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United States Department of Agriculture,

DIVISION OF BOTANY.

DODDERS INFESTING CLOVER AND ALFALFA.

About twenty-five species of dodder have been found in the United States. They are all annual plants with yellow, orange, white, or pink thread-like stems, small yellow, pink, or white flowers, usually borne in clusters, and minute scales in place of leaves. All are parasitic on green herbs or shrubs, about which their stems twine, drawing nourishment through minute rootlets or suckers which penetrate the bark of the host plant. Some are confined to particular kinds of host plants. Some grow only on plants of the clover family, others only on shrubs like the low willows, while a few appear to thrive on almost any kind of green vegetation. The majority of the species, and especially those east of the Rocky Mountains, are found on the dense vegetation in rich bottom lands, where they do little harm; but a few growing on clover, alfalfa, and flax cause serious injury to these crops.

RANGE OF DIFFERENT INJURIOUS SPECIES.

Alfalfa dodder, *Cuscuta epithimum* (fig. 1), is a European species which has been introduced into the alfalfa fields of the Pacific coast and Rocky Mountain region, but is rarely found east of the Missouri River. It thrives best on alfalfa or clover, and in many localities it is very destructive to these crops. It can live, however, on many other kinds of plants.

Flax dodder, *Cuscuta epilinum*, is an introduced species most commonly found on flax in Europe. It is the most prevalent species of dodder on alfalfa in Wyoming and Idaho, and is occasionally found in the States farther east, especially in localities where flax has been cultivated.

Clover dodder, *Cuscuta racemosa chiliana*, is an introduced species infesting clover fields in the Mississippi Valley. It lives only on the clovers and closely related species.

Warty dodder, *Cuscuta indecora*, is a native species sometimes found on clover and alfalfa in the Southern States and in the prairie regions. It grows also on a great variety of other plants.

Field dodder, *Cuscuta arvensis* (fig. 2), is the most injurious native species east of the Mississippi Valley, and is found in less abundance in nearly all parts of the country farther west. It grows

usually in dry upland meadows and pastures and lives upon a great variety of host plants. A single plant of field dodder has been found with its thread-like stems drawing nourishment from red clover, rabbit's-foot clover, flat-stemmed meadow grass, heath-leaved aster, ox-eye daisy, chondrilla, shepherd's purse, and wild onion. It will apparently grow on almost any herbaceous upland plant, but it thrives best on the clovers.

These species can be distinguished from each other only by technical characters that are practically indiscernible to the naked eye.

PROPAGATION AND MANNER OF GROWTH.

Aside from the fact that some of these species are confined to certain host plants while others are not, the habits of all are similar. The seeds are generally introduced with impure clover or alfalfa seed, or distributed with hay. They are blown about over the snow or bare ground in winter with pieces of the dead clover and alfalfa stems, but their distribution is effected chiefly by artificial means.

Dodder seeds placed in the soil germinate, under favorable conditions, in practically the same manner as do the seeds of clover or other plants, but instead of two green leaves there appears above the surface a very slender, inconspicuous yellow shoot. This bends to one side, then swings slowly



FIG. 1.—Alfalfa dodder: *a*, flower; *b*, corolla detached and spread out, showing the scales on its inner surface; *c*, mature seed pod; *d*, seed and outline of transverse section of same. Plant, scale $\frac{2}{3}$; details, scale 4.

until it strikes a green plant. If no plant upon which it can live is within reach, the dodder seedling dies as soon as it has exhausted the nutriment stored up in the seed. But if the swinging shoot comes against a congenial host it twines about it, in some places tightly, in others loosely. Where it binds the host plant tightly many rootlets or suckers (haustoria) are produced, which grow into the tissues of the host plant and draw therefrom the elaborated sap in much the same manner as rootlets of common green-leaved plants draw crude

nutriment from the soil. The host plant, robbed of a portion of its richest sap, becomes dwarfed, and many plants, especially clovers, are actually killed. The dodder plant, however, continues to grow. The lower part of the dodder stem dies and withers as soon as the nutriment in the seed is exhausted, or as soon as the shoot is made fast to a host plant.

METHOD OF SPREAD IN FIELD.

As soon as the upper part becomes well established on a living host plant, branches are produced, waving slowly about, like the first shoot, until they reach some green plant upon which they can grow. By the time the host plant first attacked dies, these branches are firmly established on several new hosts. Thus the dodder lives on, dying behind as its support is destroyed and pushing out branches in all directions to attack new plants. In this manner the growth from a single dodder seed may spread over several plants of clover or alfalfa. If this were all, the host plants might in some cases recover and produce a second crop from the roots. But soon after the dodder becomes established on the host plant it begins to produce clusters of flowers, and, if not interrupted, a succession of flowers and seeds is produced by the advancing vines until all are killed by frost.

