CONTROL OF HALO BLIGHT OF BEANS

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Summary

Halo blight (*Pseudomonas phaseolicola*) is a serious bacterial seed-borne pathogen of green beans (*Phaseolus vulgaris*). The use of disease-free seed should eliminate the pathogen from infected cultivars, but in practice this has rarely been achieved. Infection may be reduced by chemical treatment. Outbreaks of the disease have stimulated research into breeding for resistance. Sources of resistance have been identified and are being used in the green bean breeding programme at Lincoln.

INTRODUCTION

Halo blight is a bacterial seed-borne pathogen of green beans. The disease is endemic in the green bean seed crops grown in Marlborough for the home garden packet trade, and in some seasons seriously affects green beans grown for processing from imported seed. Leaves of infected plants typically show distinctive haloes caused by toxins in the tissues surrounding the initial point of infection. Bacterial exudate may appear as a greasy ooze on the pods. Severe infection results in defoliation and yield loss, and infected pods are rejected for processing. Development of the disease is favoured by cool moist conditions and bacterial spores are rapidly disseminated by wind and rain. At present, two distinct races are recognized (Walker and Patel 1964). This paper reviews control measures and describes sources of resistance and progress in breeding for resistance.

METHODS OF CONTROL

Disease-free seed.

The best method of control is the use of disease-free seed. Since 1965, New Zealand has had a bean seed disease control scheme designed to free bean seed from anthracnose (*Colletotrichum lindemuthianum*) and halo blight, and to reduce bean common mosaic virus to less than 1%. Under this scheme, crops are inspected during the summer and seed is "tagged" after harvest. The scheme has been very successful in eliminating anthracnose and bean common mosaic virus but has not significantly reduced the incidence of halo blight. There appear to be several reasons for this. Sometimes seed which is not free is sown for seed crops. Some crops may have infected plants which do not show typical symptoms or infected plants which are not found during the inspection. Disease-free seed may become contaminated during harvesting with residues from infected crops. Crop rotation and isolation may be inadequate. The halo blight infection that occurs in New Zealand crops is a major reason for processors to import their seed requirements although some imported seed may be infected also.

Seed treatments.

Several methods of disinfecting bean seed have been tried. Hot water treatments and the soaking and dusting of seed with mercurial

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compounds have reduced germination and had little effect on halo blight. More promising results have been obtained with streptomycin, although not consistently. Hagedorn (1967) found that streptomycin as a 1% seed slurry had no effect on halo blight in the subsequent crop. Ralph (1976) found that pelleting the seed with 5% streptomycin failed to control halo blight but soaking the seed in a 0.2% solution gave good control. The failure of pelleting was attributed to slow absorption of streptomycin from the pellet. Unfortunately, pelleting formulations with more than 1% streptomycin, and the 0.2% solution, all markedly reduced germination. Taylor and Dudley (1976) showed that slurries of streptomycin (2.5g/kg seed) or kasugamycin (0.25g/kg seed) reduced primary infection by 98% as did a 1% soak. The slurries were non-phytotoxic although the soak did depress field emergence. Streptomycin is used as a treatment in the USA, and on seed imported to New Zealand, but is not used in New Zealand.

Chemical control.

Attempts have been made to control halo blight in process crops with fungicides and antibiotics. Taylor (1972) achieved very good control with pod infection reduced to less than 5% by spraying with streptomycin sulphate or copper oxychloride at regular intervals from soon after emergence before disease symptoms were evident to flowering. When these compounds were applied at first flowering and at pod set, pod infection was reduced by 70%, but a single spray at pod set reduced infection by only 50% (Taylor and Dudley 1977a). Most work reviewed by Taylor and Dudley showed that regular spraying was necessary to achieve adequate control. In practice, very few growers apply sprays.

Breeding for resistance.

The halo blight epidemics in Idaho seed crops during the seasons 1963-70 are reported to have stimulated the search for resistant germplasm and some has been identified (Zaumeyer and Meiners 1975). The most useful line for breeding has been the dry bean (*P. vulgaris*) 'P.I. 150414' introduced from El Salvador. Two green bean breeding lines with resistance from this, viz 'Wis. HBR 40' and 'Wis. HBR 72' have been released (Hagedorn *et al* 1974).

At Lincoln, a number of lines have been screened in the field and glasshouse. In the glasshouse, plants at the first or second trifoliate leaf stage were kept in a humidity chamber for 24 hours. The abaxial leaf surfaces were then sprayed at 275 kPa with a suspension of halo blight races 1 and 2 till thoroughly wet. In addition, at least one point of the trifoliate leaf was sprayed until water soaking symptoms appeared. Plants were then put back into the humidity chamber for another 24 hours. Results showed that the dry beans 'P.I. 150414' and 'Great Northern Nebraska No. 1 sel. 27' were resistant. In the field, plants at the second or third trifoliate leaf stage were sprayed at 275 kPa with a suspension of both races, and were irrigated the following day. Lines were recorded for resistance (absence of leaf and pod symptoms) at the green pod stage. The pole beans (*P. vulgaris*) 'Mangere Pole' and 'Shiny Fardenlosa' in addition to 'P.I. 150414' and 'G.N. Nebra. No 1. sel 27' were resistant in the field tests. These lines are also resistant to 'top yellows', an aphid-borne virus disease of legumes. Most of the lines reported resistant to halo blight were susceptible to 'top yellows' and thus their halo blight resistance was not determined. The breeding lines 'Wis. HBR 40' and 'Wis. HBR 72' suggested by Taylor *et al* (1978) as suitable parents in a breeding programme were highly susceptible. Thus, in breeding for resistance to halo blight, one parent at least must possess resistance to 'top yellows'. Although it was suggested that other bean germplasm would be more suitable for breeding

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beans resistant to 'top yellows' (Malone 1978), the pole beans noted above may prove valuable as parents in the Lincoln green bean breeding programme. One line possessing resistance to both diseases has been selected from the cross 'Mangere Pole' x 'Gallatin 50' but it requires further crossing to incorporate bush habit and better pod quality.

Several workers have attempted to establish the mode of inheritance of resistance to halo blight (Zaumeyer and Meiners 1975). Various authors have presented conflicting results, particularly for the line 'P.I. 150414'. Taylor *et al* (1978) stated that in crosses of 'P.I. 150414' with green and dry beans, the expression of resistance is considerably affected by genetic background and environmental conditions. In a cross with 'Gallatin 50', the F1 generation was resistant but the F2 generation segregated in the ratio of 1 resistant: 2 intermediate resistant: 1 susceptible, suggesting partially dominant inheritance. Taylor *et al* considered that with low inoculum levels or under different environmental conditions, resistant and intermediate resistant plants may appear indistinguishable and thus resistance would appear completely dominant. These findings must be considered when using the backcross method to transfer resistance to the recurrent parent.

CONCLUSIONS

The development of halo blight resistant bean cultivars, together with rigorous hygiene, should allow the bean seed industry to provide all the seed needed in New Zealand.

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