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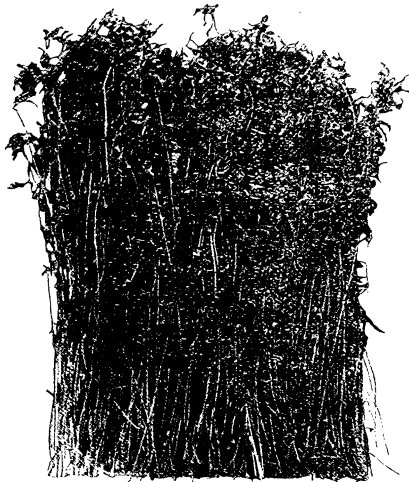
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New York Agricultural Experiment Station.

GENEVA, N. Y.



NO TREATMENT



INOCULATED AND LIMED

TWO FACTORS FAVORING SUCCESS WITH ALFALFA

SUMMARIZED BY

F. H. HALL

FROM BULLETIN BY

H. A. HARDING AND J. K. WILSON.

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* Riverhead, N. Y.

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POPULAR EDITION*

OF

BULLETIN No. 313.

TWO FACTORS FAVORING SUCCESS WITH ALFALFA.

F. H. HALL.

**Definite data
needed on
important
points.**

Fortunately for the recipients, advice given may often be good, though the giver lacks exact figures to support his views. For many years those planning to grow alfalfa have been urged to inoculate the soil and to apply lime to the soil

if the recommended litmus-paper test indicated an acid condition therein. This advice has been helpful in hundreds of cases, without doubt; yet those giving such counsel could not, until recently, have had much exact data to support the advice; and they may in some cases have induced the followers of their advice to expend money and energy in needless processes. While it has long been known that inoculation with the proper bacteria is necessary for alfalfa to do well, there had been few experiments before five years ago, that show what percentage of fields lack these bacteria or what proportion of alfalfa failures is due to this lack. Similarly, we knew that the clovers, including alfalfa, do not succeed well on acid soils; but we had not then learned, through well distributed experiments, how large or how small is the percentage of farms or fields, in New York State for instance, that are acid; nor how many that are acid will be made suitable for alfalfa growing by the use of lime. We have been told that the strip of blue litmus paper, pressed upon the moist soil, will turn pink if the soil is acid; but we did not really know whether this test is reliable as an indicator of the need of lime on such soils.

* This is a brief review of Bulletin No. 313 of this Station on Inoculation and Lime as Factors in Growing Alfalfa, by H. A. Harding and J. K. Wilson. Anyone interested in the detailed account of the investigations will be furnished, on application, with a copy of the original bulletin. The names of those who so request will be placed on the Station mailing list to receive future bulletins, popular or complete, as desired. Bulletins are issued at irregular intervals, as investigations are completed; not monthly.

**Station
tests give
information.**

To secure some exact knowledge on these points, the Station has cooperated with farmers for several years in testing the influence of lime and inoculation in growing alfalfa on their farms. These experiments prove that inoculation and lime are very helpful in many instances; they also show that there are enough cases in which they are *not* needed to make it worth while for each farmer to make tests on a small scale before he expends time and money in inoculating and liming large areas for alfalfa; since one or the other or both may not be necessary.

**Plan of
tests.**

Each test was continued through two seasons so that it could be known whether the alfalfa was really established or not; and the farmer's judgment was accepted as to the crop's success. It was counted successful only when the grower considered the crop of hay the second year a satisfactory one,—one that justified his giving up the land to the alfalfa. Neither were the results from any experiment included in the final record, whether the grower thought the crop a success or not, if any factors except the inoculation or the lime had affected some of the plats unequally, or if lack of care in planning or conducting the test obscured the results. In other words, the experiments, conducted by farmers on their own farms, have been planned and checked and supervised by the Station, and the results interpreted by both farmer and scientist, so that the information secured is both practically and scientifically valuable. No attempt has been made, however, to give exact yields.

For these tests the Station furnished inoculating soil from an old, very successful field of alfalfa at the Station, and for most of the later tests also furnished lime to apply on half an acre. In nearly all the experiments the acre plat was divided into quarters;—one without treatment to serve as a check or measure of the success of alfalfa unaided by either inoculation or lime, one inoculated, one limed, and one both inoculated and limed. In all, some 200 tests were started; but many were rejected from consideration,—some of them failures, some successes so far as

the growth of alfalfa was concerned,—because of errors in planning or carrying out the test; and, of course, some who began the tests failed to finish them or to make a report. The thanks of the Station are due, however, to the many who so earnestly and carefully aided in securing the much desired and valuable information. In all, 103 tests have been considered that show success or failure of inoculation, 64 that bring out the comparison between limed and unlimed plats and as many that give a measure of the effect of inoculation and liming combined. One or more tests were located in each of 39 different counties, well distributed over the State.

Effect of inoculation.

In nearly every case where inoculation was tested, the roots of plants on both check plats and inoculated plats were carefully examined for the nodules associated with nitrogen-gathering bacteria. Surprising to say, such nodules were found on some plants on 95 per ct. of the check plats, indicating a much more general distribution of the bacteria than was supposed. The source of these scattered bacteria is unknown;—possibly they were introduced on the alfalfa seed, though previous experiments of the Station indicate that this is improbable; more likely these scattered germs have been associated with other legumes and have developed an adaptability to alfalfa. Their presence helps to explain the many cases of success following second or third attempts to grow alfalfa on the same soil. Bacteria multiply with great rapidity under favorable conditions so that the few naturally present may in a season or two increase sufficiently to inoculate well a new alfalfa crop following one or more sowings with only scattered thrifty plants.

