Effects of volatile compounds from biofumigant soil amendments on the survival of the soilborne pathogen *Sclerotium cepivorum*

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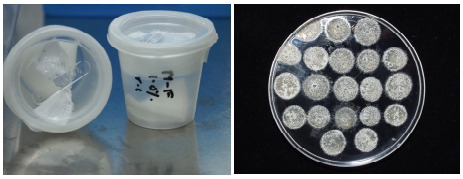
Background

The aim of this work was to assess the potential of biofumigant soil amendments for suppressing the soilborne pathogen *Sclerotium cepivorum*, the cause of Allium white rot.

Methods

Laboratory experiments: A series of replicated bioassays examined the effects of volatiles released from the soil amendment Voom® (mustard oil, 15-20% w/v allyl isothiocyanates), when applied at different concentrations, on mycelial growth (Petri dish method) and viability of sclerotia of *S. cepivorum*.
In bioassays with sclerotia, allyl isothiocyanate (98% w/v, Fluke) was used as a control. Two methods were used to expose sclerotia to volatile products. In the first method (fumigation), twenty sclerotia were placed in a mesh bag, which was attached to the inside of the lid of a small plastic cup (30 ml-cc, Huhtamaki). Treatment solutions were added to filter paper (0.5 mL/cup) placed on the bottom of the cup. The cup was sealed and incubated at room temperature for 24-hrs. In the second method (drench), sclerotia were placed directly on the filter paper before adding the treatments. After treatment, sclerotia were surface sterilised and individual sclerotia placed on PDA droplets to determine their viability. Plates were incubated for 14 days at 20°C.
Field study: A replicated field trial investigated the effects of two biofumigant soil amendments (Voom® and Fumafert®) mustard meal) and the soil fumigant (Basamid™, a.i. dazomet) on disease (white rot) incidence in a spring onion crop. Treatments were applied to a sandy soil in raised beds, 8 weeks before growing spring onions.



Sclerotia of *S. cepivorum*

Summary of results

Laboratory experiments:

- Volatile products released from the two highest concentrations of Voom (3% and 5% v/v) effectively killed mycelium of *S. cepivorum*, while lower concentrations (0.5% and 1% v/v) only inhibited growth (Fig. 1).
- Volatiles released from the two highest concentrations of Voom and the control ITCs (3% and 5% v/v) effectively killed sclerotia of *S. cepivorum* (Fig. 2).
- Low concentrations of Voom and the control were less effective in reducing the viability of sclerotia, (Fig. 2).
- Drenching sclerotia with Voom solutions was slightly more effective than fumigation in reducing the viability of sclerotia (Fig. 2).

Field trial:

- At a site with high pathogen pressure (average 75 sclerotia per kg soil), Basamid™ was more effective than biofumigant treatments in reducing the number of spring onion plants infected with white rot (Table 1).
- Concentrations of total ITCs released by dazomet were greater than those released by biofumigant treatments, which probably resulted in greater mortality of field sclerotia.
- There were no apparent differences in disease levels between plots with and without plastic cover within each treatment, suggesting that irrigation provided a good seal.

Results

Laboratory experiments

Fig. 1. Effects of different concentrations of Voom on radial growth of mycelium *of S. cepivorum* on PDA agar plates. (averages of two tests shown)

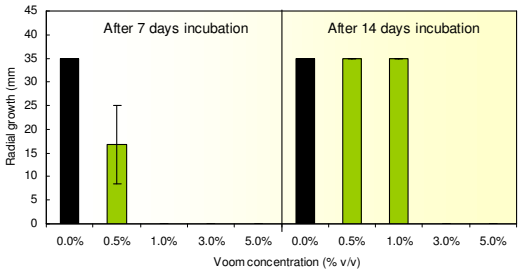
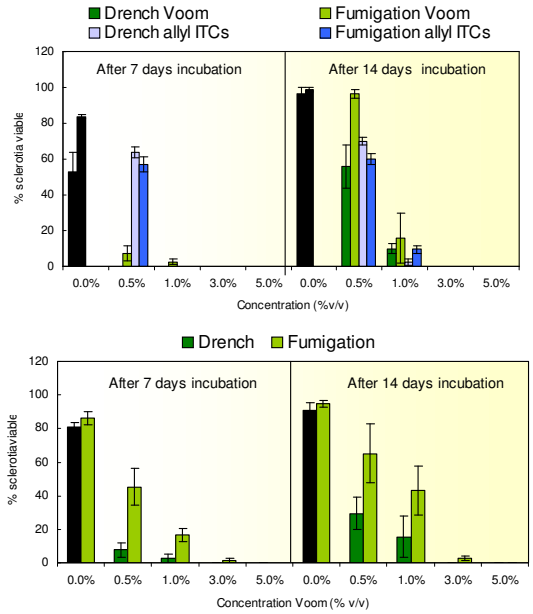


Fig. 2. Effects of different concentrations of Voom and allyl isothiocyanate control on the viability of sclerotia of *S. cepivorum*. (results from two tests shown)



Field trial

Table 1. Effects of biofumigant soil amendments and the fumigant Basamid™ on the incidence of onion white rot on spring onions.

	% plants with white rot	
Soil treatment	Tarp (-)	Tarp (+)
Untreated	13.0 a	13.8 a
Voom® (shank-injected at 5% v/v, 500Lwater/ha)	10.4 a	10.3 a
Fumafert® (400 g m^2)	11.7 a	13.1 a
Basamid™ (50 g m^2)	5.2 b	5.4 b

Means with the same letters are not significantly different at 5%. Basamid and Fumafert were broadcast onto soil then rotary hoed to 30 cm depth, followed by irrigation and tarping (LD PVC).

Next step:

- Laboratory experiments showed potential for Voom at 3-5% (v/v) to reduce the viability of sclerotia of *S. cepivorum*. However, when Voom was incorporated into soil at 5% it failed to provide a significant disease reduction.
- It is unknown whether soil factors or application methods influenced the efficacy of fumafert and Voom (e.g. decomposition and hydrolysis of ITCs).
- Future research should investigate whether higher rates of the biofumigant soil amendments, for example with similar levels of biofumigant compounds to those in dazomet, would be more effective, and economical, killing sclerotia and reducing disease.

We thank Prem Akhil for supplying Voom for the experiments

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