OTHER APPROACHES TO THE VERTICILLIUM PROBLEM

by
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Verticillium wilt caused by the soil borne pathogen Verticillium dahliae is the disease with the greatest impact on potato production in several growing areas in the United States and other hot and dry climate regions all over the world. Yield losses due to Verticillium wilt commonly range between 25-50 percent. (Figure 1.)

The strategy of the Verticillium wilt control in the Negev, the major potato production area in Israel, is based on the following:

1. Growing tolerant and resistant potato cultivars.
2. Using Verticillium dahliae free seed stocks.
3. Soil fumigation, mainly by vapor.
4. Crop rotation.

In northern Europe Verticillium wilt on potato is not a major disease in seed production areas. Nevertheless, since northern Europe countries are the main export source for seed tubers to the hot climate regions, V. dahliae resistance is a very desirable characteristic because the cultivars must be suitable for growing in these target countries.

Screening for Verticillium dahliae resistance or tolerance in potato breeding lines cannot be done in northern Europe due to the lack of suitable climate conditions. As an alternative to field experiments, attempts to screen for Verticillium wilt tolerance of potato in greenhouse conditions were unsuccessful. The Negev region in Israel can provide an ideal screening area for Verticillium wilt or early blight caused by Alternaria solani in lines produced by the European breeding programs.

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Verticillium dahliae resistance is defined as a low concentration of the pathogen in the host plant due to difficulty in penetration or colonization, late appearance of mild visual symptoms and no reduction in yield. Tolerance, however, we define as no significant reduction in yields despite a high degree of infection in the plant.

During the last 8 years we have developed a methodology for field screening of potato cultivars for V. dahliae resistance and tolerance. Soil was infested by spreading V. dahliae infected potato vines containing microsclerotia and incorporating them into the soil. A susceptible potato cultivar was then planted. The inoculum density was determined each year by several methods and found to be about 50 microsclerotia per gram of soil. Potato tested lines were then planted in replications and grown using standard procedures. Early and late blight were controlled with fungicides. The characteristic of each line tested was judged by the appearance of visual symptoms and yield reduction when compared with a parallel field where Verticillium dahliae populations in the soil were below detectable level. The average yield reduction due to Verticillium wilt was 30%. Very poor correlation was found between early tuberizing and V. dahliae susceptibility.

Since screening in field conditions is expensive and time consuming, we suggest another way for screening potato lines for tolerance to Verticillium wilt. It has been known for several years that V. dahliae produces phytotoxins, which we have proved to be the agent in the creation of disease symptoms. Cultivars, Alpha and Kathadin, which were defined as tolerant in field experiments in Gilat Experiment Station, were not affected by the phytotoxic fraction. Several susceptible cultivars did show a toxic affect. Tolerance to Verticillium dahliae in the field and to the toxic material was also found in the pedigree of 2nd and 3rd generation of Alpha. Several field experiments were performed on the cultivar Kathadin and dihaploids derived from it. Most of the dihaploids that carried the tolerant characteristic in the field were also not affected by the toxin. These results suggest that the toxin may be used as a screening tool for evaluation of potato germplasm for "Alpha-type" tolerance. Since protoplasts derived from leaves of cultivar Alpha are not affected by the toxin this can be the basis for further research on selection for resistance on protoplasts or tissue culture level.

Figure 1. Total ☐, and marketable yield ▨ of 5 European potato cultivars, grown on Verticillium dahliae infested soil (I) and V. dahliae free soil (C). Field experiments were carried out in Gilat Experiment Station in the spring of 1982 by Mazal (Ventura) Solomon during her MSC. thesis.