they are equally serious as handicaps.

14. Poison seeds like those of corn cockle and cowbane, sometimes find their way into food and feeds, causing severe sickness or death.

15. The same results come from the eating of the tubers or roots and the tops of larkspur, loco weeds, cowbanes and common scouring rushes. Some of these act more quickly than others.

16. Stunting or killing of clover, alfalfa, and other plants by dodder which attacks the tops of plants, and by broom rapes and others which attack the roots of tomatoes produces some loss.

17. The choking of drainage canals by ditch weeds requires time to remedy.

18. Tubers and fleshy roots are injured by being pierced by rootstocks of quack grass and others. They rot more easily in the bin and are unfit for sale.

19. The mouths, digestive canals, and even the feet of livestock are often injured by spiny or bearded weeds such as the prairie needle, wild barley, spiny amaranth, and sand bur. This results in the death of the animal, or a visit of the veterinarian.

Other effects of weeds that are hard to estimate are root antagonisms or conflicts somewhat different from those above mentioned, between roots of weeds and roots of cultivated plants. The extra wear on harvesting and threshing

machinery is also worth considering. The good that weeds do in furnishing greens and medicines, and in storing plant foods is very slight and need not be given here in detail. It will be mentioned in discussing each plant. Finally, if the morale of a community has any value, the presence of unsightly or dangerous weeds, due to the negligence or disobedience to law by a few people, has a depressing effect on this important characteristic.

FUNDAMENTALS OF WEED CONTROL

General Principles. Although there are many different kinds of weeds and soils each calling for special treatment, still there are general principles and facts underlying their control, which are common to all conditions.

In all cases of weed control, the length of life, kind of growth, and the seeding habit must first be considered. Then the cropping system and the nature of the soil must receive some attention. After this, the special methods of control can be selected to better advantage as to cost and convenience.

Life, Growth, and Seeding Habits. The length of life, the nature of its growth, and its rate and way of seeding and spreading, are very important in finding the name of a weed, and in deciding on what method to use in its control.

Annual Weeds grow only during one season and live through the winter, or other unfavorable times, as seeds. Such seeds live for many years if plowed under. This is true of foxtails or pigeon grasses, of ragweeds, pigweeds, cockleburs, and many others. These can be destroyed as small seedlings, before flowering time, or the seeds may be burned or otherwise destroyed.

Winter Annuals grow from seed in the fall, or after a long dry period. They finish growth and make seed early the next spring or growth period. Shepherd's purse, fleabane or mare's tail, wild lettuce, and wild barley or squirrel tail grass are examples, and their seeds also live several years if buried deeply in the soil. The small rosettes of leaves must be destroyed late in the fall or early in the spring by deep plowing or cultivation.

Biennials, or biennial weeds, grow from seeds in spring or early summer, make large amounts of food which they store away in roots, stems, and sometimes in leaves, and finish seeding the second summer. Mullens, burdocks, wild carrot, parsnip, are biennials. They often seed heavily, but they are usually easily controlled because their first year's growth, with its large rosette of leaves, is easily seen and destroyed by plow, hoe, spade, while annuals and winter annuals must be destroyed at an earlier stage of growth or else the seed must be destroyed. The latter is difficult if

not impossible in most cases, except where they can be removed from crop seeds to be sown.

Perennial weeds grow more than two full seasons and produce seed in the second or in later seasons, according to kind and to the conditions of growth, such as soil and climate. They store food in large quantities and this gives them their vitality and makes them hard to destroy. This is illustrated by the sow thistle, Canada thistle, quack grass, and milkweeds. The food is stored in fleshy roots in docks and cowbane, in stems of some thistles and quack grass, and in leaves of bulbs like wild onion, garlic, and lily. These are mostly in the ground, but cacti and some woody plants like buck brush, skunk bush, poison ivy, and wild roses, also store food in stems above ground. Many people fail to realize that some weeds can store one or more year's food supply in this way and hence fail to destroy them at their weakest period—the seedling stage. They also fail to see that only a few seeds of such weeds may produce untold trouble, if contained in a cheap grade of seed purchased of careless seedsmen or stores. As a result, the old adage, "one year of (weed) seeds, seven years of weeds", often becomes more than true.

Source of Weeds. Most of our worst weeds are from foreign countries, where they have "learned" to endure hard treatment by centuries of contact with farmers who tried to destroy them. As a consequence these foreign weeds are much more difficult to control.

Native weeds are still largely in the wild condition and are, as a rule, not so hard to control. Most foreign weeds have come into this country with small farm seeds or with garden seeds. This shows that the greatest care must be taken at all times to get clean seed because a few of the worst native weeds have not yet entered some of the farming sections. When the land is cleared of weeds, it may be kept so by strict attention to this source.

Those who cannot tell weed seeds from the seed they want to sow should send samples to the Seed Analyst of the Experiment Station at Brookings, for test and identification of seeds present, before they sow them.

Weeds produce many more seeds than most people realize. A few examples will show the truth of this. Fleabane or mare's tail in a meadow in which this weed thrives will produce from 2,000 to 3,000 seeds per square inch. These, when blown from an acre by the wind, will completely seed from 12,000 to 20,000 acres of land. Wild mustard makes from 5,000 to 10,000 seeds per plant, but cannot be spread as far as fleabane. However, its seeds last many years longer in the soil and for this reason it can project itself

into the future over large areas of land. This is also true of the foxtails or pigeon grasses, whose great number of seeds (2,000 to 5,000) is due to the stooling habit. The occasional pigweed, lamb's quarters, buffalo bur, false ragweed, morning glory, dock, and many others, allowed to ripen their seed in corn or potato fields after these are "laid by", are able to produce seeds for several years in the future, when they might be laid low by a single stroke of the hoe at the hands of low-priced labor. The spread of weeds by the underground parts like roots, rootstocks, and tubers, is just as certain even if these parts are less numerous than their seeds. For what these vegetative parts lack in numbers, they easily make up in the difficulty of being reached by the eradicator.

The spreading of weeds by seeds and vegetative parts is briefly listed below. Further facts are given later under methods of destruction and with the descriptions in the main part of this bulletin.

1. A few weeds, such as the porcupine and bunch grasses, spread by creeping seeds. These are scarcely weeds.

2. A few weeds shoot and thus scatter their seeds. Milk spurges, vetches, stork's bill, and wood sorrels illustrate this method.

3. The light parachute "seeds" or fruits of sow thistle, and Canada thistle and Milkweed seeds illustrate wind spreading.

4. Heavy seeds and fruits like those of horseweed or kinghead, and burdock are driven over the smooth frozen snow for long distances.

5. Tumble weeds, like panic grass, and Russian thistle are rolled by the wind and slowly scatter the seeds which stick more tightly to the plant than most others.

6. Some seeds or fruits like those of docks, cockleburs, and sedges are floated long distances on water.

7. Bur-like fruits, such as Spanish needles, beggar ticks, cockleburs, and sand burs are carried on the fur of animals and the clothing of hunters for long distances.

8. Undigested seeds of fruits, like berries, are carried for long distances by birds and other animals. Fruit which cannot be swallowed, is often carried long distances before it is partly eaten and the seeds are scattered along fence rows and under trees.

9. Farm machinery such as plows, harrows, and wagons carry seeds and vegetative parts like roots and bulbs.

10. Threshers, drills and harvesting machines which move from farm to farm also spread weed seeds.

11. Manure spreaders carry both seeds and vegetative parts because the feeds and bedding of livestock are rarely

free from weed seed, and unless manure heats greatly, the seeds are not harmed. This heating also drives off the nitrogen fertility which in the long run is very wasteful.

12. Trucks, railways, and boats carry weed seeds in the feed and bedding of livestock, in packing of merchandise, in farm seeds and feeds, and in many other kinds of freight.

13. The nursery stock from various sources contains, in the soil and packing, many weed seeds and vegetative parts of weeds. A few useful and ornamental plants have escaped from cultivation. Chicory, parsnip, barberries, etc., illustrate this.

14. The greatest spreader of weeds, however, is the careless sowing of impure seed. It is due primarily to the fact that the sower does not know the appearance of the seed he wishes to sow, nor does he appreeciate how much damage a few noxious or very bad weeds can do.

Soil Affects Weed Control. Since the method of control depends partly on the nature of the soil, a few hints on this complex subject will be given. Weeds that grow on sour soil such as red sorrel and docks often disappear when lime is added. If the condition is due to wet soil, such weeds as brake fern, smartweed, Spanish needle, and cowbane will disappear if the soil is drained. Weeds that thrive in dry clay or sandy soils such as wild roses, and four-o'clocks will not do so well in rich soils if a good crop rotation is followed. Quack grass, Canada thistle, and many other noxious weeds are easily destroyed on heavy or dry land, if the proper method is followed, according to the nature and depth of the soil.

It so happens that on one soil certain weeds are easily controlled, while from other soils they may be very difficult to eradicate. This is because a more expensive method and more time are needed, but this fact is not realized or put into the system of farm management.

METHODS OF WEED CONTROL

From this discussion of weed seeding, spreading, and soil effects, it must be clear that the method of control of several weeds cannot be chosen without considerable thought and careful planning. This will be further shown in the following list of methods and it will be more exactly mentioned in the discussion on each weed.

Control of the Seed Stage.

1. Sow nothing but clean, pure seed. Either send the seed to an analyst, or learn to know weed seeds and to remove and burn them. Some small seeds, such as clover or alfalfa, are over 50 per cent weed seeds.

2. Heat or boil screenings before feeding. Corn cockle and a few others should not be fed because they are poisonous.

3. Burn stubble and other fields, and fence rows which have dry weeds with their ripe seeds attached. Tumble weeds in ditches and fence rows should also be burnt.

4. Cut weeds about ready to blossom with mower, scythe, hoe, or spud. Some weeds ripen seeds if cut during early flowering days.

5. Spray young expanded annual or winter weeds or later stages, with chemicals such as iron sulphate, 100 pounds per 50 gallons of water (which will cover an acre, if applied in a fine spray). This kills mustard and most other broad-leaved plants but not the true grasses. The spray is applied fresh and the machine should be washed out after use. Other chemicals may be used in special cases or on small areas.

6. Some weeds about to blossom in hay, grain fields, and meadows can be destroyed by pasturing with sheep.

7. Protect the seed-eating birds like juncoes, finches, and field sparrows by scattering small grains in winter when heavy snows cover the dry weeds. Also protect these and the insect-eating birds against boys and other enemies. While these birds eat a little grain or fruit, the millions of weed seeds and insects consumed by them make the farmer a handsome profit in time and work saved.

Control of the Vegetative Stage of Weeds.

8. Plow the right depth to accomplish what is needed with the particular weeds and soil. In clay or heavy soil, it will usually not need to be as deep as in lighter soils. For quack grass and perennial sow thistle, the depth will be from 3 to 6 inches in different soils; while for Canada thistle, milkweeds, bindweeds, and the like it will have to be from 5 to 10 inches deep, depending on the depth of previous plowing and on the hardness of the soil. While the plow is the greatest weed destroyer, yet it protects the seeds of some weeds by burying them deeply. This keeps them alive or viable for many years. Various combinations of plow, harrow, cultivator, and drag can be made to control weeds with more certainty.

9. Harrows of various types follow the plow to good advantage in weed destruction. They not only drag out roots and rootstocks of perennials, but they cause many seeds to sprout for later destruction. However, disk harrows tend to cut rootstocks into many pieces, each of which, as in the case of quack grass, sow thistle, and Canada thistle, will sprout and make a new plant. This increases the numb-

ers of plants and is a risk, unless the process can be certainly repeated at the right time. Then it exhausts rootstocks most rapidly.

10. Deep cultivation covers larger weeds than the harrow, but there is great danger of cutting the side roots of corn and potatoes, except in the earliest stages when such cultivation is usually not needed. It is far better to cultivate more frequently and not so deeply.

11. Scraping the soil with gopher vine cutters or "sweeps" is all that may be needed in many cases to kill weeds and to give a desirable dust mulch. The usefulness of this mulch is not so much praised now as formerly. Cultivation should be necessary solely for aeration of the soil and as a ready reservoir of moisture from heavy rains, but up to the present, weed control has been the main reason for this expensive operation.

12. Crop rotation uses most of the above-mentioned operations in definite combinations for weed control. It adds others like smothering, fertilizing, and liming thereby automatically destroying many weeds which persist in grain or other specal farming. In the same way, it destroys the insect and fungous enemies of agricultural plants that are aided by weeds.

13. After clean cultivated crops are laid by, some weeds may still go to seed. Hand cutting with the hoe or spud places the finishing touches upon cultivation. Seed which would produce weeds for several years is destroyed by a few days' work, paying a high rate per hour.

14. Mowing weeds of the pasture and roadside, especially just before they bloom, destroys the seed and often kills the weeds that would otherwise continue to grow and produce more seed. Biennials are often completely controlled by this method, if it is applied at the right time.

15. Smothering by rank-growing crops like corn and sorghum, often helps to finish eradication of such weeds as quack grass in fallowed ground. Smothering or baking can also be accomplished by a heavy layer of dry straw or tar paper. This is sometimes used on small patches of quack grass and Canada thistle. Long days of hot sunshine are needed to make this method successful.

16. Nursery stock of fruit and ornamental plants with soil attached should be closely examined for rootstocks and tubers of weeds. Close watch of their growth for several years is needed to be sure that no new and harmful weeds have been introduced as seeds.

17. Threshing and harvesting machinery traveling from one farm to another should be thoroughly cleaned before being allowed to come to the farm. This applies also to

huskers, shredders, and fanning mills.

18. Low levees in river bottoms often save the annual influx of many weeds like cockleburs, sedges, docks, wild cucumbers, horseweeds or king-heads, and many others.

19. The packings from merchandise, such as hay, straw, marsh grass, mosses, etc., should always be burned.

20. Farm machinery such as wagons, plows, and harrows should be cleaned before leaving weedy fields. Seeds and vegetative parts are not only scattered within the field but may be carried to other fields by these implements.

21. The spreading of manure containing many weed seeds or growing weeds should be avoided. Hay, fodder, and bedding that is free from weed seeds will avoid this if the animals are free from burs, etc. Weed seeds are not all killed in heated manure.

22. Weed laws of greater scope and more force should be enacted so that communities, corporations, and other organizations may act fairly in destroying one of the most wasteful enemies of the farmer, the state, and nation. To get such laws, requires the cooperation of farmers and other citizens of the whole state.

Weed study should also be a part of the course in all schools whether in city or country, but in the latter more work should be given. All citizens of the state should be taught that weed control, just as sobriety and fair dealing, are vital to proper success and safety of the state and nation.

By allowing weeds to grow and spread, a few farmers can lower the efficiency of a whole neighborhood by causing a loss in price of products and by lowering of health due to hay-fever. Very few will fail to respond properly to this logic if properly presented. For them there should be a real law, just as for theft and incendiarism. Without such laws, a united, safe nation, or even civilization itself, is impossible.

In controlling groups of weeds, such as are found in fields, the kinds or species should be listed first as annuals, biennials, and perennials. Their individual control should be briefly noted after each. These controls should then be grouped in the most efficient order of use, and this should be put into the system of rotation and management. This requires study and generalship, for often a system must be changed to correct mistakes, or accidents, or to agree with climatic changes.

KEYS TO WEED FAMILIES

I. General Key to Divisions and Classes. (This Key should be used first.)

Green plants with leaves, stems, and roots that are connected by fibrous veins. These are the Vascular plants, and include Ferns and Seed Plants.

1. Plants among those in I, that never bear seeds but have minute spores instead. These are Ferns and Fern Allies or Division I, also known as Pteridophytes. About 6,000 kinds are known. The three weeds described next are not given further attention in this bulletin. See a or b.
   a. Leafy plants, spores on leaves. This is the Fern Family (Polypodiaceae). The Brake Fern is a weed, two to five feet high, in meadows, etc. The Sensitive Fern is a weed one to three feet high, in wet meadows.
   b. Leaves small and scale-like, in rings on the joints. Stems hollow, rough, and brittle. Spores in a cone at top of flesh-colored stalk. Green shoots appear later, look like small pine trees eight to sixteen inches high. This is the Field Horsetail in the Horsetail or Scouring Rush family (Equisetaceae). The green shoots which come from rootstocks are poisonous for horses and sheep. Grows on sandy soil mostly.

