

Brassica green manure crops appear to improve soil properties

In field studies by **Hoong Pung, Susan Cross & Peter Aird** (Serve-Ag Research, Tasmania) biofumigant *Brassica* green manure crops could increase the marketable yield of a subsequent lettuce crop by reducing plant loss from *Sclerotinia minor* infection.

However, the brassicas did not reduce sclerotia viability (ie. the pathogen's inoculum level). It appears they are suppressing mycelial growth of the pathogen. As ITC levels diminish rapidly after incorporation into soil, effects for disease suppression are likely to be short term.

Other important benefits of green manures such as reduced soil crusting, improved infiltration, increased organic matter and the subsequent increase in beneficial microflora and microfauna are often overlooked.

Soil improvement following a *Brassica* may produce longer lasting effects on disease suppression and crop health, as well as soil 'health'. Field studies were conducted in an attempt to quantify these beneficial properties.

Soil penetration resistance is a measure of soil compaction, which increases over time with cultivation. Generally, at field capacity, growth of plant roots is not affected at <1000 kPa; while seedling emergence will be retarded and root growth restricted at 1000-2000 kPa; and root growth is impeded other than through cracks, channels and points of weakness at >2000 kPa.

Measurements were taken in each treatment (clay soil at field capacity) following harvest of the lettuces.

Generally, in the topsoil, penetration resistance was lower at 15-210 mm in ground previously sown with the brassicas, compared to fallow (Fig. 1), indicating that plants or residues (Table 1) reduce topsoil compaction. Different brassicas performed equally well. Poor drainage from soil compaction will create a favourable environment for *S. minor* lettuce drop disease.

In the subsoil (255-410 mm), crop residue incorporated by rotary hoe to about 200 mm is less likely to be important. How-

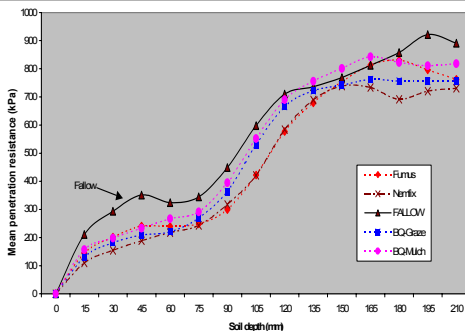


Fig. 1. Topsoil penetration resistance.

ever, *Brassica* taproots may assist in breaking up deep compacted soil. Reduced subsoil compaction was recorded following Nemfix, BQ-Graze and BQMulch, but not Fumus (Fig. 2). The difference may be related to their higher densities from better crop establishment (Table 1). The results indicate that optimum plant density and taproots combine to break up compacted subsoil.

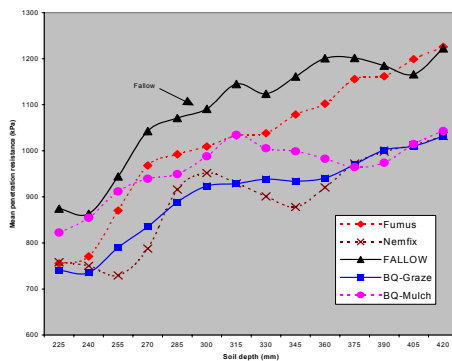


Fig. 2. Subsoil penetration resistance.

Table 1. *Brassica* plant density and biomass.

Treatment (10 Kg ha ⁻¹)	Plants m ⁻²	Dry matter Kg m ⁻²
BQMulch	186	1.28
BQ-Graze	238	1.50
Fumus	75	0.94
Nemfix	186	1.10

Lower soil compaction was also evident in a divided field with either BQMulch or ryegrass grown over winter, followed by potatoes in spring. After harvest, lower penetration resistance occurred in the area previously planted with BQMulch (Fig.

3). The blocks differed in past history, so other factors cannot be discounted.

