EXPERIMENTS ON THE CONTROL OF BLACK-LEG DISEASE OF POTATO BY DISINFECTION OF SEED TUBERS WITH MERCURY COMPOUNDS AND STREPTOMYCYIN

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INTRODUCTION

Black-leg disease of potato, caused by the bacterium Pectobacterium carotovorum var. atrosepticum (Erwinia atroseptica) is very widespread in potato stocks in Scotland, and indeed occurs wherever the potato is grown. However under Scottish conditions the disease rarely reaches epidemic proportions, and in general the rate of tuber transmission is low, so that no special attempts have been made to control the disease other than by roguing crops to the tolerances permitted under the Potato Certification Scheme. In recent years an increasing quantity of Scottish seed potatoes has been exported abroad to warmer countries such as South Africa, Southern Rhodesia and Israel. The variety mostly exported is Up-to-Date, which appears from field observations to be susceptible to black-leg. One of the frequent features of Scottish seed grown in warmer climates has been the high black-leg content of some crops, sometimes as much as 50%, during their first year of cultivation, although crops grown from seed produced in these countries generally have little black-leg: the reason for this phenomenon is not understood at present. Severe outbreaks have seldom occurred in Israel, but black-leg disease has been observed over many years in crops grown from seed newly imported from Scotland (Volcani, 1953). With regard to the warmer countries there seems little doubt now that the causal organisms originate from the seed and not from the soil especially since it has been found that the disease is not caused by soft-rot coliform bacteria indigenous there; the strain isolated from infected potatoes can produce black-leg at relatively low temperatures (below 66°F), and is identical with the strain present in Scotland (Graham and Dowson, 1960a, b).

Much of the seed exported is now washed free from soil and treated with an organomercurial disinfectant solution on a commercial scale in Scotland. This is done to ensure complete freedom from eelworm cysts, especially Heterodera rostochiensis, (Mabbutt, 1960) as well as to control surface-borne fungus diseases including dry rot (Fusarium caeruleum), skin spot (Oospora pustulans) (Boyd, 1960) and black scurf.

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(Rhizoctonia solani) (Graham, 1960). Because of the serious and continuing outbreaks of black-leg, experiments have been made during the last five years on the control of the disease by disinfecting tubers with mercury compounds, streptomycin preparations and later by using a mixture of the two.

Attempts to control black-leg by tuber disinfection have been reported on many occasions, but most of this work has been done in the United States and Canada where cut seed is widely used and where treatment is usually carried out a short time before planting. Antibiotics, particularly streptomycin, have often been employed (for example see Bonde and de Souza, 1954; Bonde, 1955) but formaldehyde (Bonde, 1950) and organo-mercurials including Semesan bel have also been tried (Robinson, Ayers and Campbell, 1960).

In general, the results have not been very instructive or promising, partly because the development of black-leg is so sporadic that it has often proved impossible to plan experiments to ensure that a definite result will be obtained even over several years. Blackleg occurred in small amounts in many instances in spite of seed treatment.

In our experiments whole (uncut) seed taken from infected crops was used, and the seed was transported by rail and cargo boat from Edinburgh to Rehovot and Beit Dagan. The tubers were therefore subjected to the changing environmental conditions during transport which may in some way effect the viability of the bacteria or decrease the natural resistance of the tuber to the development of black-leg. When planted in Israel they were of course also exposed to conditions very different from those in Scotland, and it was hoped that outbreaks of black-leg would occur so that the effect of the treatments could be judged more easily.

MATERIALS AND METHODS

In the experiments, three varieties were used, namely Majestic, Epicure, and Up-to-Date, all of which are known to be susceptible to black-leg from field observations. Crops were selected which had a black-leg content of 3% or over at inspection time (mid-July to mid-August). Tubers were drawn at random from the bulked material at normal lifting time in October and placed in bags for storage in a cool airy shed. No special selection of tubers from black-leg affected plants was made, as the process was meant to simulate commercial practice as far as possible. Furthermore, experience has shown that just as many black-leg infected plants are produced from tubers taken from "healthy" plants as those from obviously diseased plants, but why this occurs is not yet fully understood (Conroy, 1952; Graham, unpublished). As soon as possible after bagging, tubers were taken to Edinburgh, washed free from soil and portions treated with the disinfectants. After disinfection they were air dried, then placed in sprouting trays and stacked in an airy frost-proof shed until time for shipping to Israel in early or mid-December. For transportation tubers were packed in 25 lb. lots in stout, ventilated cardboard cartons and the journey by rail and cargo boat usually took 4–5 weeks. On receipt at Rehovot or Beit Dagan, some of the above samples as yet untreated were disinfected and dried, and the tubers planted as soon as