the only major areas presently known to be associated with *P. cinnamomi* in South Australia. The presence of *P. cinnamomi* in these areas is of great concern because a) Boat Harbour Creek Reserve adjoins, and partly drains into, Deep Creek Conservation Park; and b) Cleland Conservation Park is a major recreational area for Adelaide and the Park's bush walking tracks traverse the infected area.

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Phytophthora cinnamomi in the Grampians, Victoria

Jill Kennedy and Gretna Weste

Botany Department, University of Melbourne, Vic. 3052

The Grampians, spectacular mountain ranges in Western Victoria, are famous for the colour, profusion and diversity of endemic wild flowers. At least 2000 different vascular plants grow within the area, approximately 1/3 of Victoria's indigenous flora. Twenty species are endemic.

Within the last few years outbreaks of dieback disease due to *Phytophthora cinnamomi* Rands have occurred in many areas. The ranges are mostly state forest and the Victorian Forests Commission has conducted a survey which has shown the pathogen to be widespread along the gravelled roads. Because of its exceptional flora, and dramatic rocky outcrop the Grampians have considerable conservation and tourist value in addition to timber assets. During 1976 a project was initiated to study the invasion of *P. cinnamomi* into the Grampians and an outline of the results is reported here.

The presence of the fungus in the Grampians has not been accompanied by sudden, dramatic destruction of the total forest flora. Nevertheless the gradual destruction of a number of species has resulted in a mosaic of dead and living plants in the invaded areas, especially in localities where the soil is shallow.

Many of the species are susceptible and the soil is characterised by poor water retention, so that its rapid drying-out imposes a great strain on those plants whose fine roots have been rotted by *P. cinnamomi*. Heavy rains during warm months, 1971-6, have favoured sporangial production, zoospore dispersal and root infection. During subsequent dry periods deaths have occurred amongst susceptible plants.

This report records changes due to the disease during 1976 in three experimental plots, compared with controls, all located in heathland and woodland. The evidence strongly suggests that the pathogen has invaded the bush from the gravelled road verge or from gravel pits and has been present for at least 10 years. High populations occur at all depths sampled to 88 cm on site 1 and in lower numbers to 72 and 56 cm in the other plots. Deaths and symptoms of chiorosis and dieback are obvious in the understorey and dieback is now evident among the trees, such that the canopy structure is being lost. Most of the eucalypts belong to the susceptible stringy bark group.

There is a change in the species composition of the flora:—

(1) Eight species have completely disappeared from diseased sites. They are as follows:— *Tetratheca ciliata* Lindl, *Hovea heterophylla R.Br, Acacia mucronata Wild ex H. Wendl, Astroloma conostephiodes Benth, Isopogon ceratophyllus R.Br, Pultenea humilis Benth, Hibbertia fasciculata R.Br,* and *Styphelia adscendens R.Br.*

(2) There is a reduction in percentage cover by another six species, so that these may eventually disappear. They are listed as follows:— *Persoonia juniperina* Labill, *Hakea ulicina* R.Br., *Correa reflexa* Vent., *Leucopogon ericoides* R.Br., *L. virgatus* R.Br., and *Hibbertia stricta* R.Br.

(3) There is an increase in grasses and sedges. This occurs because of their tolerance or resistance to the pathogen, the increase in soil moisture due to decreased transpiration with death of heathland species and the opening of the canopy with eucalypt dieback. For example, *Hypolaena fastigata* R.Br has increased from 35-55%, *Lepidasperma filiforme* Labill from 5-20; whereas highly susceptible species have been reduced 100% and others such as *Xanthorrhoea australis* R.Br. from 28-14%. Despite the reduction of *Xanthorrhoea*, monocotyledons have increased 38% and dicotyledons have decreased 45% in dry weight per 10 m^2. There is no re-emergence of highly susceptible species.

Changes in flora due to *P. cinnamomi* may therefore be recorded in three ways:— as a reduction in species diversity; as a change in species composition; and as a reduction in total percentage cover. The severity of this change is evidenced by the disappearance of eight species from invaded areas, a high reduction in six species, and a 3-5 fold increase in sedges. These changes are more dramatic in downhill areas, although symptoms are also obvious in areas uphill from the road verge.

Downhill, there is an increase in bare ground where susceptible species have disappeared, whereas uphill areas present a mosaic of diseased and apparently healthy plants. This difference is due to the relatively rapid dispersal of the pathogen by water, compared with the very slow growth of mycelium through root contacts.