2. Seed-bearing plants. Division II. (Spermatophytes) 160,000 kinds.
   a. Seeds naked on scales of dry or fleshy little cones. Leaves mostly needle or awl-shaped, and usually evergreen. About six hundred kinds. This subdivision, the Coniferae or cone-bearers, contains the Pinaceae or Pine family, only a few of which are occasionally weeds. Pines, Spruces, Junipers, Larches (shed all leaves in winter), Tree Hemlocks, etc., are in this Family.
   b. Seeds inside one or more fruits or pistils, when young, in the center of a flower. Stamens bearing pollen (male germs) just outside of fruit. All showy flowers have two sets of colored leaves, the inside set called the petals or corolla, the outer set is green and is called sepals or calyx, and may be colored if the petal set is absent. The few kinds without green leaves are mostly parasites; e. g., dodder. This division of seed plants has two classes described as follows:
      A. Stamen, petal, and sepal sets having three or six parts each. Veins parallel in leaves as in corn, and scattered in stem as in corn or asparagus. Little plant in seed (embryo) has one (mono) seed leaf (cotyledon), hence, Class I. is called Monocotyledons. About 25,000 kinds are known. Grasses (the most important family of all plants), sedges, some lilies, orchids, and palms belong in this class. Use Key II, (Monocotyledons), if the plant in hand is a monocotyledonous one.
      B. Stamen, petal, and sepal sets having four or five parts each, or several times this number of stamens. Veins of leaves not parallel, forming circular woody tubes in the stems. Seed leaves of embryo two (di-), thus giving the name Dicotyledons to this second class of seed plants. Among its 130,000

kinds, the following groups are known to all: willows, poplars, birches, elms, smartweeds, pigweeds, pinks, buttercups, poppies, mustards, roses, apples, plums, beans, alfalfas, violets, cacti, carrots, parsnips; ash, maple and oak trees; milkweeds, potatoes, tomatoes, melons, cucumbers, sunflowers, golden rods, and dandelions. Each group or family has some weeds, only a few of which are described in this bulletin. Use Key III,(Dicotyledons), if plant is a dicotyl.

II. Key to Class I. Monocotyledons. (See Key I.).
Plants, in this bulletin, with grass-like leaves and stems. The flowers have no calyx or corolla. This, the grass order (Graminales), has two large families containing 8,000 kinds. See 1 or 2.

1. If stems are triangular and leaf-sheaths are not split open, they are in the sedge family (Cyperaceae) and are mostly ditch weeds, and are sometimes used for hay, if in wet meadows. They carry many rust diseases of valuable plants. (Over 3,000 kinds of sedges are known).
2. If stems are round or oval and leaf sheaths are split open, they are in the grass family(Gramineae). This is the most important family of plants in the world, because it includes the grain crops. Over 5,000 kinds are known. Six bad weeds from this family are described in this bulletin as follows: green and yellow foxtail are in the first subfamily; while wild oats, quack grass, slender wheat grass, western wheat grass (the latter two are not weeds), and wild barley or squirrel tail, are in the second subfamily. See pages of description in table of contents.

III. Key to Class II. Dicotyledons (See Key I.).

1. Flowers with calyx but no corolla. See first a, b or c, below.
   a. Leaf bases sheathing a stem. "Seeds" triangular or lens-shaped, Buckwheat family (Polygonaceae). Mexican Dock, Curled Dock, Sheep or Red Sorrel, three Smartweeds, and Wild Buckwheat are described. See table of contents.
   b. Leaves not sheathing the stem at bases, mealy or light green in color. Flowers in small globular clusters, and these in larger clusters, Goosefoot family (Chenopodiaceae). Lamb's Quarters, and Russian Thistle are two weeds described.
   c. Leaves mostly rough, flower clusters rough and sharp chaffy. Roots and stems mostly reddish, Pigweed or Amaranth family (Amaranthaceae). The common rough Pigweeds are described. See table of contents.
2. Flowers with petals (corolla set) that are separate from each other.
   a. Calyx and corolla parts regular; i. e., alike in size and shape.
      A. Ten stamens, fruit a pod with many seeds. Pink family (Caryophyllaceae). Corn or Purple Cockle is described. See table of contents.

B. Six stamens alike, fruit a red, oval, one-seeded berry; flat, branched thorns at the joints, flowers and wood yellow. Barberry bush in Barberry family.

C. Two, or six unlike stamens. (Sometimes no petals if two stamens). Petals four, pods with hot tasting (mustard) seeds. Mustard family (Cruciferae). Wild Mustard, False Flax, Shepherd's Purse, Penny Cress, Tumbling Mustard, and two Pepper Grasses (not true grasses) are described. See table of contents.

b. Corolla irregular, like pea or bean flower. Fruit a bean-like pod. Pea family (Leguminosae), 6,000 kinds known. Purple or Stemless Loco Weed is described. See table of contents.

c. Corolla set on top of fruit, sepals hardly visible. Flowers in reversed umbrella-like clusters. The Carrot or Parsley family (Umbelliferae). The Wild Carrot, two Parsnips, and three Cowbanes are described.

3. Flowers with petals, when present, united to form a cup or trumpet (true corolla).

a. Flowers small, cup-shaped and clustered on a parasitic vine, or long trumpet or funnel-shaped. Morning Glory family (Convolvulaceae). Clover and Alfalfa Dodders, Field Bindweed, and Hedge Bindweed are described.

b. Flowers yellow and constructed like those of potato or tomato, plant thorny. Buffalo Bur in the Nigthshade family (Solanaceae).

c. Flowers small, with tissue-paper-like petals (corollas), all close together in spike-like clusters. Plantain family (Plantaginaceae). Common and Rugel's Plantain, also Buckhorn or Rib Grass described.

d. Flowers very small, in short heads or spikes. Corollas trumpet or strap-shaped, or both kinds in the same head. One seed or fruit per flower, or none in sterile or stamen-bearing flowers. Sunflower or Composite family (Compositae). The largest family of plants (over 12,000 kinds known) with many weeds.

(1) Marsh Elder or False Ragweed, Cocklebur; Small Ragweed, Perennial Ragweed, and Giant Ragweed or Kinghead do not fit this family description well. The latter three have separate flower heads for stamens, and the pistillate or fruiting heads have only one flower each, with no corolla.

(2) Mare's Tail or Canadian Fleabane, Common or Field Sow Thistle, and Canada Thistle follow the Key description. The first has strap and tubular corollas, the second only strap corollas, while the third has only tubular corollas. The calyx in the last three weeds forms the pappus or parachute which carries the seed in the wind. See table of contents.

NOTE. These Keys give the divisions and families of plants in

the order of complexity or degree of specialization, and approximately in the order of their relationship. The most complex and recently formed family is given last; it is the Compositae, or Composite family.

QUACK GRASS

Description. Quack Grass (Agropyron repens (L.) Beauv.) is known by such names as: couch grass, witch grass, scutch grass, and wheat grass. This foreign weed is probably our worst because of the difficulty of controlling its spread in many soils by its perennial rootstocks, and because its seeds resemble other more useful grasses very closely and are widely distributed in various grass seeds and grains. Its pollen also produces hay fever in some people, and it carries the red and black rust stages of wheat stem rust.

As a pasture, however, its early growth is preferred to many others by cattle. It has been used in lawns and as a soil binder on terraces, hillsides, road grades or embankments, and in other ways. Its rootstocks are also used in medicine and it has brought from two to twenty cents per pound dried. The lower prices prevail in normal times because only about 250,000 pounds are used per year in the United States, according to Farmers' Bulletin No. 1307 of the U. S. Department of Agriculture, and because the supply is unlimited. The rootstocks are collected in the spring and sold in the drug trade as Triticum. The above bulletin states that this drug was ground into flour during the late war in Europe and was made into a nutritious bread. Several other food uses have been found, such as a substitute for coffee, and as a source for sugar. This Government bulletin also gives methods of using quack grass for hay alone and in combination; but other good grasses, less difficult to control, are availible.

The main objection to this grass is the difficulty of changing crops. Its fresh or dark green color and upright stalks are well known, but these do not separate it from all other wheat grasses. Its heads of medium length and thickness and its rootstocks distinguish it from slender wheat grass, which has very long (six to ten inches), narrow heads and no rootstocks. Its size, shape of heads, color, and structure of leaf blades all distinguish it from western wheat grass, or Colorado blue stem, which has broader, rough heads, blue color, and finely grooved leaf-blades.

See Figs. 1 to 4 for comparison of wheat grasses with quack grass.

In general, it has more of the appearance of a narrow-headed beardless wheat than of any other grain. The small differences between divisions of the head (spikelets) are neither large enough nor uniform enough to make possible a description which botanically untrained persons can apply

FIG. 1. QUACK GRASS
(Agropyron repenc (L.) Beauv.)
a, spiklet; b, same dissected to show glumes c, culm or stem; d, head or spike; e, rootstock. (After Beal, W. J.; Mich. Agric. Coll. Exp. Sta., Bull. No. 267.)

accurately. The rootstocks may be long or short, deep or shallow, according to condition of growth, age, depth of tilled soil, and recentness of plowing. The harder the soil and the less frequently tilled, the nearer the surface will the rootstocks lie, and their position must be discovered in each case of control so as to make the plowing neither too deep nor too shallow; in fact, different parts of the same field may require different depths of plowing on this account. The color of rootstocks that are not too old, is a white or dirty-white, which distinguishes it from sweet or holy grass, whose rootstocks are yellow. The latter is smaller and different in every other way, and will not be mistaken for quack grass.

The diameter of quack grass rootstocks is about the same as that of the stem a few inches above ground, but it may be thicker for a short distances when the spaces between joints are short. The roots come from the joints where there is also a scale-like leaf, inside of which one bud grows that makes the side branch or shoot, so that every joint can make a new side shoot if properly stimulated by food or cutting between joints. This shows why the rootstocks should be dragged out by a harrow or other tool, rather than cut by a disk. Cutting also exhausts the food in these pieces, and if they are never allowed to sprout more than an inch or two, the killing out process is very rapid in hot weather; the danger lies in having a rainy period come on just when they are at the right stage to require another cultivation, when this occurs, the value of the previous work is nearly all lost. (Fig. 1).

Control. South Dakota Station Bulletin No. 170 gives many details of experience in quack grass control in South Dakota; for this reason, only the most important details are given here. The seed is carried in many ways so that care is required in buying various grain and grass seeds, in cleaning animal coats, in killing rodents which carry them for food, in cleaning machinery, and in the matter of hay, fodder, manure, and flood water. Control of rootstock growth is just as important and perhaps as difficult as control of spreading by seed. All that has been previously said on the nature and depth of rootstocks, and the points brought out in the discussion of control of vegetative stages of weeds (paragraphs 8 and 9, page 13) on the thoroughness and right depth of plowing and following with the harrow to rake out rootstocks, applies here. In addition to this, the time of plowing and periods between harrowing must be right, as will be seen from the following, which is taken from the experiences of many farmers in this and other states.

First, clear off the tops by cutting and raking before shattering can take place. This may happen in an early cutting of hay or alfalfa. Then plow at the correct depth with a prairie breaker. This should be done about July 10th to 15th, when the weather is hot. Ten days later use a disk or common harrow if the sod is not too stiff. Rake the rootstocks into piles if possible and burn them when dry. Repeat this process every time the sprouts show an inch or two above ground until late in the fall. Then a very heavy disking or cultivation late in the fall or early winter to expose the remaining rootstocks to winter-killing completes that season's work. The next season, a clean cultivated crop like corn or beets (not tomatoes, melons, or tobacco) should be grown; a heavy smothering crop like silage corn or sorghum can also be grown. After the early crop is removed, stray

patches of quack grass should be deeply cultivated till winter. However, this is seldom necessary. Many have killed this weed out completely during one hot season.

Other combinations, methods, and rotations are given in South Dakota Bulletin No. 170, and United States Department of Agriculture Bulletin No. 1307. Only one other method, used on small patches, need be mentioned here; that is, the smothering or baking method with tar paper or any other light-proof material. This is laid on the patch which must be free from rubbish and stones to make it as even as possible. The paper should overlap four or five inches, should be carefully weighted down with stones, soil or other material. It should be examined after each windstorm to see that it is still tight. In hot weather, the tender shoots are scorched. In cool weather, they come up; but since they get no light, they remain tender and cannot make sugar or other foods, and the next hot day or two scorches them again. This is one of the most severe treatments that can be given a growing plant, it has the same effect as leaving a carpet in one place on the lawn for several days.

SLENDER WHEAT GRASS.

Description. Slender Wheat Grass (Agropyron tenerum Vasey) is not a weed but a useful forage grass whose description is given to aid in recognizing or identifying quack grass. The stems grow in dense clusters and there are no long rootstocks. At the base of the leaf blade, there is no prominent claw hooking around the stem from both sides, as in quack grass. The heads are twice or even three times as long as those of quack grass, and are only about half as thick, because spikelets are much smaller and spaced farther apart on the rachis or central stem of the head. The spikelets or hand-shaped clusters of chaffy scales or bracts have fewer flowers (three to five) than those of the quack grass (seven to eleven flowers).

There are other smaller differences which are shown by the microscope. However, many readers of this bulletin will not have a microscope. Since the above descriptions together with the illustrations are sufficient for practical and ordinary botanical purposes, these smaller differences need not be given here. (Fig. 2).

WESTERN WHEAT GRASS OR BLUE STEM

Description. Western Wheat Grass or Blue Stem (Agropyron Smithii, Rydb.) is a very useful forage plant which is sometimes mistaken for quack grass, especially in connection with its rootstocks. These are of a dull gray or of a yellowish-brown color, and not of a white or light green color as in quack grass. (Fig. 3).

FIG. 2. SLENDER WHEAT GRASS
(Agropyron tenerum, Vasey)
a, spike; b, rachis of spike; c, spikelets; d, sterile glumes; e, fibrous root system; f, leaf blade; g, leaf sheath. (Drawn by Ada Hayden.)

FIG. 3. WESTERN WHEAT GRASS
(Agropyron Smithii, Rydb.)

a, shows rough spike; b, spikelet, lateral view; e, spikelet in dorsal (edge) view; f, rootstock with fibrous roots. (Drawn by Ada Hayden.)

The leaves are much thicker and stiffer than those of quack grass. They also have fine grooves running lengthwise, and are covered with a waxy coat which gives them a bluish color not ordinarily found on quack grass. The heads are thicker and much rougher than those of quack grass due to the much larger spikelets. The spikelets also have a few more flowers whose chaffs or glumes are more irregular in size and in direction than in quack grass. The height of Western Wheat Grass has been compared in many localities east and west with that of quack grass and the latter has always been from four to six inches taller. The stems or culms, just beneath the heads, seem more slender and more grooved or striated than in quack grass. (Fig. 4).

