The Use of Oilseed Rape Meal for Control of *Rhizoctonia solani* in Potatoes

Karene G. Sutherland, Elaine J. Booth, Kerr C. Walker
SAC, Craibstone Estate, Bucksburn, Aberdeen, Scotland, AB21 9YA, E-mail:
k.sutherland@ab.sac.ac.uk

ABSTRACT

Nine rapeseed meals from three oilseed rape varieties/extraction methods were tested for biocidal activity against *Rhizoctonia solani*. Growth of *R.solani* was reduced by rapeseed meals at a rate of 500 mg meal/agar plate. The two most active meals were less effective at control of *R.solani* than the soil fumigant dazomet. A field application rate of 77 t/ha rapeseed meal was calculated. Potato tubers were grown in *R.solani* infected soil treated with dazomet or rapeseed meal. Emergence of potato plants in untreated and infected soils was 82 –88%. Dazomet reduced emergence to 74% and rapeseed meal reduced emergence to 4%. Stem canker developed on 27% of plants grown in infected soil, dazomet reduced this to 18%. Rapeseed meal caused emerging potato shoots to rot.

Key Words: Rapeseed-meal-Rhizoctonia-biofumigation-potatoes

INTRODUCTION

Rhizoctonia solani is an important fungal disease of potato crops, causing sunken cankers on stems and stolons, leading to poor crop emergence and reduced yields. Quality is reduced by the presence of black sclerotia (black scurf) on the tuber surface. The fungus survives in the soil as mycelium or sclerotia associated with decaying tubers, or as sclerotia free in the soil. The disease is managed by rotation and planting of non-infected tubers. Fungicides are applied to tubers going into or coming out of store for control of tuber-borne infections. Fungicidal control of the soil-borne phase of the disease is not possible or is expensive.

Oilseed rape crops are grown for their oil, but seeds also contain bioactive molecules, the glucosinolates, and the enzyme myrosinase. In the presence of myrosinase, glucosinolates are degraded into various derivatives, some of which may have anti-fungal and insecticidal activity (Bagger *et al*, 1999). The oil extraction method has been shown to influence the quality of rapeseed meal for ruminant feed, with extraction temperature influencing degradability and digestibility (Bourgin et al, 1999).

This paper reports on studies to determine if oilseed rape meal can be utilised as a biocide for control of *R.solani* and if oil extraction method influences biocidal activity.

MATERIALS AND METHODS

Nine rapeseed meals were obtained from CETIOM in France. Oil was extracted from three varieties, Agat, Express and Pollen, by three extraction methods, direct (cold pressed) extraction (non blanched), blanched and extracted, extruded extracted (Burghart and Evrard, 1999). *R.solani,* isolated from potato tubers, was maintained on potato dextrose agar (39 g/l) at 16-18^{o}C. The biocidal effect of rapeseed meal on *R.solani* was determined using the technique described by Kirkegaard *et al* (1996). Rates of meal used were 0, 10 100 and 500 mg/plate. Plates were incubated at 18^{o}C for 3 days and the diameter of colonies measured. The experimental design was a randomised block with five replicates.

The two most active meals/rates were compared against the commercially available soil fumigant dazomet (97% w/w, product name Basamid). Rates of dazomet used were 0, 0.1 1.0 10, 50, 100 and 500 mg product/plate. The methods and design were as above.

Soil from Craibstone Estate, Aberdeen was inoculated with *R.solani*, AG3, as described by Kyritsis & Wale (2002), or left untreated. Soils were placed into seed trays, size 0.01 m^{3}, to a depth of 5 cm and the water holding capacity adjusted to 50%. Rapeseed meal (77 t/ha) or dazomet (570 kg/ha) were incorporated into inoculated soil and individual trays placed into sealed polythene bags. Untreated and inoculated control soils were similarly treated. Soils

were allowed to fumigate in a glasshouse for 3.5 days, the bags removed and any gas allowed to escape for a further 3.5 days. Micropropogated potato seed tubers, variety Desiree, size 15 – 20 mm, were allowed to chit for 7 days at room temperature prior to planting. Soils were placed into 30 cm pots, 5 replicates per treatment, and 10 tubers planted in each pot to a depth of 5 cm. Pots were incubated at 10^{o}C and watered as necessary, all receiving identical amounts of water. Once untreated control plants had emerged, all pots were assessed for emergence, canker development and shoot pruning.

