ALFALFA TROUBLES

SUMMARIZED BY
F. H. HALL,

FROM BULLETIN BY
F. C. STEWART, G. T. FRENCH AND J. K. WILSON

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ALFALFA TROUBLES.

F. H. HALL.

Starting from the experiment stations and Onondaga Valley as centers, the culture of alfalfa in New York has spread, slowly at first, but quite rapidly during the last five years, until successful fields are now to be found in almost every county in the State, while on hundreds of farms this plant is the main reliance for hay. Its merits and the proved possibility of its successful culture over a wide range of soils and under diverse conditions indicate a still more general use of alfalfa; so it seems advisable to present a comprehensive account of the troubles which may occasionally affect the crop.

The conditions necessary for success in starting an alfalfa field have been fairly well discussed in previous bulletins of this Station;† therefore, methods for overcoming the difficulties met with in establishing correct cultural conditions need only be outlined here. Of insect pests there are few or none of great importance in the State. The principal troubles to be considered in detail arise from impurities in the seed, weeds and fungus diseases.

In selecting a field for alfalfa, the composition of the soil,—sand, loam or clay,—is of less consequence than some other factors; for good alfalfa has been grown upon soils of most diverse types. The soil should, however, be well drained, either naturally

* This is a brief review of Bulletin No. 305 of this Station, on Troubles of Alfalfa in New York, by F. C. Stewart, G. T. French and J. K. Wilson. Any one interested in the detailed account of the investigations will be furnished, on application, with a copy of the complete bulletin. The names of those who so request will be placed on the mailing list to receive future bulletins of the Station, popular or complete as desired. Bulletins are issued at irregular intervals, as investigations are completed, not monthly.

† Nos. 80, 118, 270, 282 (supply exhausted), and 300.
or by underdrains, so that the level of soil-water is at least three feet, and better six feet, below the surface, and so that storm water never stands more than forty-eight hours upon any spot in the field. Hardpan near the surface should also be avoided. While instances have been known of success with alfalfa on shallow soils, the natural tendency of the plant is to root deeper than any other farm crop, and a hardpan or furrow crust near the surface is detrimental. Land which heaves badly should not be chosen for alfalfa, as the root system of the plant is poorly adapted to withstand the strain of alternate freezing and thawing. The long taproots draw out or break and there are few small roots near the surface to aid in re-establishing the plants. It is probable that much of the so-called "running out" of alfalfa by grass and weeds is not due, primarily, to the weeds, but to heaving, the weeds merely taking the place of plants already dead. It is not uncommon, on heavy, "heaving" soils, to find large numbers of alfalfa plants, after their first winter, either dead and scattered upon the soil, wholly free from it, or with their crowns an inch or more above the surface and root connection so disturbed that the plants will never be vigorous though they may not die. If such soils have, unfortunately, been selected, it is doubly important to secure a good fall growth of the alfalfa and not to mow closely but to leave plants of considerable height to catch and hold the snow and thus protect the soil from sudden weather changes.

Poor soil conditions: The battle for success with alfalfa is more than half won when the crop is well started. The young plants are more delicate and tender than those of almost any other farm crop; but the old plants are rugged, hardy and well fitted to cope with adverse conditions. Thorough fitting of the land is a prime requisite to success, both in order to provide a seed bed for the young plants like that of an onion bed, and to germinate as many as possible of the weed seeds in the soil and destroy the weeds. When a field has been selected for alfalfa it is well to plant upon it for one season some clean-culture crop, like corn or cabbages, and to begin preparation for the alfalfa as early
as possible the next spring, continuing to work the soil until seeding time, so that by use of disk and spring-tooth harrows, roller and smoothing harrow, the field becomes like a well-cared for garden plat just ready for seeds. If the soil is naturally quite free from weeds, and the seeds present in the soil have germinated freely, the alfalfa may safely be sown in late May or early June. This time of seeding has given good results at the Station for twenty years or more. However, weedy soil should be continuously worked through June and July and the alfalfa put in about August 1. Whenever sown, it should be put in without a nurse crop. The seed should be sown broadcast and harrowed in very lightly. Should there be any indication that the soil is acid or is not well provided with lime, half a ton or more of this mineral should be applied in some form. Alfalfa, like clover, has much lime in its composition, and succeeds best upon soils where this element is abundant. A lack of hunus in soils where it is intended to grow alfalfa should be remedied by plowing down clover or stable manure. If the latter be used, it should be applied the fall before, or if it must be used just before seeding as a top dressing, it should be thoroughly rotted to prevent introducing weed seeds.

