Development of *Rhizoctonia solani* on four fungicide-treated potato cultivars grown in virgin potato soil

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None of the fungicides consistently reduced the Rhizoctonia index (R.I.) or altered the number of stems produced over the growing season. Regardless of seed source, cultivar or fungicide treatment of the mother tubers, the number of stems per mother tuber decreased from late June to early August. The R.I. remained relatively constant over the growing season. The incidence of sclerotial infection on harvested tubers generally was reduced by fungicide treatment of the mother tubers. The incidence of sclerotial infection appeared to decrease during the storage period on daughter tubers from untreated mother tubers but not on daughter tubers from fungicide-treated mother tubers.

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Aucun des fongicides utilisés n'a réduit de façon constante l'indice d'infection par ***Rhizoctonia*** ni modifié le nombre de tiges produites pendant la saison de croissance. Sans égard a la source de semences, au cultivar ou au traitement fongicide des tubercules-mères, le nombre de tiges par tubercule-mère a fléchi de la fin de juin au début d'août. L'indice d'infection par ***Rhizoctonia*** est demeuré relativement constant pendant la saison de croissance. Le traitement fongicide des tubercules-mères a entrain6 en général une diminution de la fréquence de l'infection par les sclérotes chez les tubercules récoltés. La fréquence d'infection par les sclérotes a semblé diminuer pendant l'entreposage chez les tubercules-filles issus de tubercules-mères non traités mais non chez les tubercules-filles provenant de tubercules-mères traités avec le fongicide.

Introduction

Numerous studies exist on the effect of Rhizoctonia *solani* Kühn on potato production (1-7, 9-12, 14, 15). Much of the research covers the effect of fungicide treatment of mother tubers on: emergence, stem canker, stolon canker, tuber size, yield, and sclerotia on tubers. The data generally have been collected once only and do not reflect changes occurring during the growing season.

The data presented in this report are from a test conducted in 1982 in which fungicide-treated tubers with sclerotia of R. *solani* were planted in soil, at the Morden Research Station, in which potatoes apparently had never been grown. Information on several canker severity categories were gathered on stems and stolons twice before harvest; sclerotial incidence on tubers in storage was monitored over time.

Materials and methods

Tubers of cultivars Norchip, Norland, Russet Burbank and Pontiac were obtained from two producers whose commercial fields were surveyed in 1982 for Rhizoctonia development (16). Some of the tubers had already been treated by the producers with one of the following fungicides: captan (Orthocide), thiophanate-methyl (Easout), mancozeb (Dithane M-45), or metiram (Polyram 7). Untreated tubers of the above cultivars were obtained from the same producers and treated with either benomyl (Benlate) or thiabendazole (Mertect), or included as the untreated control treatment. Each treatment, a single row approximately 10 m in length, was replicated four times. Data, collected June 28 and August 10, 1982, included the number of healthy stems and stolons, and stems and stolons cankered, girdled or pruned. A Rhizoctonia Index (R.I.) was calculated (Table 1) using the formula (4):

$$\text{R.I.} = \frac{\Sigma(\text{Class}^2 \times \text{number of stems or stolons per infection class})}{\text{Total number of stems or stolons}}$$

The tubers were harvested September 9, graded and placed into storage at 4-10°C. On October 15, 1982, February 1, 1983 and April 26, 1983, 20 tubers from the 5.7 - 8.9 cm (2.5 - 3.5 in.) size category were selected from each treatment and assessed for presence of sclerotia (Table 2).

Results and discussion

Stems. Regardless of producer, cultivar or mother tuber treatment, the number of stems per mother tuber decreased from late June to early August. In general, fungicide treatment June 28 seemed to cause an increase in the number of stems. By August 10, the beneficial effect of fungicides on stem production was apparent for both mancozeb and captan in Norchip and for metiram in Norland; however, a rather large drop in stem production occurred with captan in Norland and Russet Burbank. Hide and Cayley (8) found that between July and September the number of stems per plant decreased on plants from seed treated with 2% thiabendazole; as was apparent in this study.

Fungicide x cultivar interactions appeared to occur. In Norland, both June 28 and August 10, stem production from thiabendazole-treated mother tubers was similar or better than from the untreated controls, while, in Russet Burbank it was reduced considerably both dates. Captan increased stem production both dates in Norchip, reduced it both dates in Russet Burbank and in Norland increased it in June and decreased it in August. There appeared to be no correlation between stem number and Rhizoctonia Index. In many instances as the stem number dropped between assessments the Rhizoctonia Index also dropped.

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Table 1. Stem and stolon production, and Rhizoctonia Index on four cultivars planted in virgin soil with fungicide-treated tubers'.