In the Grampians the disease is not immediately severe, but progressive. The pathogen is responsible for a continuous destruction of susceptible species in the invaded areas. It should be accepted that such destruction will increase both in severity, and in area, causing big changes in the flora. It is most important that these changes be accurately recorded. While maps show location of the pathogen as widespread along roads, it must be remembered that there are large areas of forest and associated flora without *P. cinnamomi*. It is important that these areas remain uncontaminated as far as is practicable.

Since the Grampians area is so famous for its endemic flora, we feel strongly that any changes due to dieback disease should be annotated. We propose therefore, to set up small plots and to record the presence of each plant now, and in subsequent years. Five plots will be established in diseased areas and another 5 plots in an apparently healthy area nearby. Plot size has been determined from species-area curves, and will range from 10-14 square metres.

Effects of *Bacillus subtilis* and *Streptomyces griseus* on Growth of Vegetables

P. R. Merriman
Plant Research Institute, Burnley, Vic. 3121
W. E. Birkenhead
Vegetable Research Station, Frankston, Vic. 3199

Recent studies have shown that *Bacillus subtilis* and *Streptomyces griseus*, selected for antagonism to *Rhizoctonia solani* in soil, stimulated plant growth when applied as seed or soil treatments. (1, 2, 3). Following preliminary tests, *B. subtilis* and *S. griseus* were evaluated for consistent effects on the growth of carrots over four seasons and for effects on the growth of sweet corn. The results of these experiments are reported in this note.

B. subtilis and *S. griseus* were grown for 10 days at 30°C on M32 agar medium (4) in 9 cm diameter Petri dishes. Surface growth from cultures was suspended in distilled water and shaken with the seed sample for one minute. Treated seed was air dried overnight and inoculum levels at sowing varied from 10^6 to 10^{10} propagules per seed. Carrot seed was pelleted as described by Merriman et al (3). Experiments based on a simple randomised block design with treatments replicated five times, were conducted at the Vegetable Research Station, Frankston. The soil texture in the experimental area was a sandy loam, pH. 6.2.

B. subtilis increased yield of carrots in 1972 (Table 1)

Table 1. Effect on yield of carrots cv Royal Star of *B. subtilis* and *S. griseus* seed treatments over four seasons

Seed Treatment	Yield t/ha Trial 1, 1972	Trial 2, 1973	Trial 3, 1975	Trial 4, 1976
B. subtilis/pellet	83.75	64.15	60.72	—
S. griseus/pellet	53.25	66.20	60.20	—
B. subtilis	63.38	57.65	68.72	64.44
S. griseus	62.75	63.30	66.00	63.96
Pellet	56.75	57.50	60.40	—
Water	53.75	62.35	66.40	63.32
LSD				
P = 0.05	7.83	8.62	4.84	6.29
P = 0.01	10.53	11.49	6.50	8.81

and of Sweet Corn in 1974 and 1975 (Table 2), while *S. griseus* increased yield of carrots in 1972 and 1973 (Table 1) and of sweet corn in 1975 (Table 2). In addition *S. griseus* advanced onset of tasselling in sweet corn by approximately 7 days (P = 0.05) in the 1975 trial. Counts of emerged tassels on 20 January 1975 from *S. griseus* and water treatments were 30.75 and 23.50 respectively.

These results indicate a requirement for further testing to improve the consistency of the effects of *B. subtilis* and *S. griseus* on plant growth.

Table 2. Effect on yield of sweet corn N.K. 195 of *B. subtilis* and *S. griseus* seed treatments

Seed Treatment	Yield t/ha Trial 1, 1974	Trial 2, 1975	Trial 3, 1976
B. subtilis	17.11	16.64	21.79
S. griseus	15.95	17.73	21.09
Water	14.59	15.13	23.07
LSD			
P = 0.05	1.37	1.14	2.04
P = 0.01	2.08	1.59	2.70

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Soil and Leaf Fungi in a Eucalypt Plantation at Olney State Forest, New South Wales

L. Gerrettson-Cornell and H. G. M. Dowden
Forestry Commission of New South Wales,
Beecroft, N.S.W. 2119

Some groups of trees of *Eucalyptus pilularis* Sm. and *E. agglomerata* Maiden showed poor growth and dieback symptoms on gently sloping water receiving sites within this three year old plantation. However, trees on the steeper slopes within the plantation were generally taller and apparently healthy. Leaf spotting was prevalent on the *E. agglomerata*, but was not observed on the *E. pilularis*.

Since *Phytophthora cinnamomi* Rands and two other species of this genus were recovered from another part of this plantation area in 1975 (4), part of the purpose of this investigation was to determine whether *Phytophthora* spp. were associated with the dieback. The other aim of the investigation was to find whether the 'leaf spotting' was due to fungi which could cause significant defoliation.