Alfalfa will not do well on any soil unless its roots are provided with nodules produced by nitrogen-gathering bacteria. If these bacteria are not naturally present in the soil in sufficient numbers to inoculate the plants well, they should be introduced. By cooperative experiments it was found that alfalfa did well without artificial inoculation on only 13 of the 65 fields considered; while on 46 plats on these fields, where soil from the Station alfalfa field was sown, good crops of alfalfa were secured. By supplying the nitrogen-gathering bacteria, the percentage of successes was thus raised from 20 to 70.

While other methods of securing these bacteria have been recommended, that of applying soil from an established field appears to be most practicable and successful. The principal objection urged against it,—the possible introduction of noxious weeds and diseases—can be avoided by a little care in investi-
gating the field from which the soil comes. Indeed, it seems probable that this danger has been overestimated, since no case of serious trouble in New York from this source has been brought to the attention of the Station; and hundreds, if not thousands, of fields have been so inoculated. When it is considered that enough earth to inoculate an acre of soil well (150 to 200 lbs.) requires only two or three cubic feet of soil from the original field, it is plain that no very heavy seeding with weeds or diseases will be thus secured.

Securing seed. Many attempts to grow alfalfa seed in New York have been made without success; so the sower cannot depend upon home-grown seed. While it is usually impossible to find out where the purchased seed comes from, precaution should be taken against seed from the Southwest, as plants from such seed are liable to kill out the first winter. If choice is offered, seed from the latitude of New York, or further north, grown without irrigation, should be selected. Tests of good, plump, bright-colored alfalfa seed, made in the laboratory, have usually shown good germinating power; yet all directions for sowing recommend the use of 10 to 100 or more times as many seeds to the acre as there are plants in a good stand. From 70,000 to 650,000 plants to the acre will cover the ground well under different conditions; yet the 30 lbs. of alfalfa seed usually applied on that area furnishes more than 6,000,000 seeds. Evidently, most of the seeds fail to germinate in the field, or many seedlings die for one that succeeds.

Impure seed. Since home-grown seed can not be secured, there is danger that impurities and adulterations will be obtained in the purchased seed. Examinations of more than 500 samples of seed made by the Station prove the danger to be a real one. Actual dishonesty, as indicated by adulteration, was not common, less than one sample in 50 showing the intentional addition of other seeds; but impure and carelessly cleaned seed was so abundant as to be a real menace. Of 548 samples examined, almost one-fourth contained seeds of dodder, one of the worst pests of alfalfa,
while still larger percentages of the samples showed seeds of narrow leaved plantain (English plantain, buckhorn), yellow foxtail and green foxtail, considerable percentages contained wild carrot and Russian thistle, and occasional samples were contaminated with seeds of curled dock, crab grass, Canada thistle, chicory, charlock, black mustard, and quack grass, as well as those of unknown foreign weeds. Many of these weeds are already so abundant on some York State farms that the introduction of a few more in the alfalfa seed would not be a life and death matter so far as the farm as a whole is concerned; but it is most inadvisable to handicap the alfalfa by introducing a fresh supply of weed seeds into a field we have striven hard to make free from them; especially since the cultivation we have given for the alfalfa seeds will favor the weed seeds as well and make them vigorous and dangerous competitors with the alfalfa seedlings. Neither does any careful, neat farmer wish to introduce weeds upon his farm in any way, finding ample outlet for his energies in fighting those unavoidably there. It is, therefore, very desirable for the purchaser to know that the seed he buys is clean and unadulterated. This he can not be sure of by inspection, since some of the worst weeds of alfalfa bear seeds very much like those of the crop itself. The only safe way is to buy by sample and have the sample examined by an expert. The Botanist of this Station will make such examinations free of charge if the samples are properly taken. Such samples should contain at least two ounces of seed and should be so taken as to represent fairly the lot of seed to be tested. If the seed is in bags the sample should contain some seed from each bag and in all cases a portion of it should be taken from the bottoms of the bags. Unless this precaution is taken, the fine, heavy seeds of some dangerous weeds, like dodder, may not be found in the sample though present in considerable quantity in the bags, since these seeds have a tendency to settle if the bags are shipped or moved in an upright position. The samples should be enclosed in a close, strong package, marked plainly with the name and address of the sender and mailed to the Station. The rate of postage is one cent an ounce.
It may be said in this connection, however, that the danger from foreign weeds has been somewhat overestimated. Russian thistle, for example, was heralded, some fifteen years ago, as a most persistent, rapid-spreading and dangerous pest; yet it is practically unknown in New York to-day though it has undoubtedly been sown in hundreds of places in seed of alfalfa, clover and other farm crops. In alfalfa fields, in particular, unless weeds choke out the plants in their first year, the intruders have little chance for success. A full stand of well established, vigorous alfalfa plants will, after their first year, occupy the ground to the exclusion of most weeds. This should not be taken as minimizing in the least the undesirability of introducing such annoying weeds as Canada thistle, buckhorn, charlock and black mustard; but is intended merely to emphasize the fact that anything like panic over the advent of a new or uncommon farm enemy is usually far from justified.

