A SYSTEMIC FUNGICIDE (FUNGICIDE 1991) FOR THE CONTROL OF GRAY MOLD AND POWDERY MILDEW IN STRAWBERRIES AND RASBERRIES

Jack A. Freeman[1] and H.S. Pepin[2]

Abstract

Fungicide 1991 (Du Pont), a systemic fungicide, showed considerable potential for the control of gray mold caused by Botrytis cinerea, and powdery mildew caused by Sphaerotheca macularis in strawberries and raspberries. Berry infection by both fungi was practically eliminated in 'Stelemaster' strawberries when the fungicide was applied at 0.25 lb active ingredient/acre. Fungicide 1991 was equally as effective as dinocap and slightly better than sulfur for the control of powdery mildew on the leaves of 'Northwest' strawberries. Repeated applications of Fungicide 1991 at intervals of about 14 days were required to control powdery mildew when the disease was active. Fungicide 1991 proved as effective as captan, dichlofluanid and DAC 2787 for preharvest fruit rot control in 'Willamette' raspberries, and was more effective for postharvest rot control. Dichlofluanid reduced berry size, but captan, DAC 2787, and Fungicide 1991 tended to increase the size.

Introduction

Gray mold caused by Botrytis cinerea Pers. ex Fr. often causes rotting of strawberry and raspberry fruit in coastal British Columbia.

Powdery mildew caused by Sphaerotheca macularis (Wallr. ex Fr.) P. Magn. is also a problem on these crops. This disease is particularly serious during periods of warm day temperatures with heavy dews at night, a common weather condition in the coastal area. Although no precise data on the extent of yield reduction from this disease are available, severely infected strawberry plants are much reduced in vigor, and young canes of raspberries are stunted, somewhat distorted, and spindly. Fruit of both crops may also be infected and, in severe instances, they are covered with a white powdery film. The 'Northwest' strawberry and the 'Willamette' raspberry, the main varieties grown in the coastal area, are susceptible to this disease.

On the basis of earlier research conducted at the Small Fruits Substation, Abbotsford, British Columbia, captan was recommended for the control of gray mold in strawberries and raspberries (1, 2, 3). Even though a captan spray schedule results in a marked increase of sound fruit, there are still many rotted berries in the field. It has been suggested that the incomplete control of botrytis rot with a fungicide such as captan is due to poor coverage or incomplete dispersion of the spray. Therefore, it is probably that with a systemic fungicide this problem could be solved. Captan does not control powdery mildew. Thus, a systemic fungicide that would control both gray mold and powdery mildew would be particularly advantageous.

Experiments were conducted in 1967 with strawberries and raspberries to obtain information on the effectiveness of the systemic Fungicide 1991 (1-(butylcarbamoyl)-2-benzimidazole carbamic acid, methyl ester) for the control of gray mold and powdery mildew.

Methods

Gray mold and powdery mildew on strawberries

Vancouver trial— A field test with 'Stelemaster' strawberries was conducted at the Vancouver Research Station to evaluate the efficacy of Fungicide 1991 for control of gray mold and powdery mildew. The experiment was laid out in a randomized block design with four replicates. A plot consisted of a single 10-ft row with plants grown by the matted row system. Fungicide 1991 at 0.25 lb active ingredient/acre and calcium polysulfide at 0.75 lb active ingredient/acre were applied May 23, June 2, June 13, June 23, and July 4. The amount of berry infection was determined by counting the number of berries with powdery mildew, with botrytis and other rots, and with no infection. These figures were converted to a percentage of the total number of berries.

Abbotsford trial — Fungicide 1991 was compared with dinocap (Karathane) and sulfur (Magnetic 6) for the control of powdery mildew in a field test at the Small Fruits Substation, Abbotsford, A 2-year-old planting of 'Northwest' strawberries was used in this trial. The experiment was laid out in a

[1] Plant Physiologist, Research Station, Canada Department of Agriculture, Agassia, British Columbia.

[2] Plant Pathologist, Research Station, Canada Department of Agriculture, Vancouver, British Columbia.

randomized block design. Each plot consisted of a single 30-foot row. The test originally consisted of six replications with the following treatments. Fungicide 1991, 0.25 lb active ingredient/acre, was applied in three different regimes: spraying only once during the season, on July 21; spraying three times at approximately 14-day intervals, on July 21, August 3, and 18; and spraying five times, also at approximately 14-day intervals, on July 21, August 3 and 18, September 1 and 15. This plan allowed for a study of the residual nature of the fungicide. Dinocap, 0.75 lb active ingredient/acre, and sulfur, 3.6 lb active ingredient/acre, were applied three and five times only. All sprays were applied in 180 gal of water/acre.

A random sample of 20 leaves was collected from each plot in each replicate on September 1 and 20 and October 5 to determine the percentage of mildew infection. The total area of mildew infection on each leaf was determined as a percentage and was averaged for each replicate. Percentages were transformed for statistical analysis.

Gray mold on raspberries

Fungicide 1991 was tested at the Small Fruits Substation, Abbotsford, on a first-year crop of 'Willamette' raspberries. The experiment was laid out in a randomized block design with three replicates. Each plot consisted of a single 25-ft row. The plots were grown by the matted row system. Three sprays of each of the fungicides captan, 1.5 lb active ingredient/acre; DAC 2787 (tetrachlorisophthalonitrile), 1.5 lb active ingredient/acre; dichlofluanid (N-(dichlorofluoromethylthio)-N',N'-dimethyl-N-phenylsulfamide), 1.0 lb active ingredient/acre; and Fungicide 1991, 0.25 lb active ingredient/acre were applied, The first sprays were applied June 5, when many of the plants were in full bloom. The follow-up sprays were applied on June 14 and 22. Sprinkler irrigation was used.