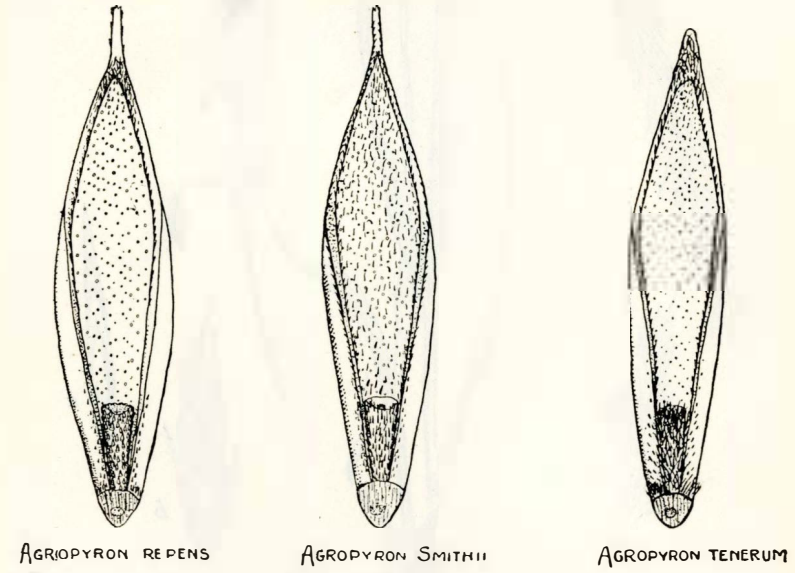

FIG. 4. "SEED" OF QUACK GRASS
(Agropyron repens)
Western Wheat Grass (A. Smithii); and Slender Wheat Grass (A. tenerum). (After J. T. Sarvis)

WILD BARLEY OR SQUIRREL TAIL GRASS

Description. Wild Barley or Squirrel Tail Grass (Hordeum jubatum L.) is a native winter annual which grows in dense tufts from six inches to two feet high, depending on soil and moisture. The somewhat bluish and hairy little mats of leaves in autumn and spring do not suggest the presence of this evil weed. Its graceful waving tops, in sloughs and along roadsides, also deceive its admirers. (Fig.5). Its pollen is thought to cause hay fever, and its awns or beards

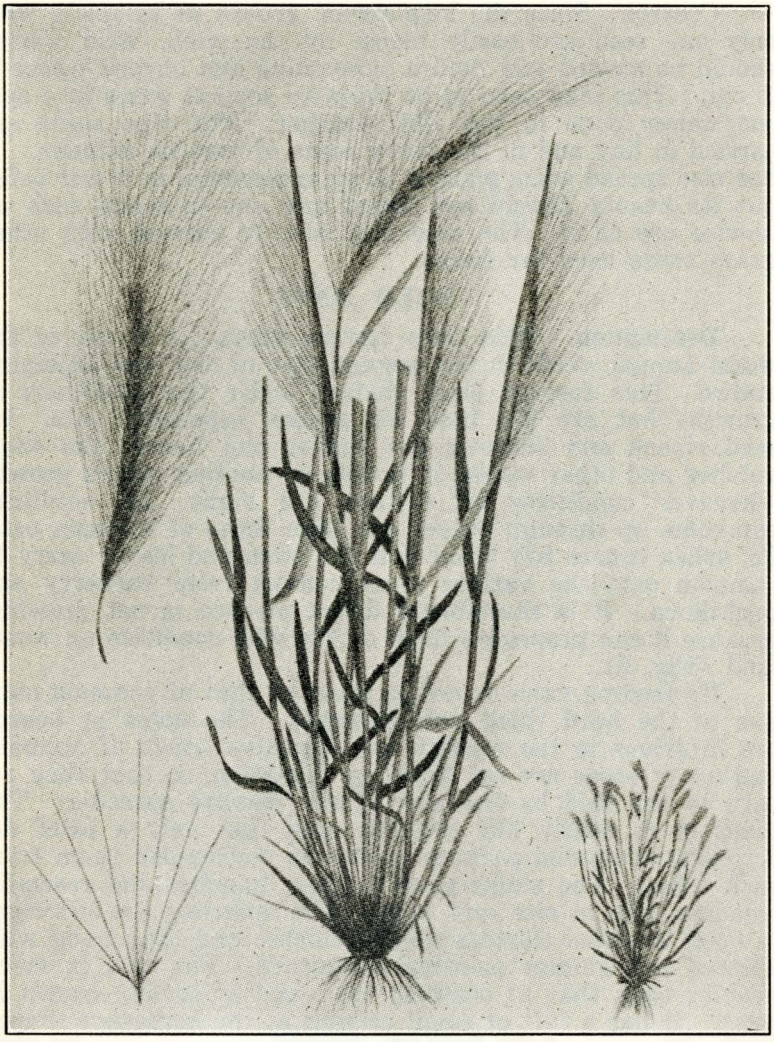

FIG. 5. SQUIRREL TAIL (WILD BARLEY)
(Hordeum jubatum L.)
(After Clark & Fletcher. Iowa Geol. Survey.)

cause much trouble in the eyes, mouths, and stomachs of livestock. Besides forming ulcers in the mouth, causing the loss of teeth, and resulting in serious poisoning, it may aid in the formation of hair-balls or bezoars in the stomach and intestines, or of severe ulcers. Wild barley and other weedy grasses, like quack grass, harbor the red or spreading stage of various grain rusts which come by way of the common barberry, described later.

Control. Since the long-awned groups of spikelets with only one seed are easily blown by the wind, Wild Barley should be mowed just before blossoming and burned where it is cut. This may need to be repeated several times in a season unless done in hot, dry weather. The ripe seeds are carried in hay and in the furry coats of various animals. It has also spread when planted as an ornamental in flower beds; but its beauty should not tempt any one to make such an unwise use of it. The seed may also be carried with other grass seeds used for lawns.

WILD OATS

Description. Wild Oats (Avena fatua L.) is one of the worst annual weeds in the eastern part of this and adjoining states. This foreign plant thrives under the conditions of growth that are the best for grains, especially oats. Its seed ripens and shatters out earlier and hence, like some vetches and other weeds, it is sure of another year's growth whenever conditions of culture are right. Its seedlings can come up through deeper soil than those of common oats. Its pollen causes hay fever and the stem and leaves carry to common oats the various rusts coming from barberry and buckthorn. It is therefore a direct menace to oat growing, because it can propagate itself in the wild condition on waste land (Fig. 6).

Its feeding value is not as great as that of common oats, due to the hard thick hull (lemma). The awns or beards are injurious to the mouths and digestive tracts of animals, and many seeds are not killed by digestion, so that they return to the field by the way of the manure spreader. The plant is so nearly like common oats that only a brief description of special parts is needed to distinguish them from each other. The stalks grow in close bunches and resemble common oats in size and color. The spikelets are arranged in open balanced clusters called panicles, and they hang with flowers and glumes pointing downward. The hull is much heavier than that of common oats, and is usually brown in color. It has a tuft of small bristles at the horseshoe-shaped scar, and parts of the hull are covered more or less by similar bristles. It has a beard or awn about an inch long, which is twisted and bent at various angles. This beard twists and bends as it becomes more moist or drier from the air and soil. By these motions it can dig itself under the soil or into the wool of sheep, just as the prairie needle or porcupine grass does. The hull, with its long brown hairs and beard, makes this weed easy to tell from oats or other crops. Its bunching habit is also distinct from most varieties of cultivated oats.

FIG. 6. WILD OATS
(Avena fatua L.)
(After Clark & Fletcher. Iowa Geol. Survey).

Control. By all means sow clean seed, even if it is higher in price. The figure of speech "sowing wild oats" has a very serious foundation. Presence of this seed in grain causes heavy dockages which cannot be afforded in such low-priced grain. Pulling up the bunches by hand, just before it ripens, is recommended by many where not much seed

was present originally. Cultivated crops keep the weed down and promote sprouting of the seeds. Winter annual crops like fall barley or rye mature earlier and are recommended as parts of the rotation which will complete its destruction. Some writers claim that the presence of this weed in large numbers is a sure sign of exhausted soil, which, when well fertilized, allows the crop plants to crown it out. Most careful observers are more certain that its presence is a sure sign of carelessness in the sowing of impure seed, and in following improper rotations.

GREEN FOXTAIL

Description. Green Foxtail (Setaria viridis (L.) Beauv.), often called pigeon grass, is very common throughout the state. It chokes out grain, potatoes, and other cultivated crops, and it grows in waste places in large quantities. Its tufted stalks are 1 to 2 feet high and slender. The leaves have rough margins, are 3|16 to 3|8 inch wide, and from 5 to 10 inches long. The heads are covered with green bristles and vary from 1 to 3½ inches in length. The spikelets are small and closely packed. They shatter readily when ripe, the small tuft of bristles remaining on the spike axis or rachis. (Fig.7.)

The seeds of this annual are about 1|12 inch long, cross wrinkled on the oval side and smooth on the flat side. Their color varies from light green to yellow or brown, depending on ripeness. They are sometimes hulled in threshing, and have a greenish-white color. These seeds are very common in clover and other small seeds.

Control. Clean seed should be sown and, if the soil is infested with seed, several harrowings before planting corn or other crops, followed by careful cultivation, will control it. After grain crops, it may sometimes be mown before seeding, and this may be followed by shallow plowing. It is well controlled by pasturing.

YELLOW FOXTAIL

Description. Yellow Foxtail (Setaria glauca (L.) Beauv.) is another European annual similar to green foxtail, but its stems are heavier, the heads have a dark yellow color, and are narrower than those of green foxtail. The "seeds" are about twice as large as those of green foxtail and may have a light or dark color. The cross wrinkles on the lemma or oval hull are more distinct than in the green species.

Control is precisely the same as for green foxtail. Several other similar foxtails are occasionally seen, only one of which, Barbed Pigeon Grass (Setaria verticillata L.) causes much trouble. Various varieties of millets are domesticated foxtails and sometimes persist for several years as weeds. (See Fig 8.)

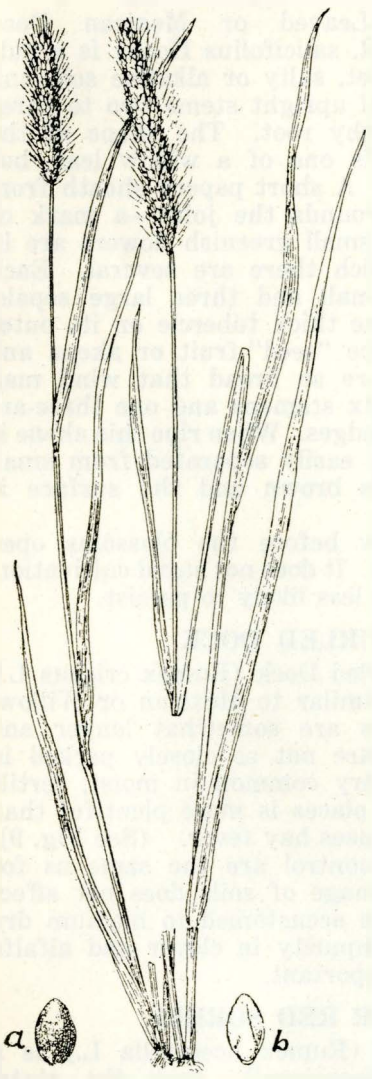

FIG. 7. GREEN FOXTAIL OR PIGEON GRASS
(Setaria viridis (L.) Beav.)
a, spikelet unhulled; b, bare grain (caryopsis) hulled out of glumes. (After Beal, Mich. Agric. Coll. Exp. Sta.)

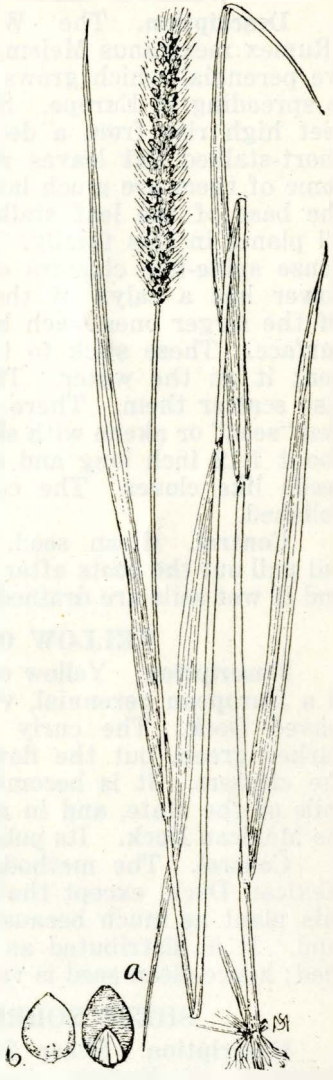

FIG. 8. YELLOW FOXTAIL
(Setaria glauca (L.) Beauv.)
a, spikelet unhulled; b, bare grain hulled out of glumes of spikelet. Hairs of spike (or raceme) not a part of the spikelet. (After Beal, Mich. Agr. Coll. Exp. Sta.)

WILLOW LEAVED OR MEXICAN DOCK

Description. The Willow-Leaved or Mexican Dock (Rumex mexicanus Meism., or R. salicifolius Hook) is a native perennial which grows in wet, salty or alkaline soil, and is spreading in Europe. Several upright stems two to three feet high rise from a deep fleshy root. The shape of the short-stalked flat leaves reminds one of a willow leaf, but some of them are much larger. A short papery sheath from the base of the leaf stalk surrounds the joint—a mark of all plants in this family. The small greenish flowers are in dense spike-like clusters of which there are several. Each flower has a calyx of three small and three large sepals. Of the larger ones, each has one thick tubercle on its outer surface. These stick to the ripe "seed"-fruit or akene and float it on the water. They are so broad that wind may also scatter them. There are six stamens and one three-angled "seed" or akene with sharp edges. When ripe this akene is about 1|12 inch long and is not easily separated from small seeds like clover. The color is brown and the surface is polished.

Control. Clean seed. Mow before the blossoms open and pull out the roots after rains. It does not stand cultivation, and if wet soils are drained it is less likely to persist.

YELLOW OR CURLED DOCK

Description. Yellow or Curled Dock (Rumex crispus L.) is a European perennial, very similar to Mexican or Willow-leaved Dock. The curly leaves are somewhat longer and darker green, but the flowers are not so closely packed in the clusters. It is becoming very common in moist, fertile soils of the state, and in many places is more plentiful than the Mexican Dock. Its pollen causes hay fever. (See Fig. 9).

Control. The methods of control are the same as for Mexican Dock, except that drainage of soils does not affect this plant as much because it is accustomed to medium dry land. It is distributed as an impurity in clover and alfalfa seed; hence clean seed is very important.

SHEEP SORREL OR RED SORREL

Description. Sheep Sorrel (Rumex acetosella L.) is a perennial of Europe, found occasionally over the state, mostly in pastures and acid soils in the Black Hills. This little sour-leaved dock spreads by rootstocks, from which arise stems 5 to 20 inches high. When present in large numbers, they rob the soil of moisture and stunt the crop. The stems from one seed bear either staminate or pistillate (seed-bearing) flowers, but not both (dioecious), and appear much alike at blossoming time. The leaves are mostly at the

FIG. 9. YELLOW OR CURLED DOCK
(Rumex crispus L.)
a, akenes, natural size; b, akene magnified; c, whole fruit (pedicel p with small and large, tubercled, calyx lobes magnified. (After Beal, Mich. Agr. Coll. Exp. Sta.)

FIG. 10. SHEEP OR RED SORREL
(Rumex acetosella L.)
"Seeds" natural size and enlarged. (After Beal, Mich. Agr. Coll. Exp. Sta.)

base as a rosette. The leaves are halberd or battle-axe shaped and thick, and are sour to the taste; hence such common names as sourweed are often used. The flowers are much like those of Mexican dock but much smaller, and the sepals are not so prominent. The "seeds" are about one-half the size of that species. (Fig 10). This should not be confused with Wood Sorrel, having lobed leaves like a clover, and larger yellow or rose-colored flowers.

Control. If the soil is well limed and fertilized, this weed cannot compete with crops of any kind. Spraying at blossoming time with iron sulphate, as recommended for Canada thistle, will kill off the stalks, but several later sprayings are needed to finish the work.

SWAMP SMARTWEED

Description. Swamp Smartweed (Polygonum Muhlenbergii Wats., or P. emersum Britton) is a native perennial of moist soils and muddy places, but it can adapt itself to drier situations. Its persistent deep rootstocks of great length make it difficult to control, and deep cultivation only spreads it. The stems are rough or somewhat hairy and generally not quite erect or they may trail along. The joints are somewhat enlarged and the leaf-sheaths are prominent above them. The leaves vary with the location in having short or long petioles and pointed or blunt tips and they may or may not be heart-shaped at the base. The leaves are somewhat rough-hairy on both sides, but this varies.

The flowers are in dark rose-colored dense spikes 1 to 3 inches long, and are sometimes in pairs. The small flowers are without petals, the five colored sepals taking their place. The five stamens project from the flower and the pistil produces a lens-shaped, black, polished, one-seeded fruit or akene, one-eighth inch in diameter.

Control. This is difficult and must be done on the starvation plan recommended for Canada thistles, and it must be carried over several years. The weed does not spread as rapidly nor are its stalks so objectionable as those of the Canada thistle. Thoroughly grubbing out small patches and watching them for several years is recommended.