RESULTS

R.solani grew to a size of 53.8 mm diameter after 3 days on untreated plates (Table 1). Ten and 100 mg meal had no effect on growth of *R.solani* but 500 mg meal/plate reduced growth. Meal from the variety Express had the most activity against *R.solani*, with the blanched meal the most active.

Table 1. Effect of nine rapeseed meals on diameter (mm) of *Rhizoctonia solani* colonies

	Variety			
Extraction Method	Pollen	Express	Agat	Mean
Untreated				53.83
Non-blanched	44.02	41.5	49.2	44.91
Blanched	49.02	37.8	45.3	44.04
Extruded	54.03	48.5	51.4	51.31
Mean	49.02	42.6	48.6	
LSD		3.92		

Dazomet significantly reduced growth of *R.solani* by 77 – 100% at rates of 10 – 500 mg product/plate (Figure 1). The ED_{50} of dazomet was calculated as 4.2 mg product. A rate of 500 mg of blanched Express meal controlled growth of *R.solani* by 46% and was equivalent to a rate of approximately 3.7 mg of dazomet. Based on a field application rate of dazomet of 570 kg product/ha, the amount of blanched meal required giving similar levels of fumigation to that of dazomet would be 77 t/ha.

Forty six days after planting, 88% of potato plants had emerged from the untreated soil (Figure 2). *R.solani* delayed emergence compared with untreated soil and dazomet delayed emergence compared with the inoculated soil. Rapeseed meal completely inhibited emergence and soil became mouldy. Little or no stem cankers or shoot pruning were found in the untreated control. Stem cankers developed on 27% of plants grown in *R.solani* infected soil and only low levels of shoot pruning were evident. Dazomet reduced stem canker levels and increased shoot pruning, but these were not significant. Rapeseed meal caused 96% of shoots to rot when less than 5 mm in length and these were scored as stem canker/shoot pruning.

DISCUSSION

Results showed most of the meal/extraction method combinations had some activity against *R.solani* if used at rates of 500 mg, agreeing with Kirkegaard *et al* (1996). Extraction method had an influence on the biocidal activity of meals produced from different varieties and no one extraction method gave the best biocidal activity. Improved biocidal activity in the rapeseed meals would be required if they were to replace the soil sterilants available at present. The excessively high levels of meal (77 t/ha) required and the poor potato plant emergence would not be acceptable in a farm situation. The variety/extraction method interactions and rates of meal required on farm would need further investigation if the use of rapeseed meals as biofumigants were to be commercialised.

ACKNOWLEDGEMENTS

The authors would like to thank EU for funding this work, all colleagues from partner Institutes/organisations involved in the Enhance project and all technical staff.

