Screening for field resistance to early blight (Alternaria solani) in potatoes

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Summary

27 clones were trialled in the Negev, Israel, in the Spring and Autumn seasons of 1984 and 1985, in a control area (kept disease free) and an Alternaria area (artificially infected with \textit{A. solani}). Disease symptoms and maturities were assessed. Significant variation in symptom expression was detected between clones and seasons, as well as a significant interaction of clones by years by seasons. The symptoms showed low correlations between seasons but were larger between years within the same season.

The clones displayed a range of maturity scores and it was demonstrated that these showed a relationship with the variation in observed disease symptoms. The deviation of symptom expression from a linear relation with maturity was taken to reflect a clone's actual resistance or susceptibility. The results showed agreement over years and it was suggested that such trials and methods of assessment might provide the basis for screening large numbers of clones.

Introduction

Early blight, caused by \textit{Alternaria solani}, is a major fungal disease of potatoes grown in hot climates, especially in irrigated crops (Harrison, 1974; Rotem, 1981). It occurs on most potato crops in the Negev in Israel and is often apparent, even on well sprayed crops, once senescence has begun. Although varying levels of resistance have been reported (Frank et al., 1979), the disease is controlled mainly by applying chemicals (Harrison et al., 1965; Stevenson, 1983) and managing irrigation regimes (Holley et al., 1985). \textit{A. solani}, an air-borne pathogen, infects by penetrating wounded foliage tissue and then develops to produce spores in a typical pattern of concentric rings. The effect of \textit{A. solani} infection on yield is unclear (Harrison & Venette, 1970; Bashi, 1979; MacKenzie, 1981; Easton, 1985; Rotem, 1981). Nachmias et al. (1988) showed, by using populations containing large numbers of clones, that infection with \textit{A. solani} caused a 22\% reduction in yield in the spring season, while in the autumn crop there was only a 7\% decrease. Thus some of the uncertainty may have arisen because previous studies used smaller numbers of unrepresentative clones and disregarded seasonal effects. It is now clear that the fungus causes an economically important decrease in yield, particularly in the spring crop.

In the Negev, crops are routinely sprayed as often as five times to control late blight,
caused by *Phytophthora infestans*, as well as early blight. Not only does this add to the variable costs of the grower but the treatments are not always effective (Easton, 1985; Platt, 1983), therefore the development of stable resistant cultivars is the only long-term solution for control of the disease. The aim of this study was to test the feasibility of using field trials to assess the levels of resistance in a range of potato clones.

**Materials and methods**

The field trials were carried out at Gilat Experiment Station in the northern Negev, Israel. The site and soil conditions have been described by Nachmias et al. (1988) who also described the two seasons of potato growing; 1) Spring — potatoes are planted in the second half of February and harvested in June, and 2) Autumn — planting is in late August and harvesting is in January.

In this study clones were grown in both seasons of 1984 and 1985 and of the many grown, 27 were present on all four occasions. All the clones in any season's trials were grown from common-origin seed. For the Spring planting, the seed tubers were grown at the high-grade seed site of the Scottish Crop Research Institute (SCRI) in Peeblesshire, Scotland. They were harvested in September/October, shipped to Israel in December, and planted in January. The Autumn trials were planted with seed grown, under careful disease control, in the Negev in the Spring season, harvested in June, and stored at 4 °C until planting in August.

The sample of 27 clones consisted of 9 cultivars, 2 clones recently (1986) given cultivar status (by being placed on the UK National List) and 16 numbered clones from the SCRI breeding programme. Most of the clones grown had not been tested previously for early blight resistance, although some of the commercial cultivars were of known status. In particular Désirée, Croft, Guardian and Maris Bard have been grown in this area for several years; the first three show partial resistance (although Croft is mainly recognized for Autumn production) and M. Bard is susceptible.

In both years and seasons two trial areas were used; the soil was fumigated and then maintained to a high health status. One area, designated Control, was kept disease free while the other, designated Alternaria, was artificially infested with spores of *A. solani*, as described by Nachmias et al. (1988). Each clone was represented in each area, in two randomised blocks, by a 4-tuber × 2-drill plot.

Foliage measurements were made on the Alternaria plot every 10 to 14 days starting 60-70 days after planting. The percentage of leaf area affected by *A. solani* was assessed by eye. The early blight symptoms were estimated as the increase in percentage leaf area infected over a 14 day period at the time of maximum increase (generally around 75 to 95 days after planting). The foliage of the Control area was scored 105 days after planting and the maturity recorded on a 0 to 5 scale, 0 representing a dead plant (i.e. an early maturing clone) and 5 representing full vigour (i.e. a late maturing clone).

**Results and discussion**

The mean early blight symptom scores for the 27 clones in the two years and two seasons are given in Table 1 and their analysis of variance in Table 2. The replicate error variance was derived by summing the error variances from all clones grown in each year and season, i.e., including clones other than the 27 clones considered here. The