A few years ago, adulterated alfalfa seed was not uncommon, and altogether too many fields showed, in their second year, a large percentage of plants with the yellow blossoms of trefoil among those with the purple flowers of alfalfa. But examination of seed samples sent to the Station by farmers, with the discovery of fraud and consequent unfavorable advertising, and similar examination of samples of seed taken in the open market, by the U. S. Department of Agriculture under Congressional authority, with public announcement of the results, have had quite a tendency to discourage this dishonesty. The courts have also aided in restricting such practices by awarding damages to the grower whose purchased alfalfa seed proved largely yellow trefoil and bur clover. These plants are not weeds, exactly; but they are greatly inferior to alfalfa in yield and feeding value, and they last but two years instead of indefinitely, as does alfalfa. The purchaser is entitled to clean seed, if he pays for it, but neither he nor the dealer can be sure of this unless proper examination has been made.
Dodder and alfalfa. One of the common impurities in alfalfa seed is dodder seed. As already stated, this was found in nearly one-fourth of the samples examined. It varied in amount from two seeds to a pound of alfalfa seed to almost 23,000 seeds. No farmer should, if it can possibly be avoided, sow even one dodder seed to the acre, for this is one of the worst weed enemies of alfalfa. It is a plant,—but a degenerate in the botanical world,—a mere tangled mass of golden or reddish threads, not much larger than horse-hairs, without roots or leaves. It is a parasite, that is, it grows, not upon the ground, where it would fight the alfalfa fairly by contesting with it for food, but upon the plants themselves, which it feeds upon, strangles and kills. As one alfalfa plant dies the parasite extends its grasp to neighboring ones, thus gradually destroying circular or irregular patches of the alfalfa, which enlarge indefinitely leaving behind a spot given up to weeds.

Of course, something can be done to get rid of dodder after it is established, as will be described later; but the process is a troublesome one, so it is better to avoid introducing the pest. It is distributed almost entirely in the seeds of alfalfa and clover, for it spreads but slowly from the spots where it is growing. A neighbor’s field may be badly spotted with it for years and your own remain clean unless you buy seed of him. Clean seed, then, is the best insurance against dodder introduction; and dodder-free seed only should be sowed. The sample should first be sent to the Station for examination, and other seed sought if this lot is full of weed seeds. If generally free from weeds, especially dangerous ones, it may still be made fit for sowing even if it does contain some dodder seeds; for these can be sifted out by using a special but easily made sieve.

Dodder is of several species, but of two general classes so far as seeds are concerned,—large-seeded and small-seeded. The seeds are smaller in size than alfalfa seeds, the large-seeded kinds only slightly smaller, however, so only a most accurate sieve will let the dodder seeds through and retain the alfalfa seeds. For this sieve a frame twelve inches square, outside measurement,
Plate I.—Tools Required for Sifting Alfalfa Seed to Remove Dodder Seed.
1, Home-made sieve 12 in. square by 3 in. deep; 2, 20 x 20 mesh wire-cloth made of No. 34 steel wire.

