Table 1. Occurrence of biotypes of *Pseudomonas solanacearum* in crop and weed host plants in Australia.

Host Plants	No. of Isolates Obtained		
	Biotype II	Biotype III	Biotype IV
Bidens pilosa (cobbler's pegs)		1	
Capsicum annum (capsicum)		1	
Crassocephalum crepidioides (thickhead)		2	1
Dodonaea lanceolata (hop bush)		1	
Lycopersicon esculentum (tomato)	3	29	5
Nicotiana tabacum (tobacco)		1	
Pultenaea villosa		1	
Rapistrum rugosum (turnip weed)		1	
Salvia reflexa (mintweed)	7		
Solanum mauritianum (wild tobacco tree)		2	
Solanum melongena (egg plant)		5	
Solanum nigrum sens. lat. (blackberry nightshade)	2	2	2
Solanum tuberosum (potato)	80	18	
Xanthium pungens (noogoora burr)		11	
Zingiber officinale (ginger)		13	55
Total No. of Isolates	92	88	63

in the vascular tissue typical of bacterial wilt of potato. Six isolates from the vascular tissue of the infected tubers were examined and found to be unaltered in the characters defining biotype II.

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Benomyl and Carbendazim Fail to Provide Effective Control of Blackleg in Rape

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Fungicide trials for the control of blackleg, caused by *Leptosphaeria maculans,* on rape (*Brassica campestris* and *B. napus*) have given conflicting results (3, 5, and Brown, A.G.P., Barbetti, M.J. and McRae Wood, P., unpublished data) in different areas and under different conditions. To ascertain the value of fungicides for the control of this disease in Western Australia, field trials were conducted in the winter of 1974 with benomyl and carbendazim, applied as seed dressings and as post-emergence sprays.

Benomyl (Benlate®), and carbendazim (Bavistin®) were incorporated into Prillcoat® rapeseed and into separate fungicide prills containing no seed, in an attempt to get rapid uptake of fungicide. Prillcoats were supplied with the fungicide incorporated into clay materials applied to the seedcoat. Seedless prills were prepared in a similar manner. It was hoped that the rapid dispersion of the clay prilling materials would allow quick release of the fungicides for absorption by the seedling roots. In addition, lime was incorporated into half of the prillcoats and prills, and phosphate was incorporated into the other half; the phosphate dissolves to form an acidic solution in which benomyl is more soluble (6). The two fungicides were applied at 140 and 280 g of product per hectare for both seed treatments and sprays. Sprays were applied at one week and at two weeks following germination. Seed was sown at 6.5 kg per hectare.

The above treatments were incorporated into 11 field trials at Green Range, Mt. Barker and at Lancelin. Plants were assessed for percentage showing crown cankers 14 weeks after germination, using the method of McGee (4).

Only three seed treatments significantly reduced ($p<0.05$) the number of crown cankers. These were 140 g of product per hectare of carbendazim in a phosphate prillcoat, and 140 and 280 g of product per hectare of carbendazim in a lime prillcoat. The effect was limited to only one of the three sites, and was not accompanied by an increase in yield. No seed treatment significantly reduced the severity of crown cankers. No seed, spray, or combination of treatments produced any significant increase in yields. No spray treatments caused any significant reduction in the number or severity of crown cankers. Even weekly sprays of benomyl at 140 g of product per hectare, from one week to four weeks after germination, have been shown to give only partial control of leaf infection for a period of one week. (M.J. Barbetti, unpublished data).

These results do not support earlier results of Brunin and Lacoste (2) which suggested that the use of systematic fungicides in France in the early stages of crop growth could result in significant crop protection from blackleg.

Nor do these results support the work of Chancogne *et al.* (3) and Pierre *et al.* (5) which showed that benomyl applied as a seed dressing could substantially reduce crown cankers. These European fungicide experimental results may not be relevant to Western Australia, where late blackleg infections can result in high levels of severely cankered plants (1). Hence, protection in the early stages of crop growth does not guarantee low levels of severe crown canker, especially under Western Australian conditions of heavy ascospore showers. Chemicals may have a place in the disease control of a semi-resistant or semi-tolerant cultivar, especially if the cultivar has only one stage of growth where susceptibility to the disease is very high.