Control of preharvest infection was determined by weighing all infected berries from each plot at each picking. The crop was picked six times between July 5 and July 29. In addition to the weights of infected fruit, the weights of marketable and cull fruit were also recorded. The size index of sound berries from each plot was determined at each picking. The effect of treatment on postharvest fruit rot was determined from a random sample of at least 2 lb of sound berries picked on July 6, 11, 18, and 25 from each plot in each replicate. The berry samples were placed in common storage at Agassiz. The percentage of sound berries was recorded 24 and 48 hr after harvest.

Results and discussion

From the results of the Vancouver test, Fungicide 1991 showed considerable potential for control of gray mold and powdery mildew in strawberries (Table 1)

By September 1, at Abbotsford, three sprays of Fungicide 1991 or of dinocap proved equally effective in controlling powdery mildew on strawberry foliage (Table 2). The sulfur sprays were not as effective as either Fungicide 1991 or dinocap. Plants that were sprayed only once, on July 21, with Fungicide 1991 showed a very slight reduction in powdery mildew symptoms by September 1, which indicated that this fungicide does not persist in or on the plant for any appreciable length of time. From the September 20 readings, it is apparent that, in order to control powdery mildew when weather conditions are conducive to the development of

Table 1. Influence of Fungicide 1991 and calcium polysulfide on gray mold and powdery mildew infection of fruit of 'Stelemaster' strawberries

Fungicide	Rate (lb active ingredient/acre*)	Berry infection (%)		Sound fruit (%)
		Gray mold**	Powdery mildew	
Unsprayed	0.25	42.9	14.8	42.2
Fungicide 1991	0.25	6.6	0	93.4
Calcium polysulfide	0.75	45.3	6.1	48.5

* Sprays were applied in 100 gal water/acre on May 23, June 2, June 13, June 23, and July 4.

** Includes some damage from rhizoctonia rot, leather rot, and sun scald.

this disease, any one of the three fungicides must be applied at about 14-day intervals. Fungicide 1991 and sulfur showed no phytotoxicity but dinocap caused some leaf curl and burn. There was no increase in powdery mildew on the leaves after September 20. The weather by this time had become cool and wet, and the disease was no longer active.

Fungicide 1991 proved as effective as the other fungicides for preharvest control of fruit rot in raspberries (Table 3). Even though the incidence of rot in the field was relatively low (about 7%), considerable postharvest rot developed (50%). A relatively high postharvest rot was also reported in raspberries in 1965 (2), when the incidence of fruit rot in the field was 1% or less. In the present test, Fungicide 1991 tended to be more effective than the control of postharvest rot. In a previous test (3) with strawberries, fruit size was affected by treatment with dichlofluanid, which caused a significant

Table 2. Influence of Fungicide 1991, dinocap, and sulfur on control of powdery mildew on 'Northwest' strawberries

Fungicide	Rate (lb active ingredient/ acre)	Number of applications**	Powdery mildew rating* on: Sept. 1	Sept. 20	Oct. 5
Unsprayed			54.1 a***	72.5 a	61.3 a
Fungicide 1991	0.25	1	42.1 b	71.7 a	54.1 ab
Fungicide 1991	0.25	3	15.5 d	53.7 b	50.0 abc
Fungicide 1991	0.25	5		25.7 c	38.6 bcd
Sulfur	3.6	3	27.7 c	58.9 ab	59.9 a
Sulfur	3.6	5		29.9 c	35.9 cd
Dinocap	0.75	3	17.9 d	51.6 b	53.8 ab
Dinocap	0.75	5		34.3 c	28.0 d
Mean			31.5	49.8	47.7
S.E. Mean			2.02	5.09	4.86

* Arcsine transformation of mean percentages of leaf surface affected.

** Sprays applied: 1-July 21;
3-July 21, August 3, August 18;
5-July 21, August 3, August 18, September 1, September 15.

*** Means not followed by the same letter are significantly different at the 5% level (Duncan's Multiple Range Test).

Table 3. Influence of fungicides on preharvest and postharvest fruit rot and berry size of 'Willamette' raspberries

Fungicide	Rate (lb active ingredient/ acre*)	Rotted fruit (lb/plot)	Sound fruit (lb/plot)	Increase over unsprayed (%)	Size index (g/25 fruit)	Sound fruit (%)*** after picking: 24 hr	48 hr
Unsprayed		4.3 a**	54.6 a	0	80.7 bc	70	51
Captan	1.5	3.1 a	63.2 a	15.7	83.3 ab	84	73
DAC 2787	1.5	3.1 a	58.5 a	7.2	85.0 a	87	74
Dichlofluanid	1.0	2.9 a	66.4 a	21.7	78.7 c	91	83
Fungicide 1991	0.25	1.0 b	60.4 a	10.6	84.3 a	97	87
Mean		2.9	60.6		82.4		
S.E. Mean		0.59	3.15		1.03		

* Sprays were applied in 180 gal water/acre on June 5, June 14, June 22.

** Means not followed by the same letter are significantly different at the 5% level (Duncan's Multiple Range Test).

*** Mean of four harvests.

reduction in fruit size. In the present test with raspberries, dichlofluanid also reduced berry size, whereas captan, DAC 2787, and Fungicide 1991 all tended to increase size.

literature cited

1. Freeman, J. A. 1964. The control of strawberry fruit rot in coastal British Columbia. Can. Plant Dis. Surv. 44: 96-104.

2. Freeman, J.A. 1965. Effect of fungicide field sprays on postharvest fruit rot of raspberries. Can. Plant Dis. Surv. 45: 107-110.

3. Freeman, J.A. 1966. A comparison of dichlorofluanid, dichloran and DAC 2787 with captan for fruit rot control in strawberries. Can. Plant Dis. Surv. 46: 126-128.