

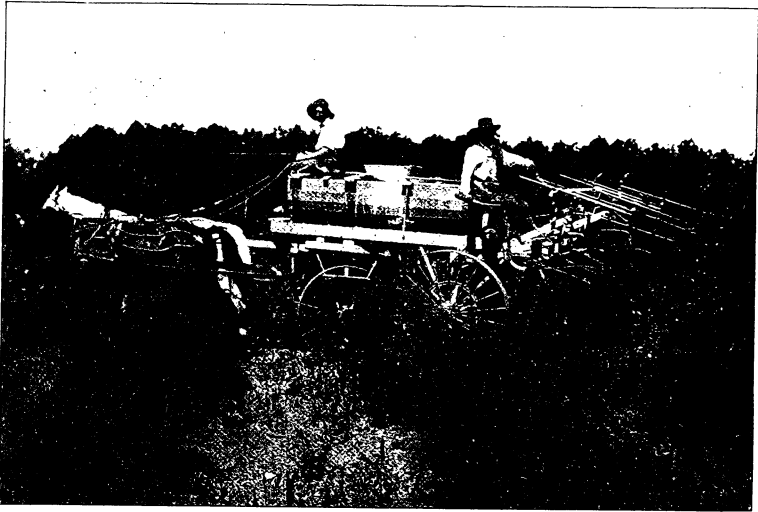
POPULAR EDITION.

BULLETINS Nos. 188 AND 189.

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GENEVA, N. Y.



PROTECTING ASPARAGUS.

F. H. HALL AND F. A. SIRRINE.

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POPULAR EDITION*
OF
BULLETINS NOS. 188 AND 189.

PROTECTING ASPARAGUS.

F. H. HALL.

**Rust a
dreaded
disease.**

A cause of dismay to growers and of perplexity to plant pathologists, asparagus rust has wrought disastrously in many fields during the past few years. Though it may have been in the country unnoticed for some time after its advent from Europe, it first attracted general attention in 1896. Since that time its spread has been so rapid that it now extends from New England to the Carolinas on the south and to Wisconsin, Iowa and Kansas on the west; and its destructiveness is so great that it threatens the ruin of the asparagus-canning industry in the sections where it was first noticed—New Jersey, Long Island, Delaware and New England.

The life history of the fungus which causes the **Fungus with many forms.** disease is marked by three distinct stages, each ending in the production of a crop of spores from which new plants may spring. This profusion of spore-forms may account in a measure for the rapid spread of the disease.

The first stage of growth of the fungus usually passes unnoticed by the owners of infested asparagus fields; for from the germination of the spores in the spring until the first fruiting in June, the entire plant is hidden deep in the tissues of its host; and this fruit-

* This is a brief review of two bulletins of this Station—No. 188, Spraying for Asparagus Rust, and No. 189, a Little-Known Asparagus Pest—both by F. A. Serrine. Any one specially interested in the detailed account of the investigations will be furnished, on application, with copies of the complete bulletins. 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.

bearing is accompanied by no such change in color of the asparagus fields as marks the ripening of the second crop of spores. This first stage, known as the "spring form," "cluster-cup stage," or, scientifically classified, as the "æcidial stage," is represented in Plate I, in which Fig. 1 shows the points on the asparagus stem where the spores are breaking through the epidermis of the host plant in clusters of cup-shaped pustules. These cups are greenish-yellow at first but change to orange-yellow as they mature. Figure 2 of this plate shows three of the minute pustules which form part of one of the clusters, as they appear under the microscope. The center pustule is discharging ripe spores, and the one at the right contains immature spores.

The summer stage follows this spring form, though the two may overlap, both stages existing at the same time in the same plant. The brown color of the asparagus fields produced by the ripening spores of this second stage, the "red rust" form, and the rapid spread of the disease at this time, cannot fail to attract attention to the fields affected. The spores from this stage discharge from slits in the asparagus stems, not from clusters of pustules, and are so numerous that they cover workmen and tools in the fields with a heavy coating like brick dust. Plate II, Fig. 1, shows the slits or rifts in the asparagus stems and thus brings out the difference between the two stages.

