Natural Bio-Fumigation to Control Rhizoctonia in Potatoes

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Glucosinolates are compounds found in all species of the Brassica, or cabbage, family. The effect of glucosinolates is already familiar as it is the breakdown of glucosinolates in mustard that gives rise to its hot taste. It is thought that glucosinolates may be present in Brassicas as part of the plant's natural defence system. Work at SAC has shown that glucosinolates extracted from Brassica seed can control the fungal agents responsible for clubroot and damping-off and also plant pests such as aphids, slugs and leatherjackets (Booth et al, 2000). A problem in utilising extracted glucosinolates is the level of care required to safely handle glucosinolate products. The concept of biofumigation allows a safer and easier means of delivery of glucosinolates to the target. Biofumigation occurs when plant material from Brassicas is incorporated in the soil, where the active breakdown products are released from the plants and 'fumigate' the soil (Kirkegaard et al, 1999).

Rhizoctonia solani is a major fungal pathogen of potatoes. It can attack stems arising from the seed tuber before emergence and cause elongated, brown sunken lesions called stem canker. Infections may be so severe that stems are pruned and fail to emerge. Rhizoctonia causes unsightly hard black superficial blemishes on tubers called black scurf, which can lead to disease in subsequent crops of seed potatoes and affect the marketability of pre-packed, washed ware potatoes. The black scurf symptoms are becoming increasingly unacceptable with the potato trade and consumers.

Soil borne Rhizoctonia is becoming increasingly important and no fungicide treatments are effective in controlling this source of inoculum. There is a need to develop a novel, environmentally friendly means of soil borne Rhizoctonia suppression. A SAC project aims to evaluate the effectiveness of biofumigation as a means of controlling *Rhizoctonia solani* and ultimately to provide information for its use in a control system for potatoes.

Brassica species contain contrasting profiles of glucosinolates which vary in their biocidal activity on different pathogens. Glucosinolate types also vary according to the part of the plant. Swede oilseed rape (*Brassica napus*), turnip oilseed rape (*B campestris*), brown mustard (*B juncea*), white mustard (*Sinapis alba*), forage rape (*B napus*), forage radish (*Raphanus sativus*) and thousand head kale (*B oleracea*) were grown under controlled conditions to supply plant material with a range of glucosinolate profiles. These were then tested for activity against Rhizoctonia in the laboratory. Activity of different rates was also tested. Lab tests used colonies of the Rhizoctonia fungus grown on agar plates and exposed to biofumigation from the different Brassica material.

Significant differences in activity of different sources of glucosinolates have been apparent and work has also shown a dose response. Results from some of the most active Brassica tissues are shown here. Root material from turnip oilseed rape (*B campestris*) (containing 2 phenyl-ethyl and 4 methyl but-3-enyl as the predominant glucosinolates) had the largest effect, reducing the size of Rhizoctonia colonies to 31.9% of untreated at the maximum dose of 500 mg dried material. Root material from swede oilseed rape (variety Synergy) and brown mustard were effective in reducing colony size to 47.1 and 47.3 % of untreated respectively. With regard to shoot material, turnip rape (*B campestris*) (containing but-3-enyl and pent-4-enyl as the principal glucosinolates) had a large effect, reducing colony size to 55.9% of control at the 500 mg rate, followed by brown mustard.

Work is ongoing to test the effectiveness of Brassicas to control soil borne Rhizoctonia in the field. The Brassicas swede oilseed rape, turnip oilseed rape, brown mustard and white mustard have been selected on the basis of their glucosinolate profile and also likely winter hardiness. Plots of these species were grown in a field known to be infected with soil borne Rhizoctonia over winter. In the following spring the Brassicas were then chopped and incorporated into the soil by ploughing to allow breakdown of the glucosinolates and biofumigation of the soil. A potato trial has then been superimposed on the site of the different Brassicas. Detailed assessments for stem canker are being carried out on the crop and after harvest the tubers will be assessed for black scurf.

Effect of Brassica shoot and root material on growth of *Rhizoctonia solani*

Brassica species	**Plant part**	**Principal glucosinolate(s)**	**Rate (mg)**	**Colony size as % of untreated**
B juncea	Shoot	Prop-2-enyl	10	98.3
brown mustard			100	88.0

			500	58.5
	Root	Phenyl-ethyl, prop-2-enyl	10	92.8
			100	60.1
			500	47.3
B napus swede oilseed rape, var. Synergy	Shoot	2-hyroxy-but-3-enyl, but-3-enyl, pent-4-enyl	10	100.1
			100	92.8
			500	77.8
	Root	Phenyl-ethyl	10	88.2
			100	49.6
			500	47.1
B campestris turnip oilseed rape, var. Debut	Shoot	But-3-enyl, pent-4-enyl	10	99.9
			100	86.1
			500	55.9
	Root	Phenyl-ethyl, 4-methoxy-3-indolylmethyl	10	91.4
			100	46.3
			500	31.9

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References

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