LADY'S THUMB and PENNSYLVANIA SMARTWEED

Description. Lady's Thumb (Polygonum persecaria (L.) Small, and P. pennsylvanicum L.) are two very similar smartweeds common in rich cultivated areas. Both are annuals; the first (a foreign plant) having a smooth stem, the second being rough near the flowers. The first is one-half to two feet high, the second one to three feet high. The joints of both are thick, and the stems of the first are red. The

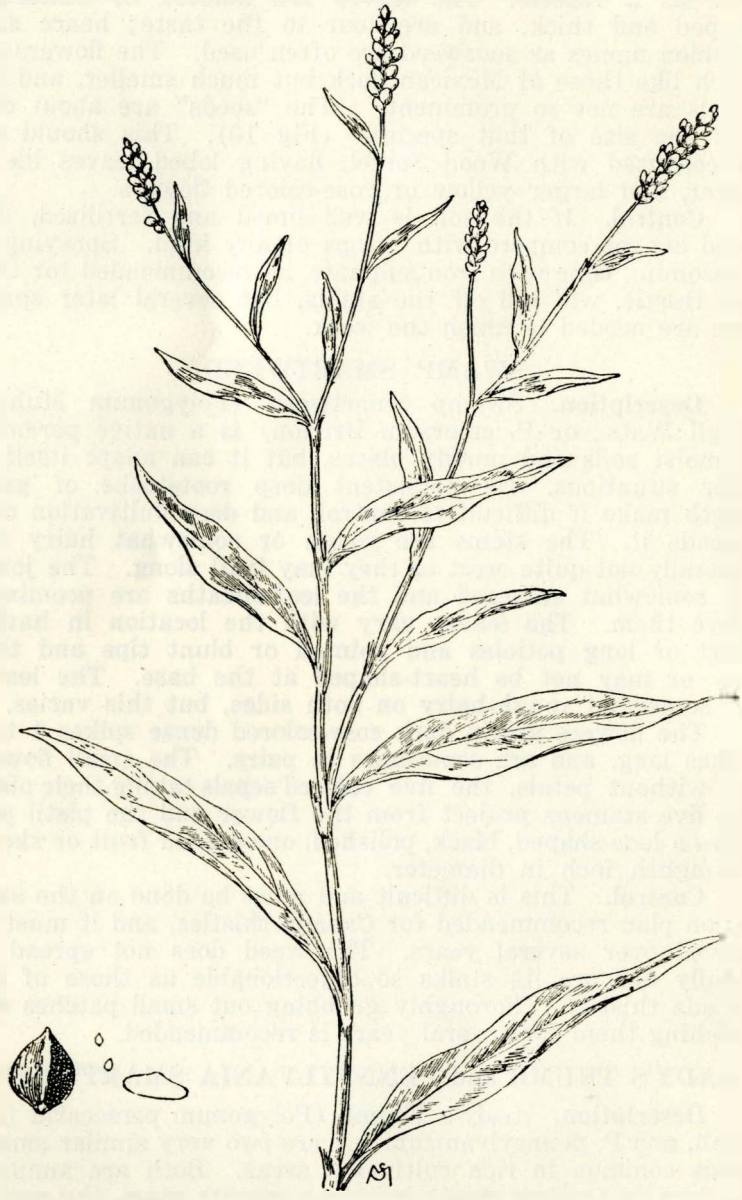

FIG. 11. LADY'S THUMB OR SMARTWEED
(Polygonum persecaria L.)
"Seeds" (akenes) natural size and enlarged. (After Beal, Mich. Agr. Coll. Exp. Sta.)

leaves of both are lance-shaped; the first being one to six inches long, the second two to eleven inches long. Lady's thumb is said to harbor corn root louse (aphis), and certain smuts kill the flowers and seeds. The flower spikes (racemes) are from one to two inches long and of a light or dark rose color. The stamens of the first are usually six, while the second usually has eight.

The "seeds" are generally lens-shaped in both kinds, but the Lady's Thumb may have a ridge on one of the flat sides. The seeds of both kinds are black and shining; the size of the first being one-twelfth to one-tenth inch, while those of the Pennsylvania Smartweed are about one-eighth inch wide. The first is a European plant, the second native. The first one has a dark "thumb mark" on the middle of the leaf. (Fig. 11.)

Control. The seeds of the first are present in clover seed and both are present in other seeds; therefore, clean seed is the first method of control. Hand pulling, if only a few are present, and mowing before blossoming in waste land, are recommended. Spraying with iron sulphate or copper sulphate, as given for Canada thistle, are also effective. Clean cultivation easily controls these weeds.

WILD BUCKWHEAT

Description. Wild Buckwheat (Polygonum convolvulus L.) is a twining European annual of fields and waste places. The leaves are arrow-shaped (sagittate) and somewhat variable. They vary from one-half to three inches in length and have long or short petioles. The leaf sheathes at the joints are small. The flowers are small, greenish-white, and in loose spikelike clusters (racemes) at the end of the vine, or in small clusters in the angles which the leafstalks make with the stem (axils). Five sepals, eight stamens, but no corolla are possessed by the flower. The single pistil in each flower makes a triangular, rough, black akene ("seed"). The seeds have the same food value as common buckwheat, a closely related weed, but if used as feed they should be finely ground to kill all germs. The seeds sprout only in very warm weather. This accounts for its late appearance in grain and cultivated crops. Seeds only live a few years in the soil. (Fig. 12).

Control. This weed is spread by grain seed, so that clean seed is the first precaution. Cultivation after removal of early crops is recommended. Clean cultivation of crops and later hoeing out the occasional late comers is important and insures control. Sheep will eat the weed from potato fields or tall corn.

FIG. 12. WILD BUCKWHEAT
(Polygonum convolvulus L.)
(After Clark & Fletcher, Iowa Geol. Survey.)

FIG. 13. LAMB'S QUARTERS
(Chenopodium album L.)
(After Oswald, Minn. Agr. Exp. Sta.)

LAMB'S QUARTERS

Description. Lamb's Quarters (Chenopodium album L.), sometimes incorrectly called pig-weed, is a European annual of fields, gardens, and waste places. It varies greatly in appearance and height (one to five feet). Its upright grooved, or often purple striped, juicy stem has many branches whose ends are studded with little rough balls of flowers, reminding one of beet seed. Beets are indeed closely related. The petioled, alternate (one at a node), pale green leaves vary greatly in shape on the same plant; the upper ones being lance-shaped while the lower ones are broader and have small lobes along the upper margins. The flower clusters have a silvery, mealy appearance due to small glandular hairs. The flowers are small, have no corolla but have five sepals and five stamens. The pistil forms a thin tissue covering of the true seed which is a dull-black, lens-shaped body, one-twentieth inch in diameter. The pollen causes hay fever. The shoots before flowering make very good and healthful greens. (Fig. 13).

Control. It is easily killed when young by harrow, weeder, and cultivator. It can be grazed off by sheep. Single stray plants in waste places and in cultivated crops after they are laid by, should be hand-pulled.

RUSSIAN THISTLE

Description. Russian Thistle (Salsola Kali L., var. tenuifolia, G. F. W. Meyer) is a European annual tumble weed of dry or alkali lands. Its close relation to Lamb's quarters shows that it is not a thistle, but the name was given solely on the spiny character of the leaves of mature plants. The leaves of young plants are long (linear) and juicy, and the stems are red striped. They can be used for silage. At the base of the mature stem, a break joint is formed so, when the branches die and curl inward giving the whole plant the form of a ball, the main stem is easily broken off by the wind and the whole plant rolls along back and forth over the field. The seeds, many of which adhere strongly at first, are thus slowly scattered as they ripen. It is these unsightly windrows which should be burned. Seeds are also spread in clover and alfalfa seed. The small greenish-white flowers are hidden in the axils of the short spiny leaves, and there may be from 10,000 to 200,000 flowers and seeds produced, depending on the size of the plant. Each seed is conical or top-shaped with a spiral groove winding around the tapering surface. It is about one-tenth inch in diameter. The embryo plant inside is very long and narrow, and follows the ridges between the grooves. (Fig. 14).

FIG. 14. RUSSIAN THISTLE
(Salsola Kali L., var. tenuifolia (After Beal, Mich. Agr. Exp. Sta.)

Control. Clean seed, and cultivation largely prevent their spread, but the roadside plants are perhaps best pastured off by sheep. Better weed laws to prevent neighbors from neglecting their duties, in the absence of fences, may also help. The pollen has produced hay fever in some people.

FIG. 15. PIGWEED

(Amaranthus retroflexus L.)
(After Clark & Fletcher, Iowa Geol. Survey.)

PIGWEED

Description. The Pigweeds (Amaranthus retroflexus L., and A. hybridus L.) are South American annuals, two to five feet in height, and have rough stems and leaves, and usually red roots. They are common in gardens and fields. Their pollen produces hay fever. The stems are rough-hairy, and red or green in color. They usually branch at the top only for seed production. The leaves are stalked, oval, or lance-shaped, and rough-hairy, and are from two to five inches long. The flowers are in sharp chaffy closely crowded clusters. They are small, greenish, and without petals. Each flower makes one shiny-black, oval-lens-shaped true seed, those of both species being one-twentieth inch long. Five lance-shaped sepals and mostly five stamens are present. The half-grown weeds are eaten by pigs and other stock. (Fig. 15).

Control. Clean clover and alfalfa seed is very important, because the seeds live over 30 years in the ground. Clean cultivation easily controls it, but this should be done when the weeds are very small. Early plowing and several harrowings at weekly intervals before seeding or planting eliminate buried seeds rapidly.

CORN OR PURPLE COCKLE

Description. Corn or Purple Cockle (Agrostemma githago L.) is a poisonous-seeded foreign annual of grain fields and waste places. The stems are erect and have few branches at the top, and are about two and one-half to three feet in height. The leaves are long lance-shaped (two to five inches long), hairy, and in pairs. The single flowers on each branch open in July, are rose-purple in color, and over one inch wide and high. Five long sepals are united into a true calyx, but the five showy petals are separate. The ten stamens are not fastened to the petals but to the end of the flower stalk (pedicel) called the torus. This is the foundation, in all flowers, to which the different sets are attached, no matter how small they are or how much the torus is expanded outward or upward around the pistil. This latter, as in cockle, is always at the original end of the torus. The pistil becomes a dry pod with many seeds fastened to a central columnar growth called a columnar placenta. All weeds previously described produced one seed per pistil and only in the pigweeds and lamb's quarters were these seeds hulled free from the pistil wall. The numerous black, rough seeds are shaken out of the top of the pod by the wind. The opening (dehiscence) occurs naturally in the drying process. The poisonous seeds are one-twelfth to one-eighth inch in diameter, and wedge-shaped in the edgewise view, and somewhat bean or kidney-shaped in the flat view. When ground into flour

FIG. 16. CORN OR PURPLE COCKLE
(Agrostemma githago L.)
(After Beal, Mich. Agr. Exp. Sta.)

with other grain, they cause a dark color and bad flavor due to a poisonous chemical (sapotoxin, $C^{17}H^{26}O^{10}$) formed naturally in the seed. This affects livestock and human beings very seriously when eaten raw or cooked, and may cause death. Vomiting, headache, diarrhoea, and difficulty in breathing are some of the effects. The screenings from grain that contains this seed should not be fed but burned. (Fig.16).

Control. Clean seed and clean cultivation are recommended. Many farmers go through their fields and pull the plant by hand and thus get seed entirely free from this bad weed of the Pink family. If too many plants are present for this method, iron sulphate or copper sulphate spray, applied just before blossoming will kill them out and not hurt the grain.

BARBERRY

Description. The Common Barberry (Berberis vulgaris L.) is an Asiatic, woody bush included here mainly because of its well-known relation to the spreading of grain rusts, although it is a weedy plant in its habits of growth and spreading. It was brought in as ornamental, and its berries are used in jelly making. Its yellow bark contains a yellow dye and a poison which has been used in medicine.

Several varieties, mostly with purple leaves, also occur in the state. The Wild Oregon Grape (Mahonia repens Don, or Odostemon aquifolium (Pursh) Rydb.) of the Black Hills has been suspected of carrying this rust (a fungous parasite), but according to experts of the United States Department of Agriculture this plant will not carry grain rust.

The common Barberry is a shrub from three to ten feet or more in height. The ridged stems are erect when young, but if numerous they bend outward slightly in age. The bark is then gray instead of reddish-brown and the regular ridges disappear. (Fig. 17).

At the joints of most shoots is found a three or more pronged thorn made from a leaf. These prongs or spines vary from one-half to one inch or more in length. In the axil or angle of this thorn, a short spur with a cluster of leaves is formed. These are obovate or reversed-oval, or spatulate in shape and have serrate or saw-tooth edges. Small racemes of ten to fifteen yellowish flowers have stamen anthers (pollen sacs) which open at the top only. Each flower produces an oval or oblong reddish one-seeded berry. This seed is hard and is not digested or killed by the birds and livestock which eat the fruit, hence they are scattered far and wide, as proven by the many seedlings found.

All green soft parts carry the red-spored or cluster cup stage of over thirty strains of grain rust. The little cups, the size of a pinhead, are in groups. These red spores are carried by the wind to the grains; in about ten days, if the weather is favorable (so that the spores are not killed before they can grow into the grain), a reddish-brown rust appears. This keeps spreading and finally the black spore stage appears which seems to do most damage. These black spores

in the following spring, make smaller spores that are carried by the wind to the opening buds or young leaves and flowers of the barberry, where the fungus gets a fresh start. Neither the black spores nor their smaller wind spores (sporidia) will infect the grain, so the control of the barberry controls the rust.

Control or Extermination. The roots of the barberry are very apt to make new buds and shoots so that they must be grubbed out thoroughly and watched for several years. The latter is also necessary on account of the seeds which do not all sprout in the following year and which are scattered far and wide as above stated. The Barberry Survey of the United States Department of Agriculture is now killing this pest by putting ten to twenty pounds of coarse rock salt around the bases of the stems. In a few weeks the plant dies, root and all; but the ground may not grow other plants for several years, especially if too much salt has been used.

The Japanese Barberry (B. Thunbergii D. C.), so often used for ornamental hedges, is not attacked by the rust. But its hybrids (crosses) with common barberry and some of their offspring, looking just like it, do carry the rust. Japanese Barberries should always be watched several years after planting to see that they are the pure species. If they bear rust they are hybrids and should be destroyed. This species is not as large as the common barberry, its leaves are small one-half to one inch long, and the thorns are not so numerous. The fruits are more nearly globular and darker in color. The branches bend outward in rainbow-curves and are easily told from the stiffer, more erect, and taller common barberry, and its purple-leaved varieties. (Fig. 18).

CHARLOCK OR WILD MUSTARD

Description. Charlock or Wild Mustard (Brassica arvensis (L.) Ktze.) is a foreign annual weed of grain fields. The rough erect stem is one to three feet high, somewhat branched near the top and all branches end in long flower clusters. It is green in color except for red blotches at the joints. The leaves vary in size and shape on the same plant and on different plants, being oval in some and lance-shaped or diamond-shaped in others. They have little or no stalk, and are variously lobed in the lower half and notched or serrate in the upper half. The upper leaves are less variable, but like the lower, are rough and hairy.