Cultivar	Seed Source	Mother Tuber Treatment	No. Stems/ Mother Tuber June	No. Stems/ Mother Tuber August	No. Stolons/ Mother Tuber August	Rhizoctonia[2] Index Stems June	Rhizoctonia[2] Index Stems August	Rhizoctonia[2] Index Stolons August
Norchip	A	Untreated	6.1	3.2	15.6	4.0	3.2	3.5
		Mancozeb	7.3	4.4	28.4	2.2	4.5	2.9
	B	Untreated	5.8	3.3	27.5	2.1	1.9	1.8
		Captan	6.2	4.2	31.2	2.4	2.2	2.6
Norland	A	Untreated	4.6	3.7	15.7	3.8	3.2	2.9
		Thiabendazole	5.5	3.7	26.8	3.9	3.5	2.8
		Metiram	6.6	4.3	30.4	3.2	2.3	2.5
		Captan	6.1	2.4	18.0	2.7	2.8	1.9
		Benomyl	5.5	4.1	24.3	3.6	4.9	2.7
	B	Untreated	5.9	3.7	22.5	2.4	3.2	2.9
Russet Burbank	A	Untreated	6.0	4.3	27.6	4.2	4.2	2.9
		Thiabendazole	3.6	1.9	11.3	4.8	3.1	2.9
		Captan	4.5	2.6	18.7	2.5	2.7	1.8
		Benomyl	5.7	3.0	20.1	4.4	2.3	1.9
Pontiac	B	Untreated	5.4	3.6	27.7	2.8	2.7	2.3
		Thiophanate -methyl	5.7	2.6	14.8	3.3	2.7	1.6

[1] The data are the means of 40 plants

[2] Rhizoctonia Index = $\frac{\Sigma \text{ (Class}^2 \text{ x number of stems or stolons per infection class)}}{\text{Total number of stems or stolons}}$

[3] Sampling dates - June 28 and August 10, 1982

Stolons. Fungicide treatment of mother tubers decreased the number of stolons produced by Russet Burbank and Pontiac. Captan enhanced stolon production only slightly in Norland compared to thiabendazole, metiram and benomyl.

A cultivar × fungicide interaction appeared to occur. Benomyl and thiabendazole enhanced stolon production in Norland, but suppressed it in Russet Burbank; captan enhanced it only slightly in Norland and also suppressed it in Russet Burbank. As with the stems there was no definite correlation between the Rhizoctonia Index and the number of stolons produced. Stolon production also appeared to be affected by the tuber source. Stolon production from untreated mother tubers in Norchip and Norland was higher for Producer B in both instances. A factor, such as seed size, may have caused such an effect.

Post harvest development of sclerotia on tubers. Observation of the harvested daughter tubers on October 15, 1982, showed that sclerotial incidence generally was reduced by fungicide treatment of the mother tubers before planting, in cultivars Norchip, Russet Burbank and Pontiac. Sclerotial incidence in Norchip was reduced 35% by mancozeb and 25% by captan; in Russet Burbank it was reduced 20% by captan and 30% by benomyl; in Pontiac sclerotial incidence was reduced 30% over the untreated controls by thiophanate-methyl. In the cultivar Norland none of the fungicides reduced sclerotial incidence except thiabendazole.

In some instances a cultivar × fungicide interaction appeared to occur. Thiabendazole reduced sclerotial incidence 40% in Norland, but in Russet Burbank sclerotial incidence was 40% greater than for the untreated control. With benomyl there was no reduction in sclerotial incidence in Norland but in Russet Burbank it was reduced 30%. Captan reduced sclerotial incidence in all cultivars treated, but little reduction occurred in Norland. The variability of the results may have been due in part to fungicide application to the mother tubers; the treated tubers were obtained from three separate sources. Sclerotial incidence on the mother tubers planted ranged from 73 - 93%, but coverage was light.

Table 2. Incidence and change of sclerotial infection on harvested tubers.

Seed Source	Cultivar	Seed Tuber Treatment	%Tuberswith Sclerotia[1,2] Oct. 15, 1982	Feb. 1, 1983	April 26, 1983
A	Norchip	Untreated	60	40	35
		Mancozeb	25	25	35
B		Untreated	65	55	40
		Captan	40	60	40
A	Norland	Untreated	70	30	20
		Thiabendazole	30	25	25
		Metiram	70	60	60
		Captan	60	50	55
		Benomyl	75	80	70
B		Untreated	75	60	45
A	Russet Burbank	Untreated	45	50	55
		Thiabendazole	85	80	80
		Captan	25	40	30
		Benomyl	15	20	10
B	Pontiac	Untreated	90	80	65
		Thiophanate-methyl	60	65	40

1 Twenty tubers were assessed per treatment per date.
2 Tubers were stored in a potato storage at 4 - 10°C at the Morden Research Station.

A surprising effect on the incidence of tubers with sclerotia appeared to occur in storage. Sclerotial incidence on daughter tubers from 'untreated' mother tubers decreased over time for all cultivars except Russet Burbank. The sclerotial incidence on tubers from fungicide-treated mother tubers tended to remain relatively constant over the storage period. Again a cultivar x fungicide interaction appeared to occur. In Norland sclerotial incidence was low for thiabendazole relative to the other treatments while in Russet Burbank it was high for thiabendazole and low for captan and benomyl.

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