THE SEED.

The seeds, thus gradually ripened and dropped, retain their germinative power five years or longer under favorable conditions, but in warm, moist soil some of the earlier of them will usually germinate during the same season in which they are produced. The conditions most favorable for their germination are the same as those which induce the clover roots to send up new shoots. As soon as the tender clover shoots begin to grow they are attacked by the dodder seedlings and their destruction is completed. If the dodder plants remain undisturbed, a supply of seed is left to be scattered by the winter winds; but if they are mowed and raked up with the crop some of the seeds are sure to gain a much wider distribution, while enough will be shaken out to reseed the original locality the following year. If threshed with clover or alfalfa, many will certainly leave the separator with the other seeds, from which they can be removed only by the most careful recleaning. *It is never safe to sow clover or alfalfa seed from a dodder-infested field.*

METHODS OF ERADICATION.

When small dodder-infested spots are discovered in alfalfa or clover, steps should be taken immediately to prevent the further spread of the plant. Its eradication becomes exceedingly difficult if allowed to remain until seeds are produced.

Mowing.—All of the vegetation on the infested spots and for a distance of at least a yard beyond where the yellow vines are observed should be mowed as closely as possible with the scythe. If the dodder seeds are formed, the material may be fed to stock, or it may be

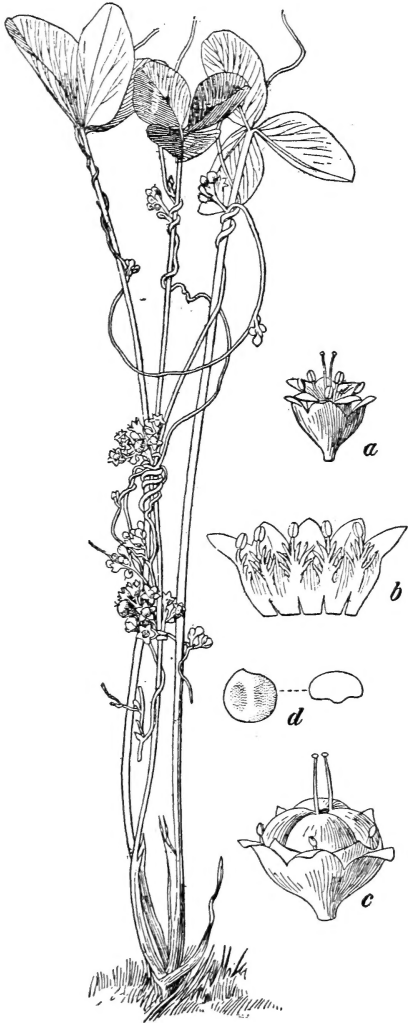


FIG. 2.—Field dodder; *a*, flower; *b*, corolla detached and spread out, showing inner surface; *c*, mature seed pod; *d*, seed and outline of transverse section of same. Plant, scale $\frac{1}{2}$; details, scale 5.

raked to the center of the area after being allowed to dry somewhat and then saturated with kerosene and burned. In any case it should be destroyed to prevent the possible ripening and distribution of dodder seeds or propagation by means of the dodder vine, and it is best to remove it from the field. Too great care can not be exercised in this apparently simple operation to prevent the distribution of dodder seeds or pieces of vine. If the air is moist, pieces of the dodder vine falling on fresh clover or alfalfa plants are likely to start new centers of growth. There is less danger of this on a hot, dry day, when the dodder vines lose their vitality more quickly. About a week after the infested spots are mowed they should be examined for a new growth of the dodder vines. The center of the spot where the seedling dodder started is most likely to show new growth, since the coils from the seedlings are lower down on the clover than those of the later growth, and some of them are likely to remain in the stubble. If there are only a few of these coils on the stubble they may be removed by hand; but if numerous they may best be treated by other means.

