The effects of *Alternaria solani* and *Verticillium dahliae* on potatoes growing in Israel

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**Summary**

The effects of two major fungal diseases of potatoes growing in hot climates, early blight (*Alternaria solani*) and Verticillium wilt (*Verticillium dahliae*), were investigated in field trials. Large populations of clones were grown in the Negev, Israel in the Spring and Autumn seasons of three years, 1983, 1984 and 1985. Although symptoms of the diseases were seen in both seasons they were less severe in the Autumn. The effects of *A. solani* on yield, when expressed as percent of the control plot yield were also less in the Autumn than the Spring. With *V. dahliae*, however, the proportional effect on yield was greater in the Autumn. The decreases in yield associated with the two diseases were examined in terms of losses to the grower. The advantages of breeding for resistance/tolerance to these diseases were clear, emphasising the need for suitable screening techniques.

**Introduction**

Verticillium wilt and early blight, caused by *Verticillium dahliae* and *Alternaria solani* respectively, are major fungal pathogens of irrigated potato crops grown in hot climates (Harrison & Venette, 1970; Douglas & Pavek, 1972; Krikun & Orion, 1979; Nachmiyas & Krikun, 1985).

*V. dahliae*, a soil-borne pathogen, is capable of surviving in field soil for many years as microsclerotia. Following their germination, the hyphae penetrate the roots (Schnathorst, 1982) and colonise the vascular system (Robinson et al., 1957; Perry & Evert, 1983, 1984) causing two major symptoms; stunting and unilateral chlorosis (followed by necrosis and wilt) in the foliage (Isaac & Harrison, 1968). Previous studies on the effect of *V. dahliae* infection on yield have been made on only a few cultivars and have not taken into account the severity of the disease or yearly and seasonal variation.

*A. solani* is an air-borne pathogen whose dark, multicellular spores are dispersed by wind and rain splash. The fungus penetrates wounded leaves, causing typical symptoms of dark concentric rings. Its occurrence is widespread but its importance in reducing tuber yield has not been clarified (Rotem, 1981).

Resistance and tolerance to Verticillium wilt of several potato cultivars has been

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reported by Davis et al. (1983) and Nachmias et al. (1985). Although some cultivars are more tolerant than others, the disease is usually controlled by soil fumigation (Harrison, 1974; Krikun & Orion, 1979). There have been few reports of early blight resistance or tolerance (Frank et al., 1979) and there are no cultivars suitable for the Negev or areas of similar climate; the disease is controlled mainly by applying high doses of fungicides and managing irrigation treatment (Holley et al., 1985).

In the study reported here, a large population of diverse potato germplasm was used in field trials to evaluate the relative importance of \( V. \text{dahliae} \) and \( A. \text{solani} \) infection over several years, their seasonal effects on yield and to assess the need for resistant/tolerant cultivars. It should be noted that \( A. \text{solani} \) can also cause symptoms in the tubers, black dry rot after storage, but only from infections that occur at harvest via mechanical damage. In this study the tubers were hand lifted to avoid this problem. The study therefore concentrates on foliage and yield characters although further losses due to development of symptoms in store and loss of quality might add weight to the case for the production of resistant/tolerant cultivars.

Materials and methods

*The site and its climate.* Field trials were carried out at Gilat Regional Experiment Station (30° 40' E, 31° 20' N) in the northern Negev, Israel in 1983, 1984 and 1985. The climate is arid-Mediterranean with mild winters and hot, rainless summers. The soil is loessial, silt loam with an average of 50% organic matter and a pH of between 7.8 and 8.1. There are two seasons for 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. These seasons have a similar overall mean temperature and daylength but their patterns differ within each season. Fig. 1 illustrates the mean weekly temperatures for 1983 and shows that in Spring temperature increases during the growing season while in Autumn it progressively decreases.

*The potato clones.* The clones used included a large range of genotypes maintained by the Scottish Crop Research Institute (SCRI) and represented cultivars, breeders' clones, Neo-tuberosum clones (Glendinning, 1976) and clones from an improved diploid population (Carroll, 1982). The number in any year or season varied from 395 in Spring 1983 to 81 in Spring and Autumn 1985. Although the composition of the population differed, even at its minimum it can be considered as a representative sample of potato germplasm. Twelve clones were present on all occasions but no trial was grown in the Autumn season of 1983–84.

*The trial management.* Husbandry was in accordance with local practice. The trials were irrigated by a sprinkle system to 700 – 800 mm of water. Fertilizers were incorporated into the soil before planting and additional amounts supplied via the irrigation system. Pest and disease management reduced the development of unintentional infections.

In each year and season three areas were used, a Control area which was kept disease free, a Verticillium area into which \( V. \text{dahliae} \) had been introduced, and an Alternaria area which was artificially infected during the growing season with \( A. \text{solani} \) spores. The control area was prepared by soil fumigation (Krikun & Orion, 1979) and during the growing season it was kept as disease free as possible.