But on the check plats the number of plants naturally inoculated was rarely great enough to insure a good crop of hay. Of 103 such uninoculated plats, only 25 bore, the second year, crops which satisfied their owners; that is crops that gave fair returns as compared with other crops on the same farms. The crop was a failure on 78 plats, or more than three-fourths of all. On plats adjoining these checks, inoculated by working into the soil from 200 to 300 pounds to the acre of soil from the Station

alfalfa field, 66 crops were counted successes and only 37 failures. In other words, on soils where less than one-fourth of the crops succeeded without inoculation, nearly two thirds of them did so when provided with the proper bacteria in sufficient numbers, a *gain from inoculation of more than 40 per ct.* in the chance for success with alfalfa.

**Effect of
liming.**

In most of the earlier experiments the effect of liming was brought out only incidentally through the grower's voluntary use of lime; but in later tests, as the value of this factor became apparent, the use of lime was made a requirement in the experiments and material was furnished by the Station. About two-thirds of all the satisfactory alfalfa experiments furnished data on the influence of lime, or 64 experiments in all, well distributed over the State. On only 11 of the check plats in these 64 tests was there a successful crop without lime, while failure on check plats was matched with success on 27 of the adjoining plats where lime had been used at the rate of 1000 to 1500 pounds to the acre. Improvement was shown on 27 more limed plats; but 11 of these were companions of check plats already counted as successes, so the liming could not be said to change failure to success though it bettered the crop; and on the remaining 16 improved plats the crops were not good enough to satisfy the owners, though better than the checks. On only 6 plats was there no improvement from the use of lime.

To summarize the influence of lime, it may be said that its use increased the chance of success about one in five, raising the percentage of successful fields from 20 per ct. with the checks to 40 per ct. where lime alone was used.

On a very large proportion of the fields under **Litmus value-** test and many others, litmus paper was used **less as test for** to determine whether the soil was acid. The **need of lime.** results were very unsatisfactory and tend to show that litmus, as commonly used, is not a reliable indicator of acidity in the soil, so far as that acidity affects alfalfa. In all but two of about 200 fields thus tested the litmus paper indicated acidity by turning pink when pressed

against the moistened soil. The one explainable exception was on a small area where the owner had recently applied a considerable quantity of wood ashes. In the other case, where the failure of the litmus to change was the same over a large field, marked benefit to alfalfa occurred from the use of 1500 pounds of lime to the acre, *contrary to the indications*. There was little apparent variation in the degree of acidity in the different soils, if the depth of color of the litmus be taken as a measure; for nearly all of the strips, which were returned to the Station for examination, showed practically the same shade of light pink. Three fields which gave no stronger indication of acidity than the others were among those where the addition of lime resulted in no apparent benefit to the alfalfa. So, in one case, an apparently neutral or alkaline soil, as indicated by litmus, was markedly benefited by liming; and in three others, moderately acid soils, to judge by the test, showed no benefit from a good application of lime. Limed soils appeared to give the same pink color on the litmus paper after liming as before.

While the simplicity of the litmus test and the ease of making it would render this a most valuable assistant to the farmer, if correct, it is to be feared that it is too unreliable to use. The farmer must, here, as in his use of fertilizers, "ask his crop to question his soil." A plan for doing this with alfalfa will be outlined further along.

United effect In the 64 cases where a check plat could be compared with one both inoculated and limed,
of lime and the joined treatments gave successful crops in
inoculation. 50 cases, raising the percentage of successes from 18 per ct. on the check plats to 77 per ct.

on the inoculated, limed plats.

Summary As to the influence of the two factors of inoculation and lime as aids to alfalfa growing, then,
and as judged by this extensive and widely distributed series of experiments, it may be said,
conclusions. briefly, that alfalfa will succeed without inoculation or lime about once out of five attempts on the soils of New York State; with lime and without inoculation, about twice out

tion or lime about once out of five attempts on the soils of New York State; with lime and without inoculation, about twice out

of five times; with inoculation and without lime about three times out of five, and with both inoculation and lime about four times out of five. As a general rule, it would be safest both to inoculate the soil and to lime it liberally if one wished to insure success with alfalfa without close consideration of expense.

But both treatments have proved unnecessary in some cases, inoculation in others and liming in still others; so the man who

No lime, no inoculation	Lime, no inoculation
No lime, inoculation	Lime and inoculation

Down-hill side of field

uses both without due study may be wasting his efforts. Each farmer who expects to grow alfalfa and who does not know his land thoroughly should test the crop and the two treatments on an experimental acre first. Let this be laid out as in the accompanying diagram. First prepare and fit the acre thoroughly as described in previous bulletins of this Station, No. 305, in particular, and then

test upon it lime and inoculation, singly and combined, using great care to restrict each agent to its allotted plat. The lime should be applied up and down the slope, if the land is not level, before the final working of the field. The two plats up hill should be seeded first, without any inoculated soil. Then apply the inoculated soil on the down-hill plats and sow the seed. By this method the inoculation will not be carried to the uninoculated plats by harrow or drill nor washed down by surface water; nor will the lime be carried across the slope to the unlimed plats. In this way the result on each plat will show the influence of the factor it is intended to show; while a little washing by rain or the use of the drill that has sown inoculated soil on a plat not intended to be inoculated may make the whole test useless.

With the knowledge gained from this experimental plat, if the crop succeeds, the owner will know just how to proceed in future attempts to grow alfalfa; and if he wishes to sow a large field or to aid his neighbors in starting one, and his field or theirs needs inoculation, he will have at hand a half-acre of soil well filled with bacteria.