Application of chemicals.—Strong brine, sulphate of lime, and dilute sulphuric acid have each been used with more or less success in destroying dodder. The sulphates of iron, potassium, and copper are most effective when dissolved in water and liberally applied in ten per cent solutions. The solutions used for this purpose should be stronger than those ordinarily used in combating insects or fungi,

as in those cases only the insect or the parasitic plant is to be destroyed with as little injury as possible to the host, while in this case both host and parasite are to be killed to the ground. Ten per cent solutions may be safely used in the best kinds of spraying apparatus, their working parts being noncorrosive. If only a few small patches are to be treated, or if no spraying outfit is at hand, the liquid may be applied by dashing it on the infested spots with a pail or dipper. Wooden utensils would be acted upon less than tin or iron. Care must be exercised lest the solutions come into contact with the clothing or person. These solutions have sometimes produced successful results when applied directly to the plants when first discovered, but they are generally more effective when used thoroughly to drench the stubble after the plants have been mowed and removed as described above. The solution, to be effective, must come in contact with the dodder vine, and especially with all of the tight sucker-bearing coils. It also kills the clover or alfalfa to the ground, but these plants usually grow up again from the roots. The places should be watched for dodder plants that may come from seeds.

Hoeing infested spots.—One of the most practical methods to complete the eradication of dodder after removing the vegetation from infested spots is to spade or hoe the soil to the depth of about 2 inches and to keep this stirred so as to prevent the growth of any plants for three weeks. This method is especially recommended if the dodder vines had begun to produce seed before their removal. The shallow cultivation will induce the germination and consequent destruction of the dodder seeds. Shallow cultivation is best, since if the soil is turned over spade deep, the seeds will be buried at different depths. Those buried deeply cannot send shoots to the surface, but they may retain their vitality several years so as to be ready to grow when turned up by the plow.

Burning.—Fire may be used to destroy the dodder. To destroy by this means seeds that have fallen to the ground, requires a considerable degree of heat maintained for several minutes. This is secured by covering the infested area with light wood or chips well sprinkled with kerosene. Straw or shavings do not produce heat enough close to the ground.

Covering infested spots.—Dodder has been killed in some instances by smothering it with a thick covering of manure, muck, or ashes, but these methods can not be recommended. A thick sprinkling of wood ashes when the clover is wet with dew may accomplish the desired result chiefly through the action of potash, but this method also is unreliable.

All of the methods given above are for application in fields where the dodder is confined to comparatively small spots. They are not practicable where large areas or considerable portions of a field are infested.

FOR ENTIRE FIELDS.

Grazing.—One of the best methods for subduing dodder after it has become widely distributed, is to turn sheep on the land, confining them with a portable fence if necessary, so that they will keep the infested areas closely grazed. While pastured in dodder-infested fields the sheep should not be moved about the farm any more than is necessary, as they are likely to carry dodder seeds and pieces of the vine in the clefts of their hoofs and in their wool.

Cultivation.—Dodder can usually be eradicated by thorough cultivation with corn or root crops for two successive seasons. For the destruction of alfalfa dodder and clover dodder, any crops may be cultivated except those of leguminous plants; but, as warty dodder and field dodder grow and thrive almost equally well on a great variety of host plants, only such crops can be grown for their eradication as will admit of clean cultivation.

PREVENTIVE MEASURES.

CLEAN SEED.

All of the four species of injurious dodder mentioned are most frequently introduced through the medium of impure seed. Every possible precaution should therefore be taken to avoid sowing clover or alfalfa seed containing dodder as an impurity. If the seed is purchased from the grower, a guaranty should be obtained that it is obtained from a field free from dodder; if from a dealer, the dealer should furnish a guaranty that it is free from dodder seed. If these guaranties can not be obtained, the seed should be carefully examined by the buyer before sowing.

CLEAN HAY.

Baled hay grown by careless farmers often contains dodder among its other impurities. If the hay is used in the city and the stable manure applied only to vegetable gardens, little damage may be done; but if it is used on a farm where clover and alfalfa are sometimes grown, the bales should be examined carefully to determine what they contain. Extreme care should be exercised to dispose of the refuse and litter from the mangers and about feeding places. Fields fertilized with manure from stables where baled hay is fed should be closely watched.

LEGISLATION.

There are at present no laws relating to dodder in force in this country. State legislation is recommended, whereby negligent and careless farmers in sections where clover and alfalfa seeds are grown may be compelled to eradicate these destructive dodders on their farms. The laws should also authorize officials in charge of highways to destroy the dodders along roadsides. Care should be exercised in framing laws for this purpose, not to impose the hardship upon farmers of eradicating the harmless species of dodder which are abundant in low grounds.

SPECIMENS WANTED.

For the purpose of further investigation, specimens of all kinds of dodder infesting cultivated plants are desired at this Department. Specimens in flower or fruit accompanied by enough of the host plant for identification are preferred. Franked wrappers for mailing the specimens will be sent upon application.

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Approved:

JAMES WILSON,
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