The fragrant flowers, of which there may be ten to twenty in each cluster, are not crowded and each one produces a pod with ten to fifteen seeds. They are two-thirds inch wide, have four yellow petals (cross-form, hence the family name Cruciferae, cross-bearers), and there are six stamens

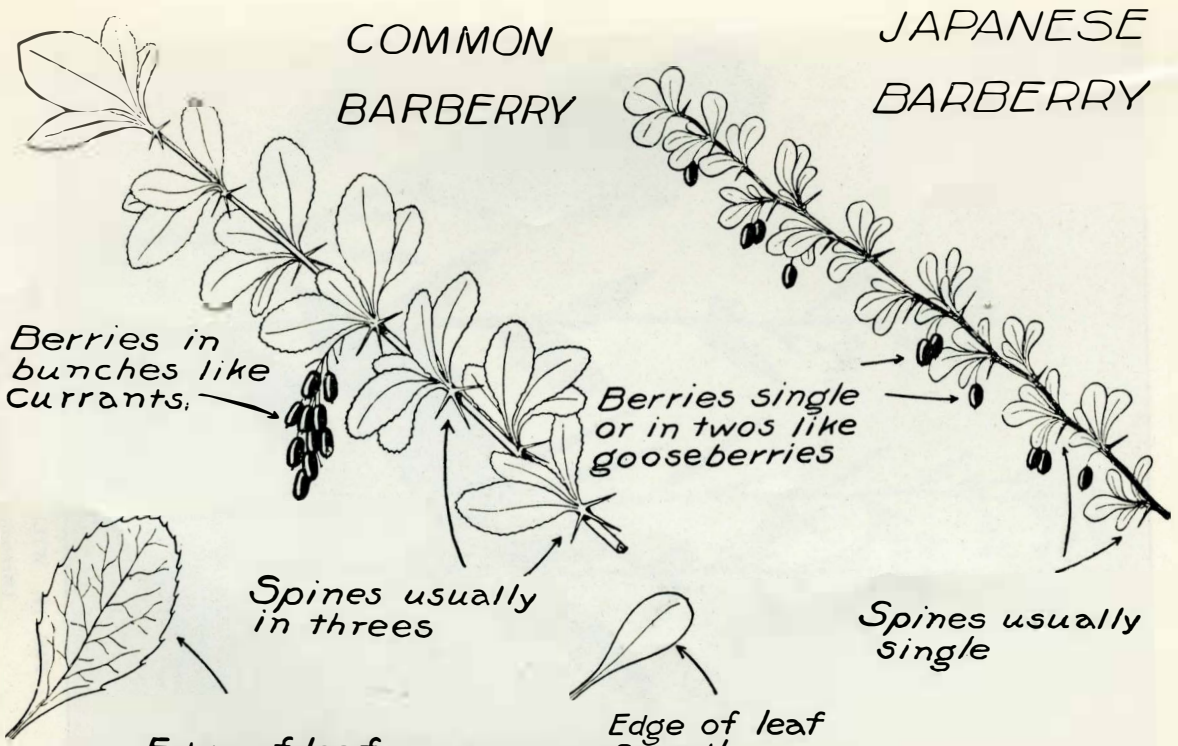

FIG. 17. COMMON BARBERRY
(Berberis Thunbergii D. C.)
(After U. S. D. A. Farmers' Bull. 1058)

FIG. 18. JAPANESE BARBERRY
(Berberis Thunbergii D. C.)
(After U. S. D. A. Farmers' Bull. 1058)

(Berberis Vulgaris L)

FIG. 19. WILD MUSTARD OR CHARLOCK

(Brassica arvensis (L.) Ktze.)
(After Clark & Fletcher, Iowa Geol. Survey.)

of which two (the remainder of an outer set of four) are short, while the four inner ones are longer. The pods (siliques) are peculiar to the family, in having two valves that fall off leaving a fan-like partition, on both sides of which the seeds are very loosely located. Over 15,000 seeds have been collected from one plant. Seeds are known to live in the soil for many years. They are of a reddish-brown or black color, and slightly pitted. They are globular and measure about one-sixteenth inch in diameter. They are carried as impurities in clover and grass seed. (Fig. 19).

Control. Sow clean seed. Use the weeder early in the spring when grain is not easily damaged. Early plowing and several harrowings before seeding are also recommended. Pasturing is a valuable method of control. The iron sulphate spray is the best control measure. This should be applied as a fine mist (100 to 200 pounds per square inch pump pressure) on a bright day at the rate of 50 gallons per acre. One hundred pounds of the salt (iron sulphate), dissolved in 50 gallons of water, is applied fresh. The machine should be cleaned after using. This spray kills clovers and other broad-leaved plants. It is not sufficiently poisonous to stock to be dangerous.

TUMBLING MUSTARD

Description. Tumbling Mustard (Sisymbrium altissimum L.) is a European winter annual whose spring rosette leaves somewhat resemble coarse dandelion leaves, but they are longer and broader and lighter green in color. The two to four foot flowering stems shoot up rapidly and the few stem leaves are long lobed and quite unlike the lower or rosette leaves. The stem branches loosely and widely, and its branches bear widely separated cream-colored flowers one-third inch wide. Each flower produces a very long needle-like pod (silique) with about 100 seeds, which accounts for the fact that these plants frequently bear over one million seeds each. The weed breaks off and rolls over the ground by the force of the wind, just as the Rusian thistle; and since the pods open late, they are scattered back and forth over the fields. The reddish-yellow seeds are oblong, grooved, and about one-twenty-fifth inch long. They are found in various commercial seeds. (Fig. 20).

Control. Clean seed, fall disking, spring harrowing, and other methods recommended for wild mustard can be used for tumbling mustard, except spraying. The latter is ineffective due to the nature of the surface of the leaves and stems. The old stems and pods should be burned and the large rosettes hoed out, as one plant will reseed a large area each year.

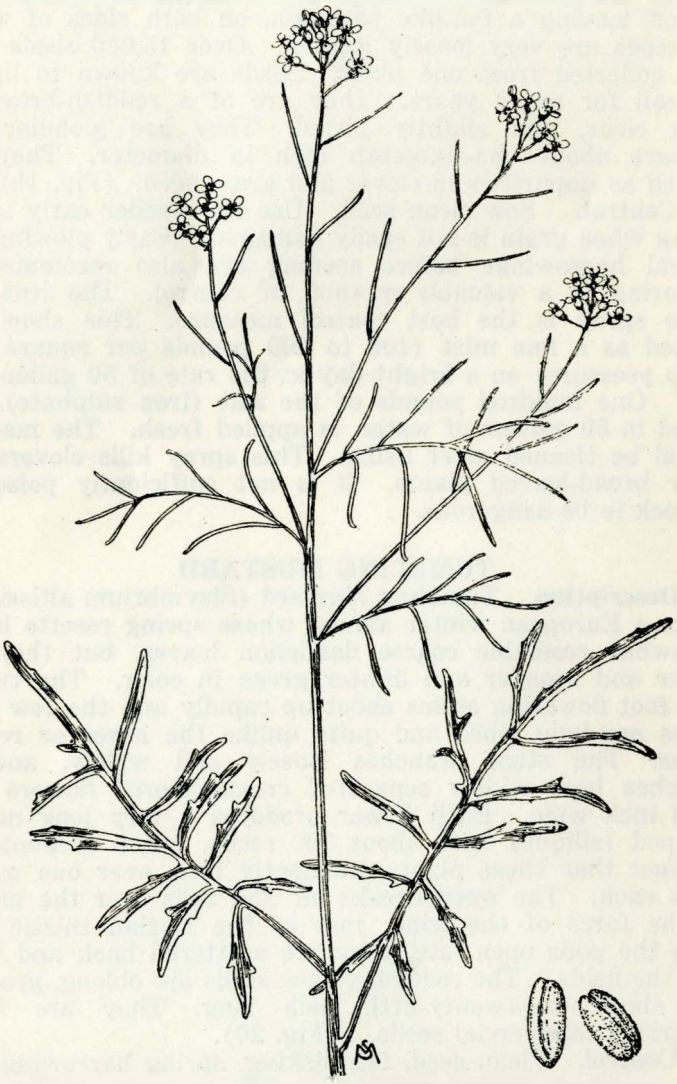

FIG. 20. TUMBLING MUSTARD
(Sisymbrium altissimum L.)
(After Beal, Mich. Agr. Exp. Sta.)

FIG. 21. SHEPHERD'S PURSE
(Capsella bursa-pastoris (L.) Medic.)
(After Oswald, Minn. Agr. Exp. Sta.)

SHEPHERD'S PURSE

Description. Shepherd's Purse (Capsella bursa-pastoris (L.) Medic.) is a little European winter annual common in gardens and other fertile areas. The fall or spring rosette reminds one of the rosette of the red-seeded dandelion, but the leaves are more flat, and they vary greatly in the number and size of the lobes. The stems are simple and branched at the top, or often they are much branched at the bottom. They vary in height from eight inches to two feet, are almost leafless and bear long simple clusters (racemes) of flowers at their ends. These continue to grow and produce flowers and pods (silicles) of a reversed heart shape, or triangular form, which are not crowded. The flower stalks (pedicels) are long and very thin. Flower clusters and leaves may bear a white rust injurious to radishes. It also carries the club-root disease of cabbage, turnips, cauliflower, etc. The leaves and stalks, as well as those of wild and of tumbling mustard have been used for greens. The pods are one-fourth to three-eighths inch long and bear about ten to twenty seeds, one-twenty-fifth inch long. A plant may bear several thousand seeds. (Fig. 21).

Control. Hoeing or spraying rosettes in early spring before blossoming, and clean cultivation easily control this weed.

FALSE FLAX

Description. False Flax (Camelina sativa L.) is a European winter annual found in grain and flax fields of the eastern and western parts of the state. It is grown in Europe for a fine oil extracted from the seeds. It was once believed to be degenerate flax, just as some still believe that chess or cheat (Bromus secalinus, etc.) is degenerate wheat. The erect thin stems are sparingly branched above the middle and reach a height of two to three feet. The rosette leaves are stalked and lance-shaped with notches or teeth, while those of the flowering stem are shorter (two to three inches long), less toothed, and the blades are arrow-shaped. They have no stalks and clasp the stem. The pear-shaped siliques are less in width than those of flax, and are widely spaced on the stem. The flowers are very small, yellowish in color, and are constructed as in other mustards. (Fig. 23).

Another species, the Small Fruited False Flax (C. Microcarpa Andrz.) is often found with this false flax. It is a shorter, hairy plant, and multiplies more rapidly by seed. (Fig. 22).

Control. Sprays are not advised as they are not positive in action. The seeds are one-twelfth inch long, hence are found in several other seeds. Clean seeds, fall harrow-

FIG. 22. SMALL FRUITED FALSE FLAX
(Camelina microcarpa Andrz.)
(After Beal, Mich. Agr. Exp. Sta.)

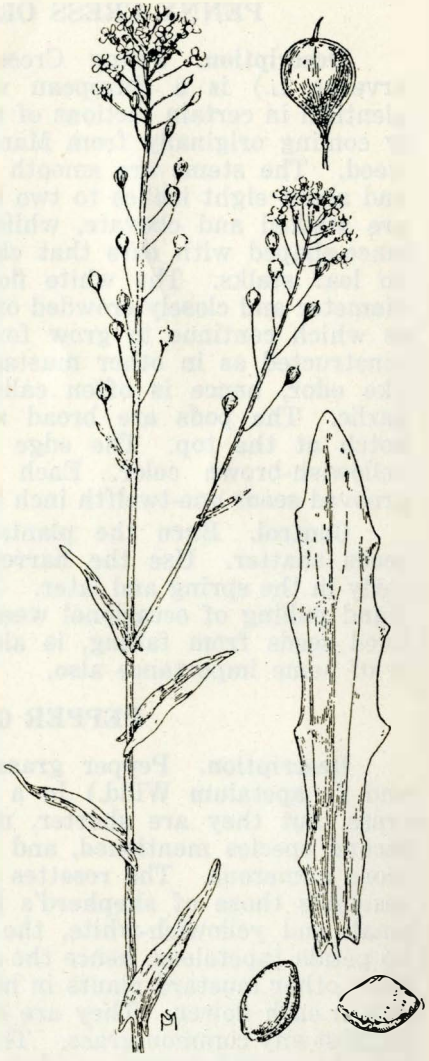

FIG. 23. FALSE FLAX
(Camelina sativa L.)
(After Beal, Mich. Agr. Exp. Sta.)

ing or disking, and spring plowing with harrowing or weeding are the best control measures.

PENNY CRESS OR FRENCH WEED

Description. Penny Cress or French Weed (Thlaspi arvense L.) is a European winter annual which is very plentiful in certain sections of eastern South Dakota, probably coming originally from Manitoba where it is a very bad weed. The stems are smooth or roughish, much branched, and about eight inches to two feet high. The rosette leaves are stalked and obovate, while the stem leaves are broad-lance-shaped with ears that clasp the stem; i.e., they have no leaf stalks. The white flowers are one-eighth inch in diameter and closely crowded on the several or many branches which continue to grow for sometime. The flowers are constructed as in other mustards. The plant has a garlic-like odor, hence is often called stinking mustard or wild garlic. The pods are broad and fan-shaped, with a deep notch at the top. The edge is broad, seedless, and of a yellowish-brown color. Each pod bears several blackish, grooved seeds one-twelfth inch long. (Fig. 24).

Control. Burn the plants with ripe pods before the seeds shatter. Use the harrow or weeder on grain fields early in the spring and later. Clean cultivation is important. Hand pulling of occasional weeds to prevent the many long-lived seeds from falling, is also recommended. Clean seed is of some importance also.

PEPPER GRASSES

Description. Pepper grasses (Lepidium virginicum L., and L. apetalum Willd.) in a general way resemble penny cress, but they are shorter, more branched, especially the second species mentioned, and their silicles are smaller and more numerous. The rosettes are prominent and somewhat resemble those of shepherd's purse. The flowers are very small and yellowish-white, the second species often having no petals (apetalous, hence the name apetalum). They differ from other mustard plants in having only two or three stamens in each flower. They are not grasses, nor do the plants suggest any common grass. They may become tumble weeds, but the second species is often too slightly branched to roll well. The seeds are small and are used for various caged birds. (Fig. 25).

Control. These weeds are controlled by the methods used on Shepherd's purse, and by burning of the half-ripe stems which should be cut while wet.

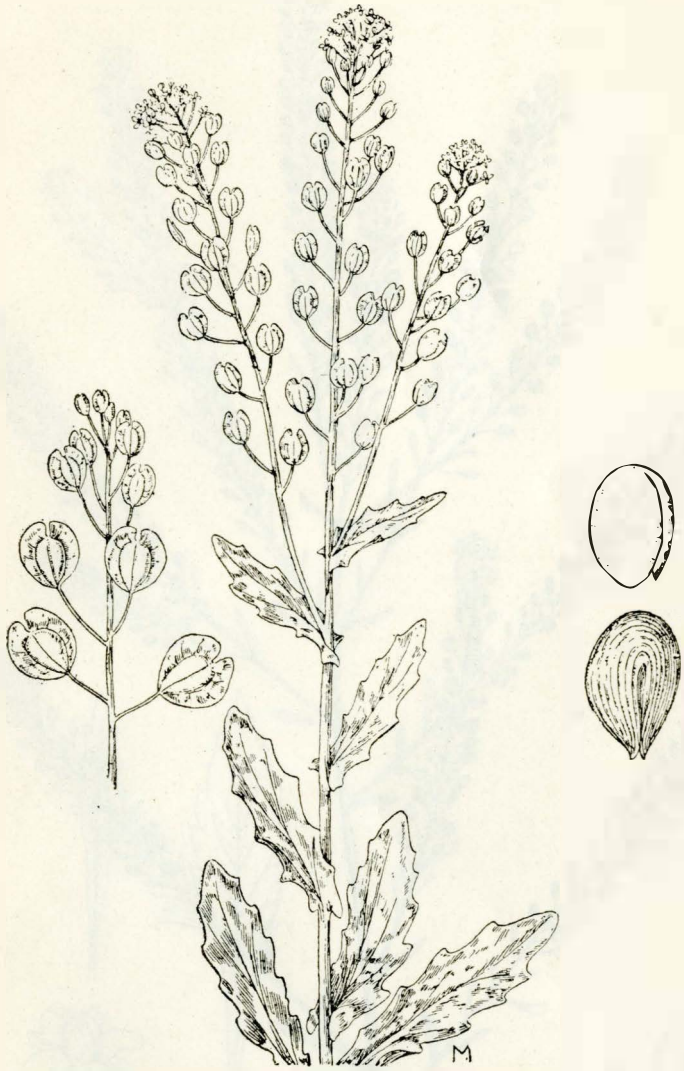

FIG. 24. PENNY CRESS OR FRENCHWEED
(Thlaspi arvense L.)
Seed enlarged, also hulled. (After Beal, Mich. Agr. Exp. Sta.)

FIG. 25. WILD PEPPER GRASS
(Lepidium virginicum L.)
One seed and a flower enlarged. (After Beal, Mich. Agr. Exp. Sta.)

PURPLE OR STEMLESS LOCO WEED

Description. Purple or Stemless Loco Weed (Oxytropus Lamberti Pursh.) is a native western perennial of higher ground in many parts of the state. The poisonous tufts of radical (from the short stem at the top of the root), leaves, and flower stalks about twice as high (ten to fifteen inches) make this and some of its similar relatives of considerable importance in grazing. The leaves have long stalks and ten or more lance-shaped hairy leaflets. The flower stalks may be three or four or several times this number. and about one-third or one-fourth of their length is loosely covered by whitish purple or violet flowers of the characteristic bean or pea type, but they are longer (one inch) and not so wide as a pea blossom. The flowers are sessile (stalkless) on the stem, and the short hairy pods are imperfectly two-celled by an inward growth of one side. Several blackish bean-shaped seeds, one-eighth inch in length or less, are borne in each pod (legume).