The third stage, known as the "winter stage," follows the one just described, either in the fall or even in the summer if the lessened vitality of its host plant betokens approaching death. It is by the spores of this stage that the fungus is carried over the winter, so Nature provides for their formation whenever the existence of the fungus is threatened by the death of the asparagus plant it infests. The third stage differs from the second only in the character of the spores. In the summer stage the spores are one-celled and thin-walled while in the winter stage they are two-celled, thick-walled and of such a dark-brown color that the stage is known as the "black rust." Both summer and winter spores may often be found in the same slit in the asparagus stem, as shown in Plate II, Fig. 2.

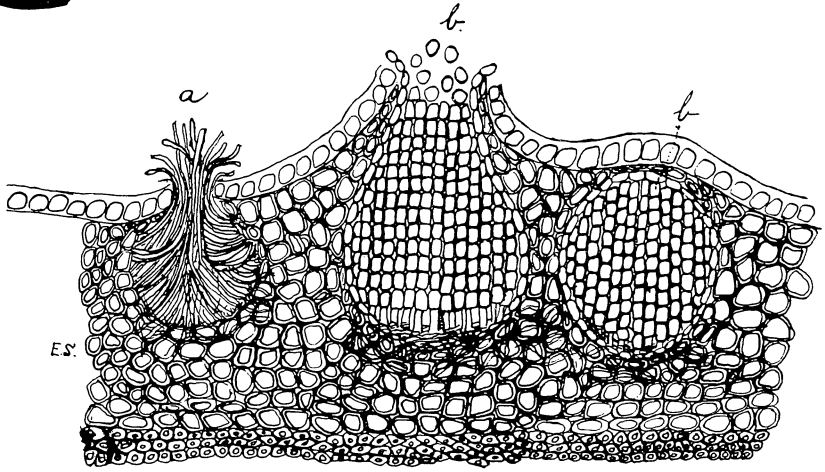


Fig. 2.

PLATE I.—GROSS AND MICROSCOPIC CHARACTERISTICS OF CLUSTER-CUP STAGE OF ASPARAGUS RUST.

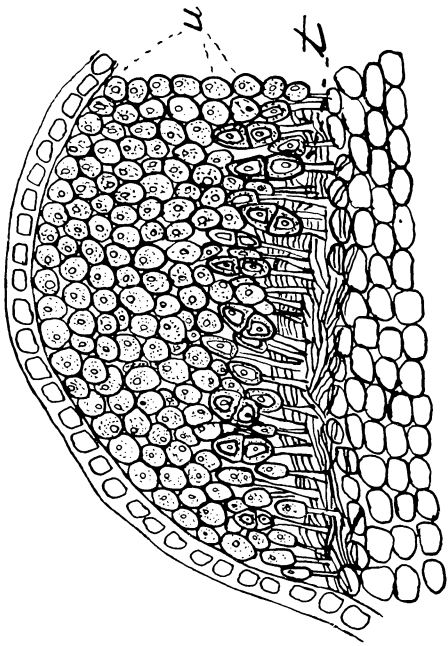


Fig. 2.

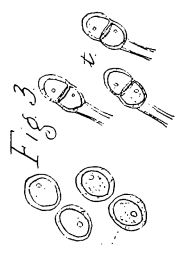


Fig. 3.

The outbreak of any plant disease may well spur the grower of the affected crop to active measures of repression ; but for most fungous troubles very effectual preventives are known ; so that watchfulness in season and careful treatment will have their reward in a yield lessened only slightly by the fungus. With asparagus rust, however, as with all of the rusts, the manner of growth of the little plants which produce the disease is such that botanists have held out little hope from spraying with fungicides.

The winter spores of the fungus germinate in spring or early summer and the slender threads which form the parasitic plants enter the asparagus when the latter is young and succulent. Here the fungus grows until fruiting time, wholly within the host plant, lessening the vitality of the infected asparagus without presenting definite outward marks. So completely protected are the fungi by the host plants that no spray mixture, however thoroughly applied, can have any effect upon them after the spores have germinated and the little filaments found their way through the outer layer of the asparagus stem.

Some other considerations have also seemed opposed to spraying as a successful remedy for asparagus rust, among them being the lack of suitable apparatus for thorough spraying of plants of this character, the smoothness of the stems and foliage of the asparagus which makes adhesion of spray mixtures difficult to secure, the claim that the spray injures the asparagus itself, and the apparent failure to secure much increase in yield from sprayed beds.

