

DISEASE RESISTANCE IN VARIETIES OF POTATOES.

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This report is the result of experiments conducted by the author, under the direction of Dr. L. R. Jones, while in the coöperative employ of the Vermont Experiment Station and the United States Department of Agriculture, Bureau of Plant Industry, during the fall of 1909-10.¹ In general, the work was the outgrowth of a series of experiments carried on by Professor William Stuart at the Vermont Station for several years previous to 1909, the results of which may be found in Bulletin 122, Vermont Experiment Station. In particular, it was the development of some research work of the previous winter on late blight. Professor Stuart conducted his experiments in the field upon over 150 varieties, with the idea of determining, if possible, the disease resistant qualities of both American and European varieties of potatoes, to the late blight, *Phytophthora infestans* (Mont) Bary, a fungus which causes the loss of many thousands of bushels of potatoes yearly in New England, especially in Maine and Vermont, and periodically the loss of one-half the entire crop or more in that section.

European potato growers have for years been breeding and testing potato varieties for the disease resistant quality, until they have developed a series of varieties which have proved by field trials to be highly resistant to fungus diseases. The processes as carried out by them necessitated growing the tubers for several years in succession and noting the amount of infection each year. This, of course, is at best a tedious operation, giving slow and often unsatisfactory results.

In 1908 Mr. N. J. Giddings, then of the Vermont Experiment Station, found that resistance to the late blight could be determined with some degree of accuracy by artificial inoculation of the tubers, with pure cultures of the fungus, under sterile conditions in the laboratory. The value of the laboratory method for testing varieties of potatoes for disease resistance is easily seen when we consider that it would permit us in two or three weeks to test the resistance quality of any variety, a process which

¹The full results of these experiments are to be published in a forthcoming bulletin of the United States Department of Agriculture, Bureau of Plant Industry.

heretofore by laborious field experiments has taken as many years. The purpose in the trials of 1909 was to determine more fully the reliability of this method and its applicability for comparative trials with a large number of varieties.

In all, 76 varieties of potatoes, 46 of which Dr. Jones collected in Europe, were tested. Practically all of these were varieties of economic value in their respective localities. Most of the European varieties were of reputed disease resistant qualities. All had been grown on the Vermont Experiment Station grounds under as similar conditions as possible, for four years previous to these experiments.

The method used was, first, to prepare sterile test tubes by placing a small absorbent cotton wad in the bottom of each tube and adding to each one c.c. of water. The tubes were then plugged with ordinary cotton and sterilized in the autoclave. The next step was to place in each such tube a small sterile block cut from a raw potato. Considerable care was necessary to avoid contamination in this process. The work was all done under a transfer hood freshly washed out with corrosive sublimate solution. The potato tubers were first washed then immersed for about five minutes in a corrosive sublimate bath. They were then peeled with sterile knives and the sterile interior flesh was finally cut into several small blocks of such size, about $1 \times 1 \times 4\frac{1}{2}$ cm., as would drop easily into the tubes. These tubes were then held 24 hours at about 22° C., in order that any contaminated tubers might be detected and discarded before the inoculations were made. The inoculations were made from pure cultures of *Phytophthora infestans* growing on lima bean agar and about 15 to 18 tubes of each variety were inoculated. About twelve varieties were run in each series, two of these varieties used as checks, being the same in all the series. For these checks Professor Wohltmann and Green Mountain varieties were used because they showed a very uniform growth all through and stood at the two extremes, the former being one of the most resistant varieties, the latter one of the most susceptible.

For each inoculation, a small piece of the fungus was transferred with a platinum needle from the agar to the block of potato and scratched into it to prevent its drying up before infection could take place. If proper care was taken in making this inoculation, a uniform growth was obtained on all the blocks of the same variety.

After inoculation the cultures were placed for incubation and growth in a temperature of about 15° to 16° C. It was found that at this tem-

perature they developed a fair growth of the fungus in about six days, and this reached a maximum on about the tenth day. All the tubes of each variety were then assembled and compared with the checks as to their relative amounts of growth. These results were judged by two or three observers independently of each other, and each judgment recorded. For purposes of comparison the relative growth was expressed in percentages. Although this was a somewhat arbitrary standard its usefulness is shown by the fact that these independent observations rarely varied more than five to ten per cent.

For the final results all these tests were made in duplicate and all the observations on any one variety were averaged. These averages may be grouped into three main classes. First, a highly resistant class, those exhibiting a growth of from 1-35 per cent. Second, a middle class, those exhibiting a growth of from 35-66 per cent, and third, a susceptible class, exhibiting a growth of from 65-100 per cent. It was found that those falling into class one were in every case those which were of tested disease-resistance and were practically all of European origin. Those falling into class two were largely of reputed disease-resistance and were also largely of European origin. Those falling into the third class were practically all of American origin and included many of our most important commercial varieties. Since these results, in the main, correspond to those obtained by Professor Stuart, in his field trials, we feel safe in drawing the conclusion, that thus far our American breeders of potato varieties have been developing types which stand for yield and quality regardless of disease-resistance, while European breeders have been developing disease resistant varieties. This, we believe, explains in a measure, the heavy loss occasioned by fungous disease in our American potato crop. Unfortunately the most resistant of the European varieties are not of the best quality and color for the American market. It therefore remains for the potato breeders of this country to develop varieties which combine the desirable qualities of the best American potatoes with the disease-resistant qualities of the hardiest European potatoes. In connection with this it will undoubtedly be the laboratory method here explained which will be used largely in testing the disease resistant qualities of new hybrids and seedlings in the attempts to develop this new ideal potato.

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