Underground rootstocks are also said to spread this plant. The poisonous action of this plant is usually slow. A habit is first acquired for it. The eyesight is first affected. The crazed animal later goes through many queer antics and finally starves to death. Cure in early stages is effected by giving good feed and confining the animal to keep it from eating more of this plant and to avoid setting an example for other animals of the herd or flock. (Fig. on cover page).

Control. Cropping the ground or hand hoeing are the most certain methods, but the latter is time-consuming over large ranges, yet it has paid well in many instances.

WILD CARROT

Description. Wild Carrot (Daucus carota L.) is a European biennial, brought to this country in agricultural seeds. The leaves of the rosette are finely divided, much like those of the cultivated carrot, which was derived from it, and the stem leaves become smaller as they approach the dense, inverted, umbrella-shaped cluster of flowers from which the family (Umbelliferae) takes its name. The clusters are compound; i. e., umbels in a greater umbel, which is concave and imitates a bird's nest. The flowers are small and white-pink or purple with no visible calyx, and five petals on the top of the fruit which has two "seeds" (mericarps) that are prickly. But these prickles rub off easily allowing the seed to get into many kinds of small commercial seeds.

Control. Plant clean seed. Cut the rosettes or mow the plants a week before blossoming starts.

FIG. 27. SPOTTED COWBANE OR WATER HEMLOCK
(Cicuta maculata L.)
(After Beal, Mich. Agr. Exp. Sta.)

WILD PARSNIP

Description. Wild Parsnip, sometimes called escaped parsnip, (Pastinaca sativa L.) is the common parsnip of gardens escaped from cultivation and scarcely needs description. Its tall ridged hollow stems with large open umbels of yellow flowers are familiar to all. The rosette and stalk leaves are large and coarse like those of celery. It is not to be confused with the very broad-leaved, white-flowered, hairy plant called cow-parsnip (Heracleum lanatum Michx.) which sometimes poisons cattle.

Control. This weed is easily controlled by cutting before seeding. The cow-parsnip is perennial, while the common parsnip is biennial. They have deep fleshy roots which can be plowed under and the seed is very short-lived, especially that of the common parsnip, which is not poisonous except that the stalks may cause trouble in cattle eating large quantities.

SPOTTED COWBANE OR WATER HEMLOCK

Description. Spotted Cowbane or Water Hemlock (Cicuta maculata L.) is a deadly poisonous native perennial. It is intermediate in size and appearance between parsnip and wild carrot. The smooth, hollow, red or purple-spotted stems and the finger-like clustered (fascicled) perennial roots in wet soil are very characteristic. These roots are very sweet-scented and often tempt boys to eat them when plowing, thus causing many deaths. A small amount of the sweet tops causes death in cattle. The leaves have from ten to fifteen lance-shaped leaflets, one to three inches long and somewhat serrate. Several loose compound umbels of white flowers produce several hundred poisonous seeds one-twelfth inch long, which may be carried by high water. (Fig. 27).

Control and Extermination. If the land cannot be drained, hand pulling after rains, in midsummer just before flowering, must be resorted to for several years. If these do not pull out well, a small spade, broad mattock, or hazel hoe must be used.

BULB BEARING WATER HEMLOCK

Description. The Bulb-bearing Water Hemlock (Cicuta bulbifera L.) is also found in wet ground in some parts of the state. The plant is about half the size (two to three feet high) of spotted cowbane, and its leaves have long narrow (linear) leaflets. It rarely bears seed, but has small bulblets one-eighth to one-fourth inch in diameter in the axils of the upper leaves, and is thus easily recognized.

Control and Extermination. The same as for Spotted Cowbane.

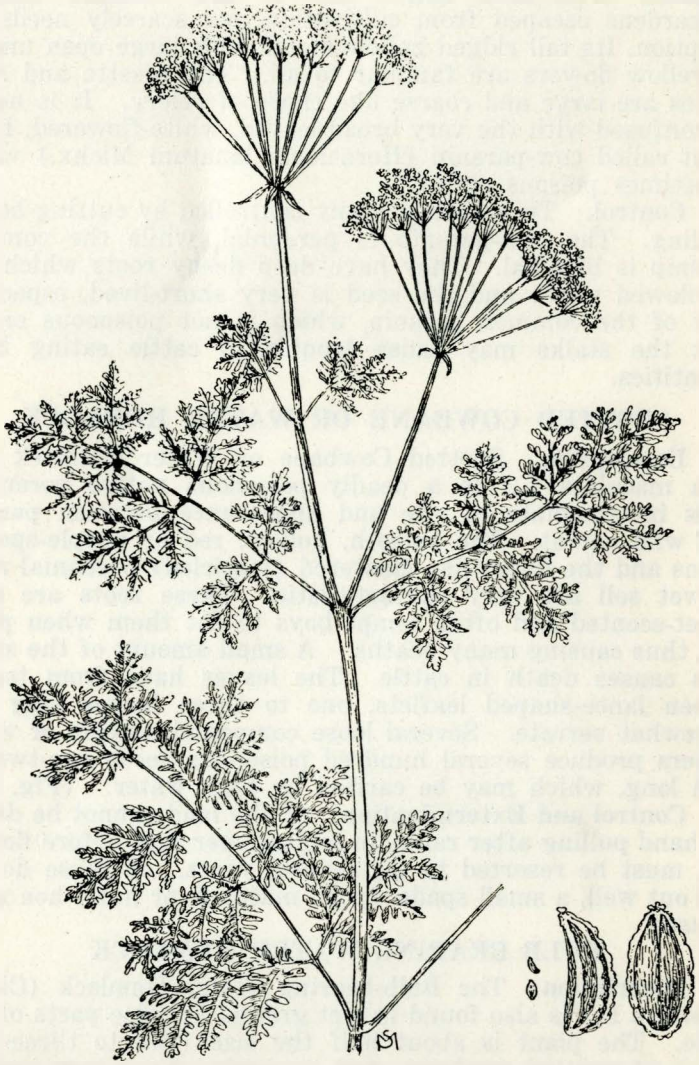

FIG. 28. POISON HEMLOCK
(Conium maculatum L.)
(After Beal, Mich. Agr. Exp. Sta.)

POISON HEMLOCK

Description. Poison Hemlock (Conium maculatum L.) is a deadly poisonous plant of the same size as spotted cowbane. It is doubtful whether this weed exists in South Dakota, but it should be looked for. Since the stem is spotted, the flowers white, and the roots fleshy, the best method of recognizing it is by its finely-cut leaves which somewhat resemble parsley. (Fig. 28).

Control and Extermination. The same as for Spotted Cowbane. Importation of its seeds and leaves for medical use is probably responsible for its introduction and dissemination in this country.

ALFALFA, CLOVER, FLAX, and FIELD DODDERS

Description. Alfalfa, Clover, Flax, and Field Dodders are all yellow, orange-or reddish-yellow vined annual parasites without green leaves. Two are native and two are foreign. The latter are more closely confined to the clovers, alfalfas, and flax. Dodders all belong in the genus Cuscuta. The species are not described here because they are too difficult to distinguish without very accurate and technical descriptions. Such descriptions are meager enough in most of the larger texts, and they cannot be applied by anybody but experts. (See Figs. 29,30,31). However, the very thin, orange-colored network binding the host plants together in a very tangled mass, and the small or large knots or masses of whitish, pinkish, or yellowish, globular flowers are never forgotten after first seeing them. The facts that the plants are not rooted in the soil, that they send sucker-like roots into the host plant at nearly all points of contact, are also very positive points in recognizing these parasitic weeds which, strange as it may seem, are related most closely to morning-glories, such as Creeping Jenny and Hedge Bindweed described later. From two to four slightly rough seeds are borne in each pod which is the result of one flower; but the flowers are so numerous that seeds are all too plentiful, and even though very small, one-thirtieth to one-fifteenth inch in diameter, they are found in various clover, alfalfa, and other small seeds.

Their shape varies somewhat, but may be described as oval-angular; their color varies from light yellow to brown, gray, tawny, or blackish. Their texture and general shape, but not their species size, may be best learned by marking a clump of wild dodder in a waste place and collecting the seed when ripe. The seeds sprout late in the spring or early summer. The small coiled embryo is much like that of Russian Thistle, except that both cotyledons are missing. Aft-

FIG. 29.
FIELD DODDER
(Cuscuta arvensis Beyrich.)

FIG. 30.
FLAX DODDER
(C. epilinum Weihe)

FIG. 31.
CLOVER AND ALFALFA DODDER
(C. epithymum Murr.)

(After Beal, Mich. Agr. Exp. Sta.)

er sprouting, only sufficient root is formed to get water for a few days. A shoot several inches long quickly rises from the ground and sways about till it touches a host plant. Sucker roots soon penetrate the host and the connection with the root dies and soon breaks. This leaves the young plant to suck all its water and food from the host plant which may be clover, alfalfa, flax in case of the foreign species, or any other young host from onions to sunflowers, in the case of the native dodders.

Control. Learn to know any dodder seed, and do not sow seed with one dodder seed in it. Several thousands can

be inspected in one evening on white paper, with the aid of a low-priced magnifying glass. If in doubt, send a good sample of seed to the Seed Analyst at the Experiment Station.

When dodder is first found in a field, mow the whole infested area, and a few feet outside, very close to the ground, and pile and dry it where cut. Then burn it. If it is not found till seed has formed (after August first), then it should not be piled up or turned, because the seed shatters out. Old straw, or other similar material that will burn well, and some kerosene should be added to make a very hot fire in order to burn the seeds. No fields sowed with seeds liable to contain dodder should be without inspection every two or three weeks in June and July. If dodder covers the field early in July, the field should at once be thoroughly plowed. Such cases ought to be extremely rare, and those with ripened dodder seed still less frequent. If discovered very early (middle of June), the field may be pastured heavily, but this is not as certain to get the best results as the other methods mentioned. Clean seed is by far the cheapest insurance against these destructive pests.

HEDGE BINDWEED

Description. Hedge Bindweed (Convolvulus sepium L.), a native perennial, is about twice the size of Field Bindweed in every way. But the flowers have slightly different colors and shapes, and the leaves are more nearly arrow-shaped. The seeds are one-fifth inch long and broader in proportion to length, than those of Field Bindweed. They are nearly smooth and black or brown in color. The markings of the hilum end (point of attachment in the pod) are also much more distinct than the Field Bindweed. (Fig. 32).

Control. The rootstocks are thicker and less brittle than in field bindweed, so they may be raked or harrowed together, dried and burned, or they can be fed to pigs. The starving-out process gives surest results. Clean seed is also important. These seeds live several years in the soil, hence early plowing and harrowing are also of value.

FIELD BINDWEED

Description. Field Bindweed (Convolvulus arvensis L.) is often known as Wild Morning Glory or Creeping Jenny. It has a trailing or twining thin vine, with one halberd (battle-axe) or arrow-shaped leaf at each joint. It is a foreign perennial with deep, fleshy, white rootstocks from which many vines spring. The pink or white funnel-shaped flowers on short or long stalks, come singly, from the axils of the leaves and produce one pod with four seeds. These are dark-brown or black, and rough. They measure one-eighth to

FIG. 32. HEDGE BINDWEED
(Convolvulus sepium L.)
(After Beal, Mich. Agr. Exp. Sta.)

FIG. 33. FIELD BINDWEED
(Convolvulus arvensis L.)
(After Beal, Mich. Agr. Exp. Sta.)

one-sixteenth inch in length and have two flat faces and a curved back. The five petals are grown together their full length, making a true corolla about one inch wide. Five stamens are attached to the throat of the corolla, on the inside. The sepals are short and scale-like, and they overlap somewhat. (Fig. 33).

Control. Sow clean seed. The white rootstocks produce shoots at each joint; hence the ground should be plowed to the right depth (just deep enough to get them all up). After this, clean cultivation, in which the short (one to two inch) sprouts are cut off as often as they appear, should be the rule. This should later be followed by the hoe. Fallowing the same as for Canada thistle or quack grass should be used in bad cases covering large areas. Pasturing, hogging out, smothering, and spraying are of doubtful value.

BUFFALO BUR

Description. Buffalo Bur (Solanum rostratum Dunal) is a very thorny annual in the Nightshade family. It is a native and thrives in prairie soils. The nearly erect, thorny stems are from one to two feet high and break off after ripening the seed, thus distributing many that have not been shaken out of the thorny pods earlier. The alternate leaves are five to eight lobed, the outer three being the largest. The yellow flowers are very striking, resembling a tomato blossom and having the flower parts very similar. Several flowers are found in loose clusters. The prickly pods, about one-half to three-fourths inch long, bear several large, flat-circular, rough, black seeds one-tenth inch wide. They are distributed in hay, in wool, by wind and water. (Fig. 34).

Control. This disagreeable weed is comparable with the sand bur (a grass) of some sandy regions and should be prevented from seeding by cutting or pulling when beginning to flower or a litle earlier. Some of the perennial ground cherries related to Buffalo Bur must be treated as Canada Thistle, Milkweeds, Water Smart-weed, and Field Bindweed are treated; namely, by the cutting and starving-out methods.

COMMON PLANTAIN

Description. Common plantain (Plantago major L.) is an Asiatic perennial of moist lawns and fields. The stem is very short (caudex) and corm-like with many fibrous roots. The leaves are in a tuft and spread outward somewhat from the short invisible stem. The leaf stalks are two or more inches in length and grooved on the upper side. They are green or greenish-white near the stem and not pink as in the next plantain (P. Rugelii) described. The oval strongly ribbed leaf blades, three to six inches long, are some-

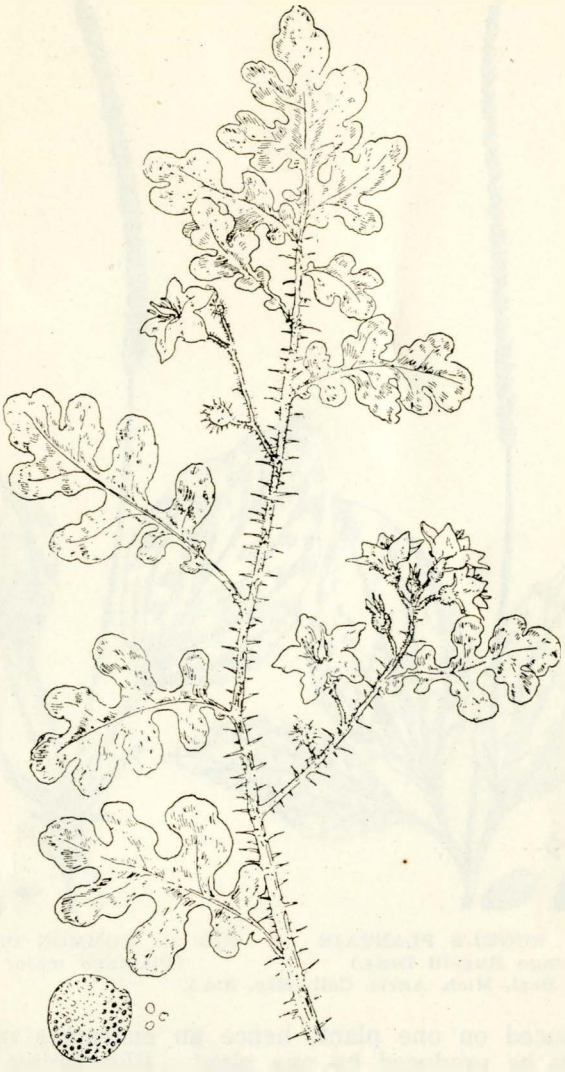

FIG. 34. BUFFALO BUR
(Solanum rostratum Dunal.)
(After Beal, Mich. Agr. Exp. Sta.)

what fleshy, wavy, and may be strongly notched at the bottom edges.

The small papery flowers are crowded on long spikes resembling a rat's tail. These spikes are from five to fifteen inches or more in length, and from three to fourteen or more

FIG. 35. RUGEL'S PLANTAIN
(Plantago Rugelii Dcne.)
(After Beal, Mich. Agric. Coll. Exp. Sta.)