(Natural size.)
should be made from three inch strips of light wood, and upon one side should be tacked tightly a square foot of wire cloth 20 x 20 mesh made of steel or iron wire, No. 34 on the Washburn and Moen gauge. As this special mesh cloth is not commonly on the market, the Station at first had a quantity made and placed on sale by Dorchester and Rose, Geneva, N. Y. These dealers have renewed the supply on their own account and will keep the cloth in stock. They sell it at 20c. a square foot, postpaid. To those who desire to secure the cloth elsewhere, the Station will furnish small samples free; and similar cloth only should be used.

In using this sieve, only small quantities of seed should be handled at a time and the sifting should be long-continued and thorough. A half-pint cup full is a convenient amount and each lot should be treated for a full half minute. If seeds of large-seeded dodder are present, it is well to repeat the operation to insure removal of every seed. Complete directions for this sifting are given in Circular No. 8 of this Station. Such treatment takes out a few of the small alfalfa seeds; but it is believed that the loss in this way is inconsiderable, since it is usually held to be unwise to sow the very small seeds of any plant. An additional advantage is that a considerable proportion of buckhorn seeds are removed by the dodder-seed sieve, one sifting taking out more than one-fourth of them and two siftings more than one-third.

Doddler-infested spots in alfalfa fields usually escape notice the first year, but become prominent and extend quite rapidly the second season. The spots where the alfalfa has been destroyed show plainly early in May, because the surrounding alfalfa becomes green before the weeds do on the spots. The dodder itself does not show at this time, but during the second and third cuttings the masses of shining, yellowish threads are very conspicuous on the alfalfa plants bordering the spots. Not unfrequently the dodder mats are so dense that they impede the progress of the mower. If the dodder spots increased in number rapidly, the pest would indeed be a very serious one, as each
infestation means the death of practically all the alfalfa over an area which increases in size every year. But the dodder in the field spreads to new areas only slowly; for seed production in New York State is scanty;—probably no seed is produced by some of the species. The weed is distributed to some extent by the mower and rake, which carry the affected alfalfa plants away from the spots. The dodder lives as long as the alfalfa remains succulent and soon fixes itself upon new plants. It has generally been stated that the dodder lives but one year and that the renewal of the spots in the spring is due to new plants coming from seed; but researches made by the Station Botanist prove that the dodder frequently, if not usually, lives over winter on the crowns of alfalfa, yellow trefoil, red clover, dandelion and daisy fleabane. This hibernating dodder appears in the form of tufts of short, stout yellow threads, attached to the bases of the branches close to the ground around the crown of the plant and especially on the undersides of branches lying close to the ground. Such dormant threads can be easily forced into growth at any time in late winter or early spring by bringing them into a warm, moist atmosphere. Winter-surviving dodder was found abundant around spots in five different fields examined, and in each of the last three years. Another observer in the State says he has found living dodder in the spring before it could have come from seed, for at least three years previous to 1906.

Destroying dodder.

This low-lying habit of dodder and the fact that it may produce flowers and seeds very close to the ground, make it impossible to destroy by any system of mowing or close pasturing. The only feasible methods of eradicating it when once established involve also the death of the host plants. These methods are plowing up the field, digging up the spots, smothering out the plants or burning over the infested areas. Of these, the last is usually the simplest, easiest and most effective. If the field contains many spots, plowing it all up may be best. If the stems and seeds are well buried, it would probably be safe to seed again with alfalfa, but it would be better to use the land for a clean-culture crop for a year or so first, especially if the dodder is known
to have produced seeds. The length of time that dodder seeds will live in the soil is not known. Digging over the entire spot, with a liberal strip around it, is sometimes practicable; but if the alfalfa has become well established the roots make digging very difficult. On stony soil this method is not to be advised. Smothering out the alfalfa and its parasite may be accomplished by putting on a heavy layer of straw, old hay, coarse manure, or other refuse; but this method leaves the unsightly piles of mulch in the field as hindrances to the haying tools.