In another example, compaction following two brassicas and pyrethrum in three adjacent blocks was compared. The perennial pyrethrum was terminated after three years, while the brassicas were sown in winter and rotary hoed in spring. Lower soil compaction was evident in the BQMulch and Fumus blocks, compared to pyrethrum (Fig. 4).

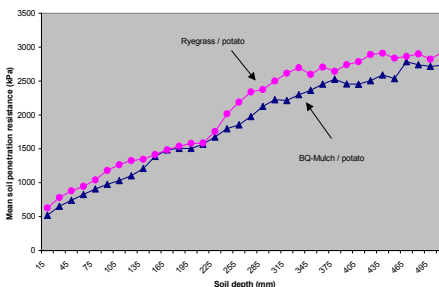


Fig. 3. Soil penetration resistance in a potato field following fodder rape or ryegrass.

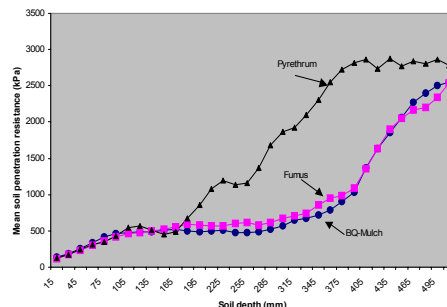


Fig. 4. Soil penetration resistance following brassicas and pyrethrum

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Horticulture Pests and Diseases

Exploring biofumigation potential of mustards

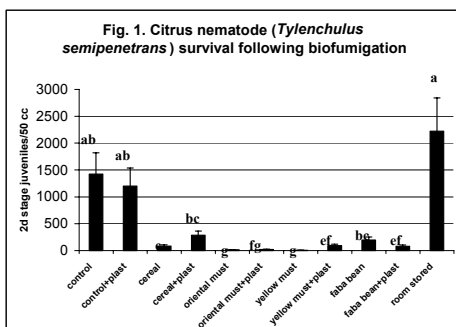
Work by **Oleg Daugovich** and **James Downer** (University of California Cooperative Extension-Ventura County) and **Ole Becker** (UC-Riverside) measured the effect of tissue mulching and irrigation on survival of *Sclerotinia minor*, citrus nematode and seed of bur-clover, annual ryegrass and pigweed.

Oriental mustard (*Brassica juncea*), yellow mustard (*Sinapis alba*), faba bean (*Vicia faba*) and a mixture of cereals (rye and triticale) were chopped with a mower at late flowering and sprinkler-irrigated with 30 mm of water within 0.5 h. Bare-ground controls were included.

All pests and pathogens were buried in gas and water-permeable bags at 20 cm prior to irrigation, recovered 7 days later and analyzed for viability. All plots were split and half of each was covered with black PVC after bag burial.

Mulch from all plots was collected and aqueous extracts were used in laboratory assays for sclerotia growth and weed germination. Romaine lettuce and celery were planted following biofumigation.

Any organic material reduced citrus nematode survival (Fig. 1), while in the bare ground control it was similar to room temperature-stored bags. Nematode suppression was 92% greater after oriental and yellow mustard (except yellow mustard/plastic) than after cereal or legume, indicating mustard allelochemicals possibly suppressing nematodes.

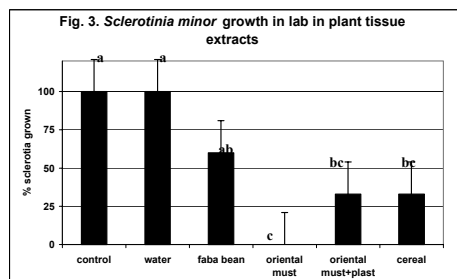
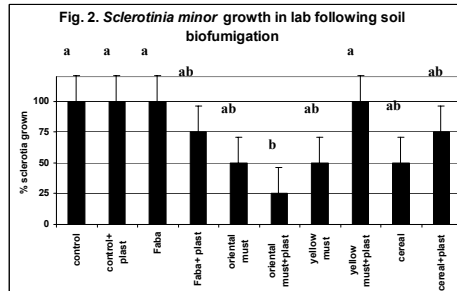


Biofumigation did not affect *S. minor* sclerotia, except when oriental mustard was used in combination with plastic (75% reduction compared to control) (Fig. 2). Results from other treatments appear inconsistent and variable.