FIG. 36. COMMON PLANTAIN
(Plantago major L.)

are produced on one plant, hence an enormous number of seeds can be produced by one plant. Blossoming starts in May or June and continues through the summer, and seeds ripen in less than two months. The seed is greenish-black and horny in texture, and its surface is covered by very fine, nearly parallel lines. Each seed has a scar on one side from which small wavy lines spread in all directions. Seeds are about one-twentieth inch long. (Fig. 36).

Control. Cultivation easily controls this weed, but in lawns it should be spudded out with a dandelion spud or chisel.

Grains and small farm seeds often have high percentages of this seed which can be removed by proper machinery, but it is much safer to buy clean seed.

RUGEL'S PLANTAIN

Description. Rugel's plantain (Plantago Rugelii Dcne.) is very much like common plantain, but has slightly larger and more erect leaves. The base of the leaf stalks are purple or pink, and the seed is larger, but of the same shape as common plantain. The small blackish seeds are angular and roughened by small irregular pits. The pods are longer than in common plantain and the sepals have a sharp ridge that is easily seen. (Fig.35).

Control. The larger seeds are harder to separate from small farm seeds than those of common plantain. The other methods of control are the same as for common plantain, to which may be added the use of crude carbolic acid (poison) which is squirted upon the plants after a sharp stick has made a hole in the stem or near to it in the ground.

BUCKHORN, RIB GRASS, or ENGLISH PLANTAIN

Description. Buckhorn (Plantago lanceolata L.) is a European plant found in small crops like clover and alfalfa, and along roadsides. It is a perennial with leaves, stems, and roots arranged as in common plantain, but it is a smaller plant with fewer and shorter flowering spikes which are placed on long slender stems or scapes, one to one and one-half feet high. The leaves are shorter, are strongly ribbed, very narrow, and have no distinct stalks. They may lie flat on the ground when the plants are young, but stand nearly erect on old plants. The shiny light-brown seeds are horny in texture, and about one-tenth inch long. They are long to oval in shape and have a deep groove on one side, as if the edges had been turned or folded over it as in wheat, but a small scar can sometimes be seen in the middle. (Fig. 37).

Control. Seeds are difficult to separate; hence, buy no seed containing Buckhorn seed, because this weed is a much worse pest than common plantain, and tolerates cultivation better. In lawns, treat as common plantain. A few other plantains resemble this in a general way, but by close attention to the size and to shape of leaves and spikes, they can easily be told apart. They are, as a rule, not bad weeds. The pollens of several plantains have been suspected of causing hay fever.

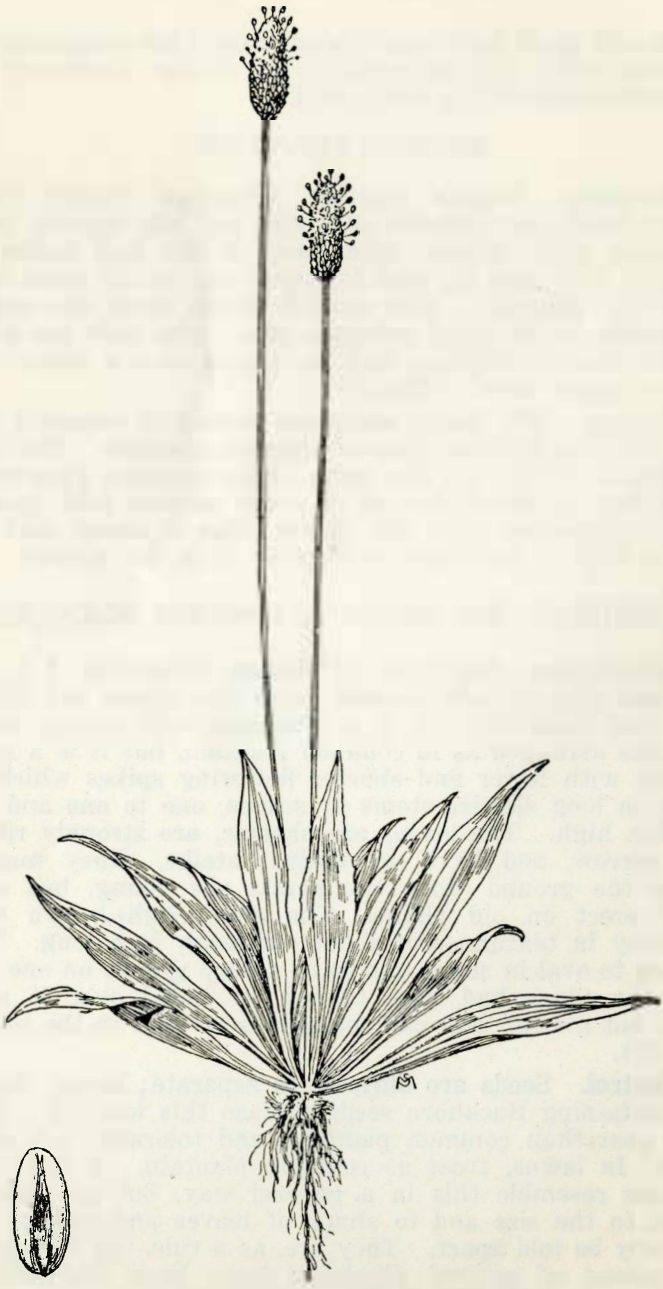

FIG. 37. RIB GRASS OR BUCKHORN
(Plantago lanceolata L.)
(After Beal, Mich. Agr. Exp. Sta.)

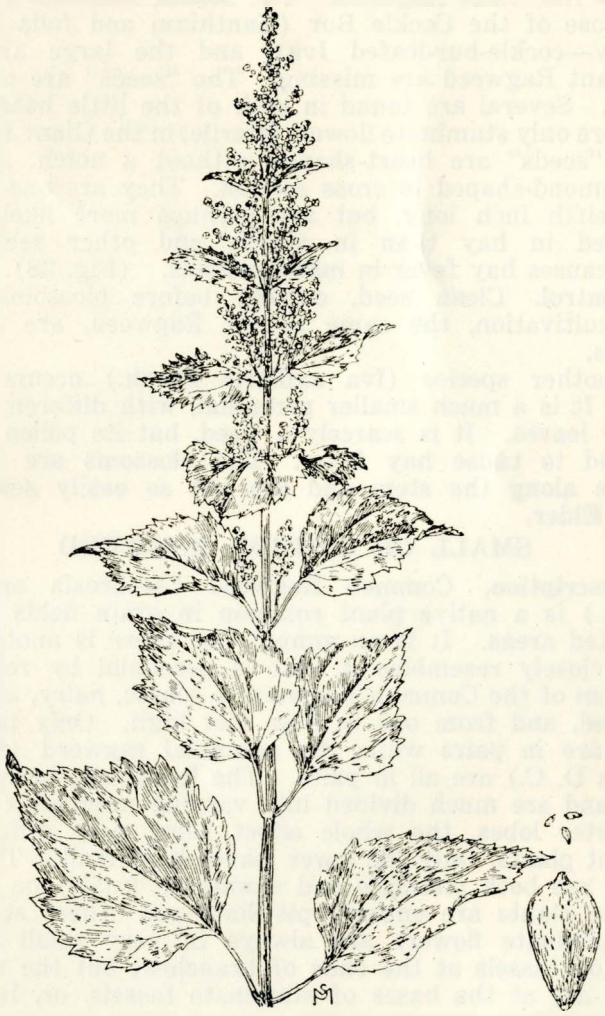

FIG. 38. MARSH ELDER
(Iva xanthifolia Nutt.)
(After Beal, Mich. Agr. Exp. Sta.)

MARSH ELDER OR FALSE RAGWEED

Description. Marsh Elder, False Ragweed, etc. (**Iva** xanthifolia Nutt.) is a native annual which very closely resembles the Giant Ragweed. The leaves, however, are much like those of the Cockle Bur (Xanthium and folia for leaf, literally—cockle-bur-leafed Iva), and the large akenes of the Giant Ragweed are missing. The "seeds" are all in the tassels. Several are found in each of the little heads where there are only staminate flowers (sterile) in the Giant Ragweed. These "seeds" are heart-shaped without a notch, and they are diamond-shaped in cross section. They are one-tenth to one-twelfth inch long, but are perhaps more likely to be scattered in hay than in alfalfa and other seeds. The pollen causes hay fever in many persons. (Fig. 38).

Control. Clean seed, cutting before blossoming, and clean cultivation, the same as for Ragweed, are the best controls.

Another species (Iva axillaris Pursh.) occurs in the state. It is a much smaller perennial, with different-shaped, smaller leaves. It is scarcely a weed, but its pollen may be expected to cause hay fever. The blossoms are in small clusters along the stem and are not so easily seen as in Marsh Elder.

SMALL OR COMMON RAGWEED

Description. Common Ragweed (Ambrosia artemisaefolia L.) is a native plant common in grain fields and uncultivated areas. It is an annual, but there is another kind which closely resembles it that is perennial by rootstocks. The stem of the Common Ragweed is coarse, hairy, and much branched, and from one to four feet high. Only the lower leaves are in pairs while the perennial ragweed (A. psilostachya D. C.) are all in pairs. The leaves are hairy underneath and are much divided into varying numbers of longer or shorter lobes, the whole effect being very different on different plants. Only the lower leaves have stalks. The small flowers are both pistillate and staminate (male) on a plant, or some plants are entirely pistillate and others staminate. The staminate flowers are always in very small inverted heads, on tassels at the ends of branches; but the pistillate flowers are at the bases of staminate tassels, or, in wholly pistillate plants, appear at the ends of many branches. The pollen is said to cause hay fever in some people. The seed is produced from August onward, and this is its only method of reproduction. The seed is one-tenth to one-fifth inch long and has a sharp beak with several smaller points in a row, like a crown, around the shoulder, but these may be absent. The color is a grayish-brown or almost black in

FIG. 39. SMALL RAGWEED
(Ambrosia artemisaefolia L.)
(After Beal, Mich. Agr. Exp. Sta.)

FIG. 40. GIANT RAGWEED
(Ambrosia trifida L.)

some cases. This weed gives milk a bad flavor. (Fig. 39).

Control. It is carried in small seeds and in other ways. Clean seed is the surest control, but it is not hard to control by thorough plowing after harvest and before it seeds. It does not withstand cultivation in a good rotation of cultivated crops, and weed sprays easily kill it. Occasional plants in odd places should be pulled out before blossoming.

PERENNIAL RAGWEED

Description. Perennial Ragweed (Ambrosia psilostachya D. C.) is a native perennial of rich or sandy soils. It closely resembles the Common Ragweed, but is somewhat coarser in appearance because the divisions of the leaf blades are larger and fewer in number. The leaves are nearly all in pairs and are thicker and more hairy than those of the Common Ragweed. The perennial rootstocks run several inches below the surface of the soil and allow it to multiply rapidly. They, with the paired leaves, are dependable differences between this weed and the Common Ragweed..

The "seeds" are also darker in color, and often have no crown of small points as in the Common Ragweed. The "seed" is also obovoid; i. e., thicker below than at the crown. The flowers are arranged just as in Common Ragweed, and a great amount of pollen, which produces hay fever in many people, is produced by the staminate flowers.

Control. Care in the purchase of seed is important. Small areas of the weeds can be sprayed with iron sulphate as recommended for Canada thistle. Strong salt brine has been used, but in all sprayings of perennial weeds it should be remembered that they will sprout again and may need a second or third application. Deep cultivation, in hot weather after a grain crop is removed, will expose and kill the rootstocks and will control the worst stands of this weed.

GIANT RAGWEED, HORSEWEED, or KINGHEAD

Description. Giant Ragweed, Horseweed, or Kinghead (Ambrosia trifida L.) is a very tall native annual growing in rich moist soil. Its coarse, rough stem, one-half to one and one-half inches in diameter, bears leaves in pairs which are six inches to one foot or more apart. The leaves are three-lobed (trifid), but are sometimes entire; there is a well-marked variety in the western part of the state which has entire leaves. The flowers are arranged, as in the Common Ragweed, but are much larger and the "seed" is very much larger (one-fourth to one-third inch or more in length). It is of a corky texture and light gray in color. The kernel or seed proper is large as in the sunflower, and it would make good and highly nourishing food. The pollen has caused hay fever and the weed should be controlled for this reason, if for no other. (Fig. 40).

Control. Mowing before flowering is the best control measure. The weed does not spread rapidly except by water, or by wind and ice-covered snow. It is easily killed by weed sprays when two or three feet high.

AMERICAN COCKLEBUR OR CLOT BUR

Description. American Cocklebur or Clot Bur (Xanthium canadense Mill) is a native annual, common in loose rich soils. It has a thick, juicy, black-spotted, smooth stem. There is one large, coarse, triangular or heart-shaped, slightly three-lobed leaf at each joint. The plant is one to three feet high, and may be branched above. The two-seeded, hooked burs are borne in small clusters in the axils of the upper leaves. Each bur represents a head of two pistillate flowers. The staminate flowers are borne on small spikes at the ends of branches and they soon wither after the hay fever producing pollen is shed. In flower structure and arrangement, they are therefore different from most plants of the Sunflower or Composite family, although much like the true ragweeds in this respect. (Fig 41).

Control. Cutting hay, etc., before blossoming, spraying with iron sulphate when young as for mustard control, and clean cultivation for two or more years are recommended. The latter is necessary on account of the two seeds in each bur, which do not both sprout in the same year. If deeply buried, they live several years. Other precautions are cleaning the burs from the furry coats, manes, and tails of animals, and flood prevention by levees.

Common Cocklebur (Xanthium commune Britt.) is also plentiful in some parts of the state, and looks much like American Cocklebur. It inhabits drier, denser soils and is a bad pest in some places. Its control is similar to that of American Cocklebur. (Fig 42).

MARE'S TAIL OR CANADA FLEABANE

Description. Mare's Tail or Canada Fleabane (Erigeron canadensis L.) is a native winter annual, most widely distributed over the state. It is an erect, hairy, rough-stemmed plant from one to ten feet high, depending on the fertility and moisture of the soil. The oily sap has medicinal value and the distilled oil repels mosquitoes, but the sap may cause poisoning of the skin. The many thin branches and small flower heads, of the upper part, together with the many long narrow leaves of the lower parts of the stem give the weed the shape of a well-combed mare's tail, and hence the most common name, Mare's Tail.

The leaves are alternate and close together. Those of the rosette are spatulate or lanceolate, while those of the stem are long-lanceolate to linear. The flower heads are only one-sixth inch long and the white flowers scarcely show, due to the scales around the outer part of the head. On

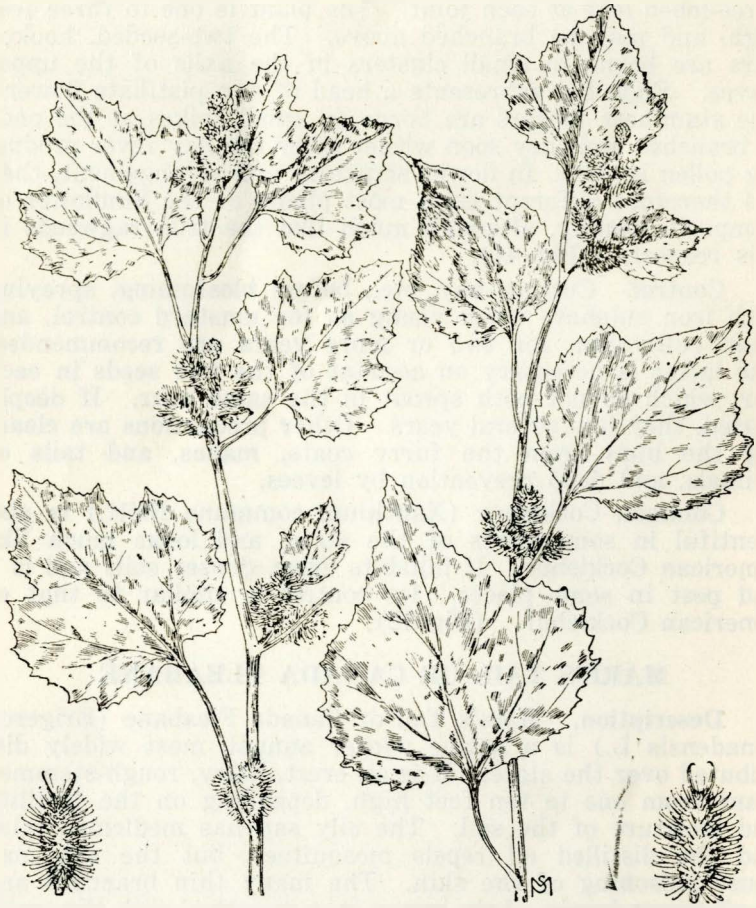

FIG. 41. AMERICAN COCKLEBUR (Xanthium canadense Mill.) (After Beal, Mich. Agr. Exp. Sta.)