For burning over the spots, the first week in May is the best time, as the limits of the spots then show plainly, the dodder is not yet extending rapidly to bordering plants and has not seeded. The hay and weeds on the spot should be mowed, including a three-foot strip all around the margin. The mowed material should be allowed to dry thoroughly and then raked to the center of the spot; next, with an ordinary garden sprinkler, soak the stubble, especially about the borders, with kerosene. Scatter the dry hay and weeds evenly over the spot and add similar material until enough is present to make a hot, lasting fire over the entire area. Then ignite it at two or three places on the windward side. A larger quantity of hay or rubbish alone might be used, but the kerosene draws the fire down to the ground where the dodder threads might otherwise escape. If it is decided to reseed the burned-over spots, they must be spaded up and put in condition. This is usually not advisable, since the chances are decidedly against success with the new seeding because weed seeds are liable to be abundant on such spots, where the killing out of the alfalfa has given the weeds full sway.

Several species of fungi attack alfalfa and produce diseases; but only one of them is common. This disease, however, is probably the cause of greater lessening of yields than any other alfalfa trouble unless it be weeds. This disease is leaf-spot, also known as rust and blight, a trouble prevalent throughout the whole State, on all types of soil, in dry weather as well as wet, and coming at any time during the season. It sometimes ruins new fields, and injures older ones severely, though it seldom
PLATE II.—ALFALFA AFFECTED WITH LEAF SPOT (*Pseudopeziza medicaginis*). Affected leaves fall prematurely leaving the stems bare. (Natural size.)
kills those past their first season. It is usually most destructive to the second and third cuttings, though it may sometimes appear to a considerable extent early in the season. The lower leaves of the plants are first attacked. They show numerous small brown spots, turn yellow and fall. The disease advances with, or faster than, the growth of the plant and the loss of the leaves gives the stems a "trimmed-up" appearance. Sometimes only a few leaves are left toward the ends of the stems and branches and these are usually, though not always, yellowish in color. The brown or black spots vary in size from mere specks to pinhead size or larger, are irregularly distributed and show on both surfaces of the leaf but are more conspicuous on the upper. They are irregularly circular in form, but without very definite boundaries.

This disease is so common and spreads so easily that there appears to be no method of preventing fields, even new ones, from becoming infected. The only remedy for it is to mow off the plants when their growth appears to be checked by leaf spot. The mowing stimulates growth and the plants throw out new shoots which usually outgrow the disease. If the trouble appears in newly-seeded fields, only the tops of the plants should be cut off, four inches or more from the ground.

**Clipping for weeds.** Clipping is frequently necessary in new fields to control weeds. Such unwelcome intruders as crab grass, foxtail, lamb's quarters, pigweed, ragweed, and barnyard grass, spring into growth rapidly on the well-tilled soil, and frequently are abundant enough and vigorous enough to threaten the life of the less pushing alfalfa plants. Clipping in late June or in July discourages these annual weeds, prevents their seeding and at the same time seems to stimulate growth of the alfalfa, thickens the crown and causes it to send out side shoots. The little mulch made by the tops clipped off, which should not be removed, protects the roots of the alfalfa from the sun, checks evaporation and thus aids the crop. Whenever weeds appear to be crowding the alfalfa, the mower should be used; but if a good stand of the forage plant has been secured, clipping is seldom necessary after the first season.
Other diseases of alfalfa due to fungi occur in New York; but only in scattered areas and to a limited extent. It is unlikely that any of them will cause serious loss at any time, although exceptional conditions may cause one or another of them to spread. The principal ones are: Wilt, which produces large, dead, brown areas on the stems with resultant wilting and death of the plant attacked; and anthracnose, quite similar in general appearance to wilt, but with smaller, elliptical, sunken spots on the stems, gray in color, with darker specks sprinkled over the spots. Others are root rot and damping off of seedlings, downy mildew, and three or four uncommon leaf spots due to different fungi.

Besides these diseases caused by fungi, that is, by minute plants of low order which live in or on the alfalfa, there are a few other diseases. One of these, a root knot, is due to the attacks of a nematode, a minute worm which embeds itself in the tissues of the root. This is not uncommon, but the damage done by it is inconsiderable, as yet.

White spot and yellow top need little description beyond the names. The spots of the first disease are on the leaves, but the light color easily distinguishes them from any other of the leaf spots. Yellow top might be confused with leaf spot, since the leaves in that disease also frequently become yellow; but in yellow top it is the upper leaves that first show the yellow or purplish color and they do not fall, while in leaf spot the lower leaves turn yellow and drop off, giving the trimmed-up appearance. The cause of neither white spot nor yellow top is known, but both are presumably physiological troubles.