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**Research Project Report for the Ohio Vegetable
and Small Fruit Research and Development Program**

Project Title

Management of *Rhizoctonia hypocotyl* rot and clubroot in radishes

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Objectives of the Research

The objective of this research project was to evaluate the efficacy of biopesticides and fungicides against *Rhizoctonia solani* and *Plasmodiophora brassicae*, both of which have been difficult to control in radishes grown on muck soils in Ohio.

Experimental Design and Methods

The experiment was conducted at Buurma Farms, Celeryville, OH. Fertilizer (N-P-K-S 8.4-0-36-9.6, 250 lb/A) was broadcast and incorporated into the field on 23 Apr. The field was disked, leveled, and raise beds were prepared on 23 May. Radish cv. 'Cabernet' was direct seeded on 1 Jun. The herbicide Dual II Magnum was applied at 1.5 pt/A on 24 May. Treatments were arranged in a randomized complete block design with four replications. Each plot consisted of three, 20 ft rows seeded at a rate of 10 seeds/ft. The field was overhead irrigated with 1.25 in. water on 16 Jun. Muscodor was applied at the rate of 7.4 and 3.5 oz/ft³ soil 7 and 5 days before planting by using a broadcast spreader and a Land Pride RTA 2064 rototiller to incorporate the product to a 4 in. depth in the plots. Irrigation was applied as necessary to maintain moisture in the Muscodor-treated plots prior to planting. Treatments applied as in-furrow and foliar sprays were applied in 24.75 gal water/A at 15 psi by using a Stan-Hay vacuum seeder/sprayer containing three Tee Jet 8002VS nozzles spaced 18 in. apart with a spray band of 7 in. on 1 and 20 Jun, respectively. Radishes were harvested from a 10 ft section of the center row for each treatment on 29 Jun and numbers of marketable radishes, radishes with *Rhizoctonia* root rot symptoms, radishes with clubroot, healthy culls and damaged culls were recorded. Average maximum temperatures for 24-31 May and 1-29 Jun were 71.9 and 86.5 °F; minimum averages were 45.13 and 58.1 °F and rainfall was 0.33 and 1.52 in., respectively. Data were analyzed by ANOVA using SAS statistical software. Means were separated using Fisher's protected least significant difference test.

Results

All treatments resulted in significantly higher total yield than the untreated control, from which no seedlings emerged. Plots treated with the low rate of Muscodor either 5 or 7 days prior to planting had the highest total yield, both significantly higher than the standard treatment (Thiram seed treatment). Ranman 400SC applied in furrow also resulted in higher total yield than the standard treatment. None of the other treatments significantly increased total yield compared to the standard. Marketable yield was generally low due to a high number of off-size culls, but was highest for plots treated with the low rate of Muscodor, the low rate of Serenade ASO, Ranman 400S and the standard Thiram. Rhizoctonia root and hypocotyl rot incidence was highest in plots treated with Muscodor 7 days prior to planting. No treatments resulted in significantly less Rhizoctonia root and hypocotyl rot than the standard Thiram seed treatment.

Treatment, rate and application time	Total yield (no./plot)	Marketable yield (no./plot)	Total healthy (no./plot)	Total culls (no./plot)	% Rhizoctonia
Maxim 0.16 fl oz/100 lb of seed + Amistar 80WG 0.068 fl oz/1000 ft row in-furrow at planting followed by Amistar 80WG 0.068 fl oz/1000 ft row (foliar)	21.8 de	2.8 cd	10.8 d	16.3 fg	1.1 cd
Maxim 4FS 0.16 fl oz/100 lb of seed + Amistar 80WG 0.135 fl oz/1000 ft row in-furrow at planting.....	20.5 e	3.5 bcd	12.0 cd	16.8 efg	1.8 d
Maxim 4FS 0.16 fl oz/100 lb seed + Amistar 80WG 0.135 fl oz/1000 ft row (foliar)	31.3 cde	1.3 d	22.0 bcd	29.0 a-f	2.8 d
Maxim 4FS seed treatment 0.16 fl oz/100 lb seed Moncut 70-DF 0.61 oz/1000 foot row in-furrow at planting.....	40.0 bcd	4.5 bcd	22.0 bcd	34.0 abc	3.8 d
in-furrow at planting.....	30.3 cde	1.8 cd	13.5 cd	25.8 b-g	9.0 cd
Muscodor 3.5 oz/ft ³ soil 5 days before planting	58.5 ab	9.5 ab	35.3 ab	41.3 a	12.3 cd
Muscodor 3.5 oz/ft ³ soil 7 days before planting	72.3 a*	15.0 a**	37.3 a	37.3 ab	29.5 b
Muscodor 7.4 oz/ft ³ soil 5 days before planting	27.3 cde	0.8 d	18.0 cd	22.0 c-g	15.5 c
Muscodor 7.4 oz/ft ³ soil 7 days before planting	39.8 bcd	2.5 cd	12.5 cd	17.3 efg	42.5 a
Ranman 400SC 6 fl oz/A in furrow at planting.....	41.8 bc	7.8 a-d	19.8 cd	29.8 a-e	11.0 cd
Serenade ASO 0.05% in-furrow at planting	32.8 cde	10.5 abc	24.8 abc	21.8 c-g	1.5 d
Serenade ASO 1.0 % in-furrow at planting	36.8 cde	3.0 bcd	23.3 bcd	31.8 a-d	4.8 cd
Serenade ASO 2.0 % in-furrow at planting	21.5 de	2.0 cd	13.5 cd	18.8 d-g	4.5 d
Thiram 50WP 8 fl oz/100 lb seed	22.0 de	5.0 a-d	12.8 cd	15.5 g	6.0 cd
Untreated control (raw seed).....	0.0 f	0.0 e	0.0 e	0.0 h	-
P value	0.0001	0.0365	0.0034	0.0019	0.0001

*Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at $P \leq 0.05$.

**Marketable yield data were log transformed prior to analysis; non-transformed means are reported.

Conclusions

The biofumigant Muscodor was effective in reducing pre-emergence damping-off of radishes, resulting in higher yields than in the untreated control. However, Rhizoctonia root and hypocotyl rot was higher in Muscodor-treated plots, possibly as a result of Rhizoctonia inoculum increasing after Muscodor was exhausted. The combination of Muscodor soil treatment with Thiram or Maxim seed treatment and follow-up treatments with Serenade ASO, Ranman and/or Amistar may protect radish from Rhizoctonia rot. Clubroot did not appear in this experiment.