Many other remedies or lines of hope for the unfortunate asparagus-grower have been suggested ; and tried with various degrees of success and failure. Burning the rust-infected " brush " has been urged by some writers ; and if the practice could be thoroughly enforced for a series of years in an entire asparagus-growing section and the work should be done just at the right time, the wholesale destruction of the forming and unscattered winter spores would undoubtedly restrict the disease in time. Under conditions existing on Long Island, however, and in other sections where asparagus growing has been so long

**Protection
by spraying
distrusted.**

**Other
remedies
also fail.**

established that hedgerows, waste places and abandoned beds raise crops of rust-infected plants to spread a liberal supply of spores, it is doubtful whether burning the brush on cultivated fields is of much avail. It is certain that cutting and burning the plants too early seriously weakens the beds; while if the work is delayed too long enough spores will be formed and scattered on the beds to give a good start to the disease the next year.

Planting on heavier soils with good moisture-holding power has also been urged as a means of overcoming the disease; but careful study of many fields on Long Island and in Madison and Oneida counties failed to show any advantage with fields or parts of fields on heavy land or on land that was especially well watered. The conclusion reached from this series of observations was that low-lying beds, even on heavy soil, and especially beds liable to be covered with fog and heavy dew during the early morning, suffered most from the rust, while beds on lighter soils above the usual fog level were not nearly so badly affected. The presence of the fog moisture seems to afford conditions favorable for germination of the spores and the spread of the disease.

Certain varieties of asparagus have been brought forward as "rust proof" and there are undoubtedly some varieties more resistant to the fungus than others; but under Long Island and Oneida county conditions the most ardently recommended "rust proof" varieties failed to show sufficient resistance to entitle them to the name.

Hope has also been held out that the outbreak of the rust would be only temporary and that in a few years the disease would lose its virulence; but no signs of this appear at present.

Since the other remedies suggested have proven faulty and since there remained a possibility that spraying, thoroughly done at the right time and continued as needed, might prove fairly effective, the urgent need of help for the fast-failing fields demanded that a thorough test of the spraying be again made. The first trial, 1898-'99, was mainly to test the effectiveness of a combined resin-Bordeaux mixture, three rows of Columbian White asparagus (one-fifth of an acre) being sprayed with 1-to-8 formula Bordeaux mixture to which was added two gallons of the stock resin

solution described in Bulletin No. 144. Three applications of the spray mixture were made, on August 5 and 17 and September 1, one barrel of the mixture being used each time. Great care was taken to have every part of the asparagus thoroughly coated with the fungicide, without allowing the nozzle to remain stationary long enough to wet the plants so they would drip. The mixture adhered well and no trace of spray injury could be found. The unsprayed portion of the field, just adjoining the sprayed rows, was stripped of foliage and dead by October 7, but the sprayed plants held their foliage until killed by frost. Plate III shows the difference between the treated and untreated areas on September 27. The next year careful record was kept of the yield from the sprayed and unsprayed rows, both amount and character of the asparagus cut being taken into consideration. The middle sprayed row (one-fifteenth acre) was selected as most likely to represent fairly the effect of spraying, and its yield compared with an average unsprayed row. The results are shown in concise form in the table below.

TABLE I.—TOTAL YIELD AND VALUE OF SPRAYED AND UNSPRAYED ASPARAGUS, 1899.

	Total yield in pounds	Bunches.			Value.		
		Primes	Culls.	Total.	Primes	Culls.	Total.
Sprayed row.....	438.2	118.6	27.4	146.0	\$16.61	\$1.64	\$18.25
Unsprayed row	258.4	53.0	33.0	86.0	7.42	1.98	9.40
Differences	179.8	65.6	-5.6	60.0	9.19	-.34	8.85
Percentage of gain.	69.5	123.75	-17.0	70.0	123.75	-17.0	94.0

As these results are from a small area and subject to more or less error they should not be considered alone as showing the value of spraying; but from a study of them it is very evident that spraying protected the asparagus from rust and was profitable to the owner. The total yield by weight, and by bunches, of the sprayed row was nearly three-fourths more than that of the