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Cytokinin activity of Benomyl

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The systemic fungicide benomyl has as part of its chemical structure the benzimidazole molecule. Cytokinin activity has been demonstrated for both benzimidazole (2, 6) and benomyl (7). In a trial to assess the effect of benomyl (50% w.p.) and mancozeb (80% w.p.) on infection of broad beans (*Vicia faba* L.) by *Botrytis fabae* Sard, it was noted (Table 1) that despite similar levels of disease the amount of leaf and flower abscission was significantly different. It was thought that this difference may have been due to a cytokinin-like activity by the benomyl sprays. As the only report of such an effect by benomyl (7) did not involve foliar sprays, an attempt was made to confirm these results using this method of fungicide application and a different assay technique.

The standard cytokinin assay used (5) involved the determination of chlorophyll breakdown in wheat leaves as a measure of the ability of benomyl to delay leaf senescence. This assay is particularly appropriate as leaf senescence stimulates the growth and development of *B. fabae* (3). Wheat plants cv Pinnacle were grown in 15 cm diameter plastic pots containing U.C. Mix 1 (c) (1) in a glasshouse maintained between 10°C and 20°C. When the plants were 10 – 12 cm tall they were sprayed to run-off on two consecutive days with the chemicals shown in Table 2. From each pot, sections 2.5 cm long, cut 2 – 3 cm from the leaf tips were divided into two 1 g samples. One sample was frozen and the other incubated in the dark

Table 1. Effect of benomyl and mancozeb on leaf and flower abscission induced by *Botrytis fabae* infection of broad bean.

Tabulated parameter	Treatment †	1st Sample‡		2nd Sample	
% leaf area diseased	mancozeb benomyl	14.09 16.88	n.s.	15.3 21.0	n.s.
Av. leaf area/plant (cm^2)	mancozeb benomyl	1009 1151	n.s.	314 748	*
Av. no. flowers/plant	mancozeb benomyl	41.4 41.5	n.s.	2.8 11.1	*

† Treatments at the rate of 2 kg/ha in 500 1/ha applied one day after first sampling.

‡ Samples taken 6 and 8 weeks after inoculation.

* Difference between means significantly different at 5% level.

at 30°C for 80 hours, floating on deionized water. Chlorophyll contents of the samples were determined by extracting in 4 x 12 ml of 80% ethanol at 90°C (5). The four extracts were pooled and made up to 50 ml and their optical densities measured at 655 nm.

The ability of benomyl to inhibit chlorophyll degradation is clearly shown in the results (Table 2). The inability of the broad spectrum fungicide mancozeb to inhibit chlorophyll breakdown indicates that the effect of benomyl was not due to the inhibition of microbial breakdown of chlorophyll. The results of the benzimidazole treatment are consistent with the many previous reports (e.g. 6) regarding the ability of this molecule to inhibit chlorophyll breakdown.

Table 2. Effect of mancozeb, benomyl and benzimidazole on chlorophyll degradation in wheat leaves.

Material Sprayed	Concentration active ingredient	Optical density 665 nm after incubation	% Chlorophyll* degradation
benzimidazole	0.1%	1.21 †	36%
benomyl 50% w.p.	1%	0.80	57%
mancozeb 80% w.p.	1%	0.51	73%
nil (control)	–	0.54	71%

* Initial chlorophyll contents were not significantly different at P = 0.05.
Average initial chlorophyll content was 1.88 (O.D. 665 nm).

† L.S.D. 5% = 0.07.

The effectiveness of benomyl as a systemic fungicide against *B. fabae* may in part be due to its cytokinin-like activity. As *B. fabae* requires senescent tissue for sporulation and cytokinins inhibit leaf senescence (4), then benomyl may indirectly reduce sporulation and thus retard an epidemic. The results reported in this note reinforce the remarks by Skene (7) about the need for caution in interpreting the results of spray trials using the benzimidazole group of fungicides.

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