FIG. 42. COMMON COCKLEBUR (Xanthium commune Britt.)

FIG. 43. MARE'S TAIL OR CANADA FLEABANE
(Erigeron canadensis L.)
(After Beal, Mich. Exp. Sta.)

this account the plant generally has a yellowish-green appearance. (Fig. 43).

Control. Hand pulling or cutting long before blossoming is important. Where it is cut at blossoming, the seeds may ripen; after this, the ground should be burned over, especially if it is a stubble field. Late plowing, after autumn rains which start the rosettes from seed, is the most fatal blow that can be struck. Spring plowing is also effective. The enormous rate and the method of seeding (by wind) is discussed at the beginning of this bulletin (bottom, page nine) just before the list of "methods of spreading of weeds by seeds", etc.

PERENNIAL SOW THISTLE

Description. The Perennial Sow Thistle (Sonchus arvensis L.) is fortunately not, as yet, widely distributed in this state, but it should be known and actively looked for. It differs somewhat in height and in shape of leaves from the Common Annual Sow Thistle, but the greatest difference lies in the under-ground perennial rootstocks of the Perennial species which enable it to spread rapidly. The Perennial Sow Thistle has a straight, soft stalk from two to five feet high, which branches sparingly near the top. Each of the branches bears a dandelion-like head of blossoms. Each of the minute blossoms with a strap-shaped corolla produces a "seed" (akene or cypsella) with a parachute (pappus or calyx) which enables the wind to carry these "seeds" long distances. These akenes are one-tenth to one-eighth inch long, tongue-shaped, with five wrinkled ridges on each of the two flat faces and a very small crown to which the pappus is attached. There is no pappus-beak as on a dandelion akene. The leaves of this European perennial alternate on the stem and they are lobed somewhat like a very coarse dandelion leaf, but the tip, not well shown in Fig. 44, is quite characteristic, for it has a peculiar "pivot shape" not found in other plants likely to be mistaken for it. (Fig. 44).

Control. Only seed absolutely free from the seed of this pest should be sown. A great responsibility rests on all who sow clover, alfalfa, and other small seeds, and upon all who supervise or inspect farm operations, due to the fact that this weed seed and that of others like quack grass, dodders, Canada thistle, mustards, and several others, may be included and thus widely scattered over the state. Since the wind-blown seeds are carried for many miles, the plants must be cut before blossoming. They should be burned as soon as they are dry enough. Spraying with iron sulphate, as for mustard or Canada thistle, has given fair results; but the best remedy is the starving-out process accomplished by

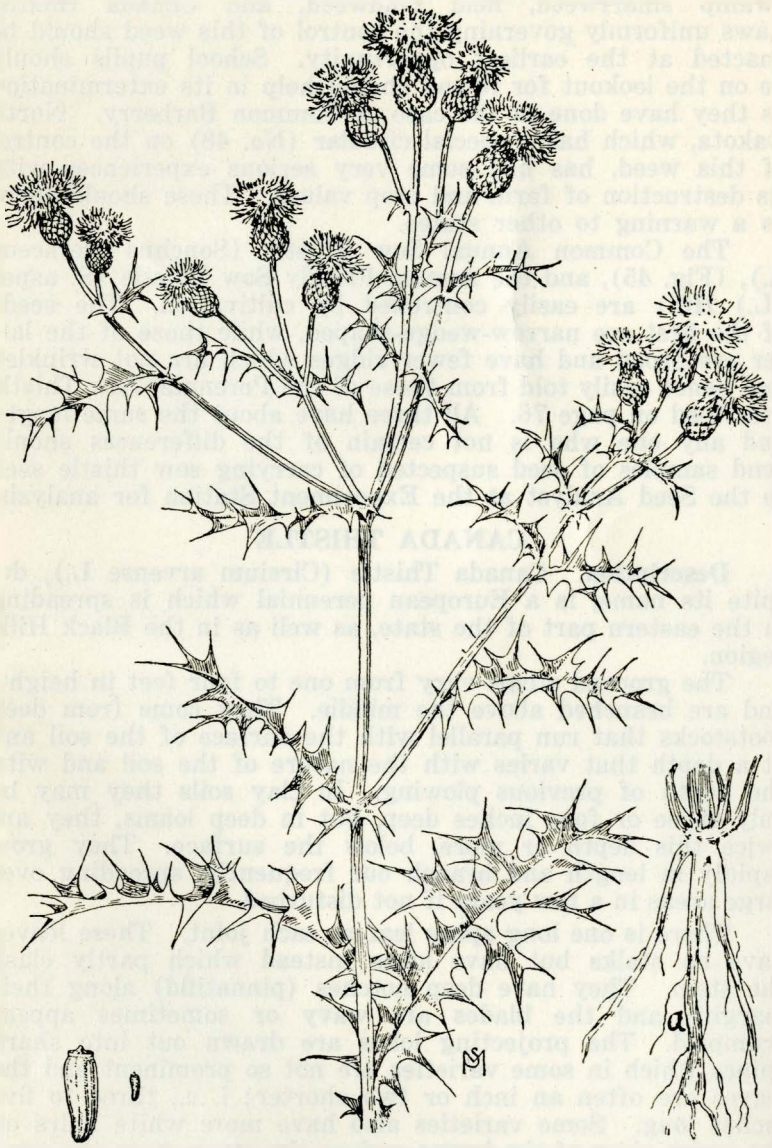

FIG. 44. PERENNIAL OR FIELD SOW THISTLE
(Sonchus arvensis L.)
(After Beal, Mich. Agr. Coll. Exp. Sta.)

clean cultivation or by dry fallowing, as given for quack grass, swamp smartweed, field bindweed, and Canada thistle. Laws uniformly governing the control of this weed should be enacted at the earliest opportunity. School pupils should be on the lookout for it and should help in its extermination as they have done in the case of Common Barberry. North Dakota, which has a special circular (No. 48) on the control of this weed, has had some very serious experiences with its destruction of farm and crop values. These should serve as a warning to other states.

The Common Annual Sow Thistle (Sonchus oleraceus L.), (Fig. 45), and the Annual Prickly Sow Thistle (S. asper (L.) Hill) are easily controlled by cultivation. The seeds of the first are narrow-wedge-shaped, while those of the latter are broad and have fewer ridges which are not wrinkled and hence easily told from those of the Perennial Sow Thistle described on page 76. All three have about the same length and any one who is not certain of the differences should send samples of seed suspected of carrying sow thistle seed to the Seed Analyst at the Experiment Station for analysis.

CANADA THISTLE

Description. Canada Thistle (Cirsium arvense L.), despite its name, is a European perennial which is spreading in the eastern part of the state, as well as in the Black Hills region.

The grooved stems vary from one to four feet in height, and are branched above the middle. They come from deep rootstocks that run parallel with the surface of the soil and at a depth that varies with the nature of the soil and with the depth of previous plowing. In clay soils they may be only three or four inches deep, but in deep loams, they are twice this depth or more, below the surface. They grow rapidly in length and branch out frequently, spreading over large areas in a few years if not disturbed.

There is one long spiny leaf at each joint. These leaves have no stalks but have lobes instead which partly clasp the stem. They have deep notches (pinnatifld) along their margins and the blades are wavy or sometimes appear crumpled. The projecting lobes are drawn out into sharp spines which in some varieties are not so prominent and the leaves are often an inch or two shorter; i. e., three to five inches long. Some varieties also have more white hairs on the under sides of the leaves and on the stems than the common form.

The oval or globular flower heads are from one-fourth to three-fourths inches thick and vary otherwise in shape. They are nearly dioecious; that is, the heads of one plant or

FIG. 45. COMMON ANNUAL SOW THISTLE
(Sonchus oleraceus L.)
(After Beal, Mich. Agr. Coll. Exp. Sta.)

group of plants from one seed will have nearly all staminate (pollen-bearing) flowers, while other plants from another seed will have only pistillate (seed-bearing) flowers with few stamens. The pollen has been suspected of causing hay fever. The small rose-purple or lavender flowers are all tubular in shape and are fragrant. Blossoming time varies with the climate beginning in June and lasting till July or August. Seeds of single plants ripen in about four weeks. To prevent this, plants must be cut a week or two before any heads open, because the seeds ripen in many cases if cut in blossom. (Fig. 46).

The smooth seeds are of a tan or light brown color, and have faint parallel lines running lengthwise. They have a small, tipped crown to which is lightly attached, a small white parachute (pappus, the calyx) that helps somewhat in spreading the seed by wind. The seeds are slightly curved and flattened except at the crown, and are about one-eighth inch long. Much more seed is produced in the cooler northern climates. In some states they seem to spread only by rootstocks after being brought in with alfalfa or other small seeds.

Control. The most important method is care in buying clean seed. Canada thistle seeds are difficult to remove from other small seeds without special machinery. By cutting or by spraying with iron sulphate or blue vitriol a week or two before the first flowers open seeding is prevented, but spraying is not as certain as low cutting. These sprays are made by dissolving 100 pounds of iron sulphate ($FeSO^4$) in 50 gallons of water, or 15 pounds of blue vitriol (copper sulphate $CuSO^4$) in the same amount of water, this is to be applied as a fine spray. The iron sulphate should be applied fresh; and after using either spray, the machine should be well washed out, pump and all.

After spraying or cutting, a more drastic method should follow. As soon as the grain or hay is removed, and this should be within two weeks, the field should be thoroughly plowed and harrowed. Deep cultivation should follow as soon as any sprouts reach two inches in size, and before they have time to make and store food in the rootstocks for next season.

The next year a clean cultivated crop should be grown and the shoots of the thistle should be kept down promptly, even if hand work with a hoe is needed. The hoe should still be used after the crop is" laid by" for the summer. In cultivation, special shovels or sweeps which cut an inch or two deep are the best.

Pasturing the weed out of meadows is not very certain unless salt is first put on. In small areas it can be smothered

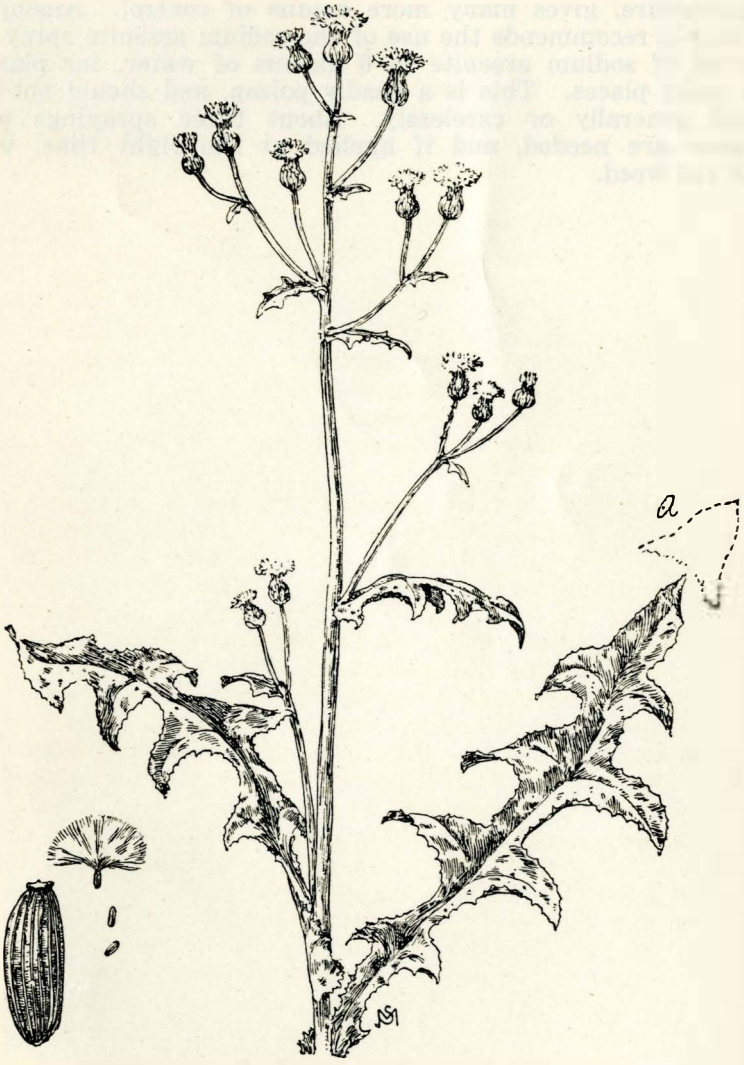

FIG. 46. CANADA THISTLE
(Cirsium arvense L.), a rootstock
(After Beal, Mich. Agr. Exp. Sta.)

by the tar paper method, while in large areas of fertile soil, smother crops like silage corn or sorghum work well.

Farmers' Bulletin 1002, United States Department of Agriculture, gives many more details of control. Amongst others it recommends the use of the sodium arsenite spray, 1 pound of sodium arsenite to 6 gallons of water, for plants in rocky places. This is a deadly poison, and should not be used generally or carelessly. About three sprayings per season are needed, and if applied at the right time, will kill the weed.

BOOKS AND BULLETINS ON WEEDS*

WEED BOOKS

1. Blatchley, W. S.: The Indiana Weed Book. Contains descriptions and control of 150 weeds, with Key to the families and explanations of plant parts. (190 pages). (Was $1.25)**. Published by The Nature Publishing Co., Indianapolis, Indiana.

2. Georgia, Ada: Manual of Weeds. Contains descriptions and illustrations of 530 weeds, methods of control, and a list of 70 poisonous plants, (597 pages). (Was $2.00). MacMillan Co., New York, N. Y.

3. Pammel, L. H.: Weeds of the Farm and Garden. Describes 300 weeds (partly illustrated), gives Keys to the families, seed laws, botany of weeds and their migration, with many phases of weed control. (290 pages). (Was $1.50). Published by The Orange Judd Co., New York, N. Y.

FLORAS. (Weeds and other plants described but no control given).

4. Britton, N. L. and Brown, A.: A Flora of the Northern United States and Canada. (3 large volumes, illustrated, $13.50). Charles Scribner's Sons, New York, N. Y.

5. Gray's New Manual (7th Ed. by Robinson, B. L. and Fernald, M. L.). Nearly 5,000 kinds of plants described and partly illustrated (925 pages) (Was $2.50). Published by The American Book Co., Cincinnati, Ohio.

6. Rydberg, P. A.: Flora of the Rocky Mountains and Adjacent Plains. 5900 plants described (not illustrated), 1122 pages. (About $7.00). Published by the author, Curator of the New York Botanic Gardens, New York, N. Y.

7. Peterson, N. F.: Flora of Nebraska. 1355 plants described, not illustrated. (About $1.00). Published by the author, Lincoln, Nebraska.

8. Flora of South Dakota (by Over, W. H. and Petry, E. J.) in preparation. (Will doubtless issue in 1925, as a Bulletin of the South Dakota Geologic and Biologic Survey, Vermillion, S. D.).

* Only the most available and best aids to further study of weeds are here given.

** The last prices known to the writer are given. Prices are now somewhat higher in some cases.

WEED BULLETINS

9. Beal, W. J.: Seeds of Michigan Weeds, Bull. 260 (very excellent); and

10. Beal, W. J.: Michigan Weeds, Bull No. 267. (250 weeds described and illustrated, with weed control measures): Michigan Agric. Coll. Exp. Station, East Lansing, Mich.

11. Hooper, S. W.: Fight the Sow Thistle, Circular No. 48. North Dakota Extension Division Agricultural College, North Dakota.

12. Hansen, A.: Canada Thistle and Methods of Eradication, U. S. Dept. of Agric., Farmers' Bull. No. 1002.

13. Kephart, L. W.: Quack Grass, U. S. Dept. of Agric., Farmers' Bull. No. 1307.

14. Marsh, C. D.: The Loco Weed Disease, U. S. Dept. of Agric., Farmers' Bull. No. 1054.

15. Sloan, S.: Quack Grass, So. Dak. Agric. Expt. Sta., Bull. No. 170.