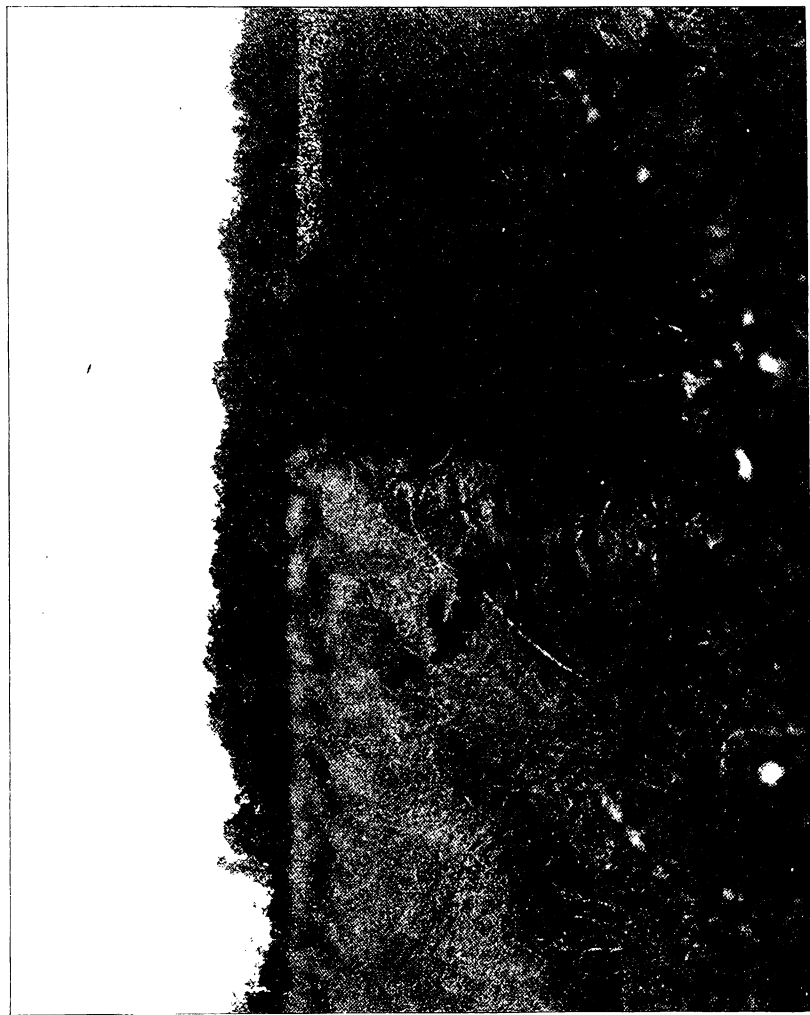


PLATE III.—UNSPRAYED AND SPRAYED ASPARAGUS.
(Taken Sept. 27, 1898.)

unsprayed row ; and the prime bunches of sprayed asparagus were more than twice as many as those from the unsprayed row. On the basis of these figures the gain from spraying an acre would have been \$132.75.

These tests were repeated in 1899-1900 under conditions less liable to give errors, the area being larger and more precautions being taken to secure a field of uniform character.

The yielding capacity of the field before treatment was found by careful weighing and grading of the cuttings in 1899. After the last cutting was made the brush was allowed to grow for four weeks, after which five sprayings were given, the first on July 28. Alternate rows were sprayed and left as checks. The rust showed on the unsprayed rows August 19 and by August 24 had spread to all parts of these rows. They were killed by September 10. The sprayed rows remained green until the middle of October, but it was only the growth made between July 1 and August 10 that survived the attacks of the rust until October 15 ; that is, a growth that was completed, hardened and thoroughly sprayed before the rust struck the bed. All the new sprouts which came up in the sprayed rows after the rust appeared in the field were destroyed.

Cutting began on this field on May 14, 1900, and lasted until July 2, 38 cuttings being made. Every precaution was taken to secure uniform cutting and grading on all sections of the field, so that the figures obtained should represent exactly the comparative values of the sprayed and unsprayed crops. Comparisons were made, not only between sprayed and unsprayed rows, but also between the yield of the current season, on treated and untreated rows, and yields of the season before spraying was begun. This last is necessary to ascertain whether or not the rust is continually lessening the vitality of the beds so that each crop is smaller than the one preceding ; and to see to what extent the spraying will check or overcome any such decrease. The results proved that in the case of every unsprayed row the yield in 1900 was less than it was 1899, the decrease on the seven rows being 179 pounds. On the sprayed rows, on the contrary, there was an equally constant gain in yield of from 11 to 22 pounds to the row, the total increase being 110 pounds.