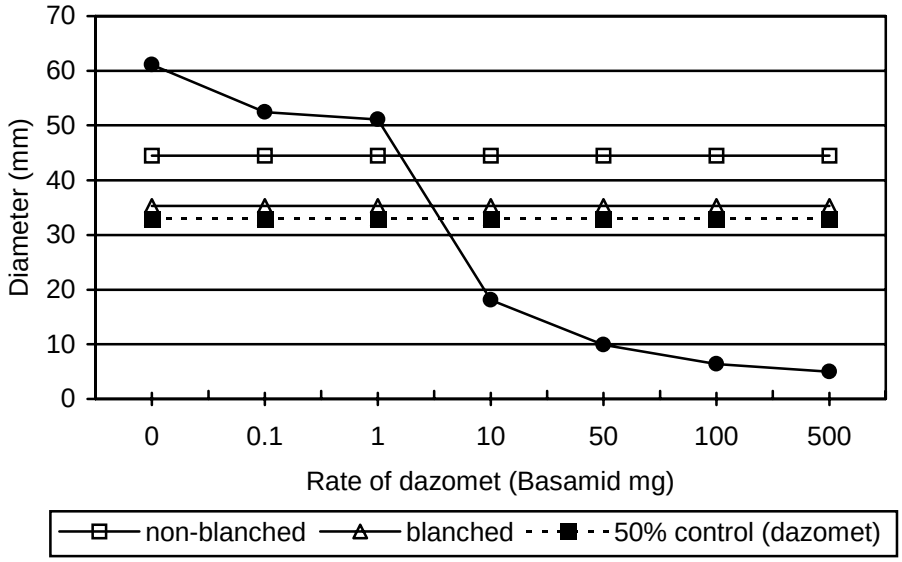

Fig. 1. Biocidal efficacy of rapeseed meal versus dazomet for control of *Rhizoctonia solani*

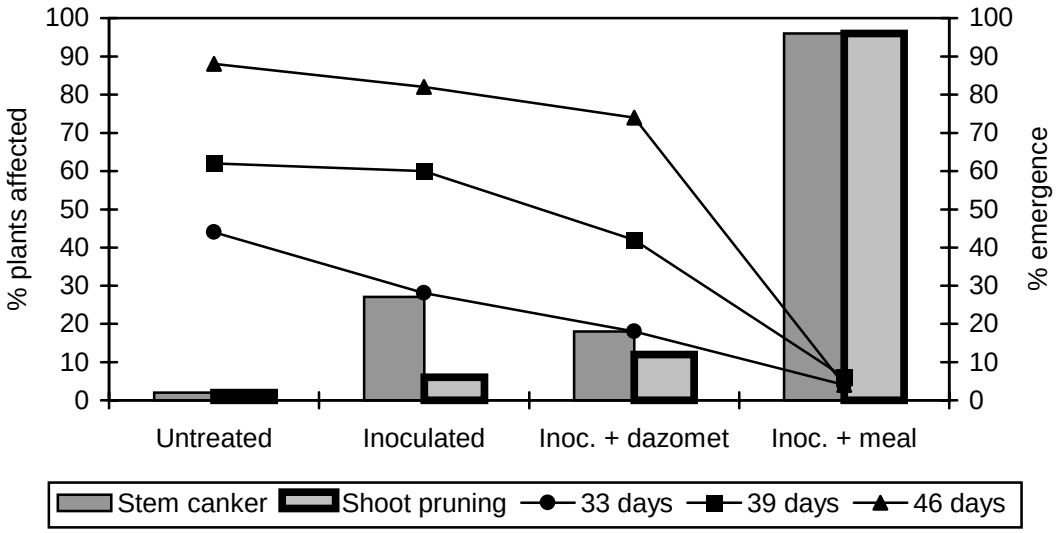

Fig. 2. Effect of rapeseed meal on emergence of potatoes and control of *Rhizoctonia solani*

REFERENCES

Bagger, C.L., S. Buskov, J.B. Hasselstrøm, E. Rosa, H. Sørensen and J.C Sørensen, 1999: Bioactives from cruciferous crops especially glucosinolate derived products produced in pilot plant scale and used as biocides supplementary to synthetic pesticides. Proc. 10th Int. Rapeseed Congr., Canberra, Australia. CD rom

Bourgin, B., P. Burghart, L. Droguet, J. Evrard and M-P. Le Guen, 1999: Effects of crushing conditions on meal quality. Proc. 10th Int. Rapeseed Congr., Canberra, Australia. CD rom

Burghart, P and J. Evrard 1999: CETIOM's oil mill pilot plant. Proc. 10th Int. Rapeseed Congr., Canberra, Australia. CD rom

Kirkegaard, J.A., P.T.W. Wong,. J.M. Desmarchelier. 1996: In vitro suppression of fungal root pathogens of cereals by brassica tissues. Plant Pathology 45, 593 – 603

Kyritsis, P. and S.J. Wale, 2002: Effect of soil temperature and moisture, inoculum level and depth of planting on the development of *Rhizoctonia solani* on micropropogated potato seed tubers. Proc. Crop Protection in Northern Britain 2002, pp 305 -310