Oriental mustard tissue extract effect on sclerotia growth was further assessed in the laboratory.

No sclerotia grew in aqueous extracts

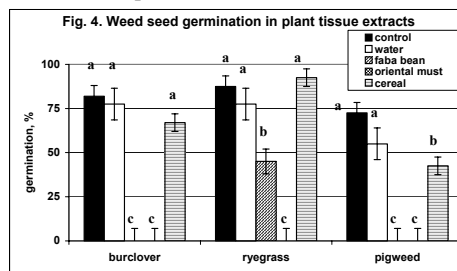
from oriental mustard tissue (Fig. 3) and sclerotia growth was reduced about 60% in tissue extracts from oriental mustard + plastic, and cereal. Oriental mustard exceeded other crops in inhibiting sclerotia growth in both field and lab tests.



Abundant presence of *Trichoderma* spp. (fungi with useful biocide potential) was observed in plates with sclerotia of both field and lab isolates from oriental mustard plots. This observation agrees with Australian results that documented prolific growth of *Trichoderma* spp. at ITC concentrations well beyond what killed a range of pathogenic fungi.

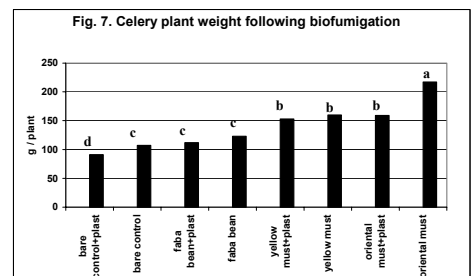
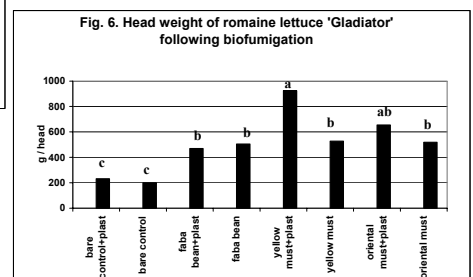
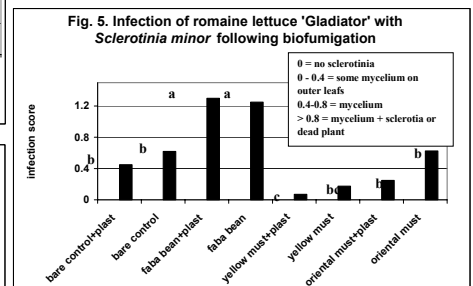
This suggests that dynamic changes in the microbiological community may be partially responsible for suppressive effects of *Brassica* spp. on certain soil-borne pathogens.

No inhibition of weed germination occurred in the field but aqueous extracts of oriental mustard completely inhibited germination in the lab (Fig. 4). This corresponds with findings of the *S. minor* assays, and indicates the need for identification of allelochemicals and correlation of their concentration with suppression of soil-borne pests and weeds.



Infection of lettuce with *S. minor* was 91 and 68% less after 'biofumigation' with yellow and oriental mustard, respectively, than after faba bean (Fig. 5).

Lettuce after yellow mustard/plastic was nearly infection-free (7.6 times lower infection score than control). Yellow mustard/plastic resulted in the largest lettuce heads (Fig. 6). Control celery were lightest (Fig. 7) and heaviest after mustards.



This study and literature reports show beneficial effects of mustards on subsequent crops.

However, it is unclear which allelochemicals were the most suppressive for pests and pathogens and if lack of suppression was a result of low concentrations of those allelochemicals.

Additionally, microbial community changes need investigation for possible indirect effects of mustards on following crops.

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