When the comparison is made between the sprayed and unsprayed rows alone, the results are as shown below :

TABLE II.—TOTAL YIELD AND VALUE OF SPRAYED AND UNSPRAYED ASPARAGUS, 1900.

	Total yield in pounds	Bunches.			Value.		
		Primes	Culls.	Total.	Primes	Culls.	Total.
7 sprayed rows.....	875.4	192.6	83.4	276.0	\$26.96	\$ 5.00	\$31.96
7 unsprayed rows.....	592.4	121.9	84.1	206.0	17.06	5.04	22.10
Differences	283.0	70.7	— .7	70.	9.90	— .04	9.86
Percentages of gain.....	47.8	58.0	— .8	34.0	58.0	— .8	44.5

Considering the results in this table alone, it will be seen that the increased money value of the crop was only enough to pay the additional cost of spraying ; but the disadvantages against the spraying in this case must be taken into account. In the first place, the attacks of rust in previous years had lessened the vitality of the whole field so that its yield was only about one-third what it should be ; and, secondly, each of the alternate unsprayed rows was a constant source of infection to the sprayed rows. A field regularly sprayed from the first would probably show more decided gains as compared with an unsprayed field. Had the entire field been sprayed the yield would undoubtedly have been better than it was on the single sprayed rows. With all these disadvantages to contend with, the increase yield from spraying is 47.8 per ct. in weight and 44.5 per ct. in value. This amount can surely be taken as representing what is to be gained from spraying alone, without the aid of any other preventive or remedial measures.

Spraying with any of the forms of power sprayers on the
by power market, and the impossibility of covering large
apparatus. fields with hand sprayers, led to the designing by
 Mr. Serrine and Mr. Downs of a power sprayer

which has given most excellent results in thorough tests of it already made. This machine, in the act of turning at the end of a row, is shown on the title page. A full description of it, with detailed plans for construction, is given in the complete edition of this bulletin, which will be gladly sent to any one who desires further information concerning the apparatus. It consists, essentially, of a 250-gallon, half-round tank suitably mounted on a four-wheeled truck with arched axles to straddle a row of mature asparagus; a single-acting triplex pump throwing 360 gallons per hour; a nozzle carrier which can be raised and lowered at will; and 20 nozzles, so connected to the carrier by piping with shear and telescoping joints that they can be adjusted to spray asparagus of any age in rows of different widths and to cover all parts of the plants with a thin but complete coating of the spray mixture. The machine, drawn by two horses and managed by two men, will spray an acre of asparagus in an hour, and is far more economical in the amount of mixture used than hand sprayers covering the same plants. The cost of the machine is considerable, as one cannot be built for much less than \$200. The apparatus, however, would probably repay its cost in time and materials saved, for the owner of 15 acres or more of asparagus; or for several owners working together, who have a large enough acreage to make power spraying necessary.

An asparagus pest. In 1896 many asparagus plants were found to contain, just below the surface of the ground the little flax-seed-like bodies which form one stage in the life history of some of the flies, like the Hessian fly. Adults have now been raised from these "flax-seeds" and found to be small, metallic-black flies about one-sixth of an inch in length. They are found to be quite common on the flowers and branchlets of the asparagus, especially on plants that have been eaten into by the asparagus beetle. The maggots, or larvæ, of these flies are about one-fifth of an inch in length, somewhat flattened and of a transparent-white color. They are found in mines in the asparagus stems, just beneath the epidermis, the mines usually beginning near the surface of the ground and extending diagonally downward about the stem below ground for a distance of three or four inches. On

seedling beds and newly set beds, the mining of these maggots has caused some injury, especially during 1900; but no serious trouble has been observed on cutting beds, though they are probably numerous enough to cause some weakening of the plants. The seedlings turned yellow and died much earlier than they would naturally do. The maggots change to puparia—the “flax-seed” stage—in the fall and show on the infested stems as small, oblong, dark-brown, raised spots beneath the epidermis of the stalks near the base.

Though the insect is not yet a serious pest, it will be well to adopt some repressive measures should it appear upon a bed. The eggs of the first brood are probably deposited early in June, so no small shoots should be allowed to grow on the cutting beds to receive these eggs. Pulling the old stalks in the fall and burning them when dry will destroy many of the puparia.