FUNGICIDES FOR CERCOSPORA LEAF SPOT DISEASE OF WATERCRESS

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Leaf spot disease of watercress, caused by *Cercospora nasturtii* is a serious foliar disease of watercress. The disease spreads quickly under rainy windy conditions. The fungus thrives under the dense canopy of watercress. Under right weather conditions the disease can render the crop unmarketable within a couple of days.

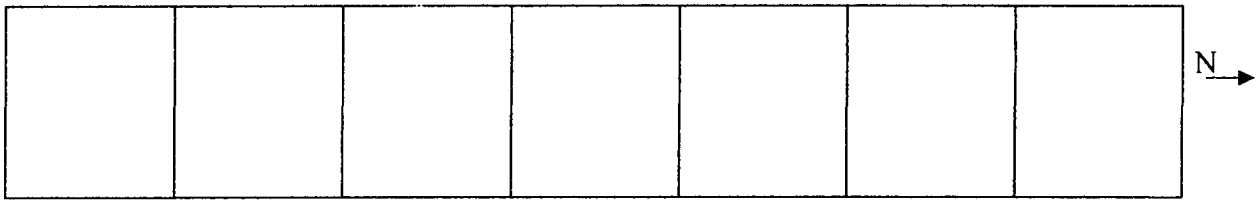
Currently Quadris (Azoxystrobin) is used to control the disease. Applications of Quadris are followed by Switch close to the harvest time. There is some concern that over time the fungi may develop resistance to Azoxystrobin. Consequently an experiment was conducted to evaluate Fenbuconazole (Indar, Dow Agro Sciences, EPA Reg. No. 62719-421) and Tebuconazole (Folicur, Bayer Crop Science, EPA Reg. No. 264-752) for leaf spot disease control in watercress.

Material and Methods

Crop: Watercress, B&W selection #1.
Fungicides and application rates:

1. Folicur (Tebuconazole), Bayer Crop Science, EPA Reg. No. 264-752. @7.2 fl.oz/acre
2. Indar (Fenbuconazole), Dow Agro Sciences, EPA Reg. No. 62719-421. @2 oz./acre
3. Quadris (Azoxystrobin), Syngenta, EPA Reg. No. 100-1098. @9 fl.oz./acre
4. Switch (Cyprodinil & Fludioxonil), EPA Reg. No. 100-953. @11 oz./acre

The sprayer unit used to apply fungicides was a CO2 pressurizes sprayer. The spray volume was 40 gal. per acre at 40 psi. The field plot layout is given in figure below. The soil type in the experimental area was Oldsmar Fine Sand.



Bed # 1	Bed # 2	Bed # 3	Bed # 4	Bed # 5	Bed # 6	Bed # 7
0.019 acres	0.019 acre	0.019 acre	0.019 acre	0.018 acre	0.019 acre	0.022 acre

The irrigation water flow in the beds was from west (top) to east (drain end). The irrigation water was captured in a ditch at the east end (bottom) and re-circulated. The irrigation was stopped at each application of the treatments, night prior to the treatment and was resumed the following day.

Pre plant treatment of the beds included, application of Roundup herbicide to the existing weeds, cultivation and leveling the beds. All beds were planted on January 9, 2006. The crops were fertilized with a liquid formulation containing NPK by injecting the mix in the irrigation water. Three experiments were conducted in this study. Each experiment is discussed below.

Experiment 1

The treatments were as follows-
Indar was applied to beds 1, 2, and 3.
Folicur was applied to beds 4, 5, and 6.
Quadris was applied to bed 7.
The first treatment was applied fifteen days after planting on January 24, 2006.
The second treatment was applied seven days after the first application on January 31, 2006.
The crop was harvested on February 6, 2006. A single rain event was recorded on February 4.
The amount of rain fall was 4 inches. The results are given below.

Yields and general observations:
Table 1

Treatment	Yield, bunches/acre	Leaf spot count Spots per bunch	General observations
Folicur,7.2 fl.oz/acre	32,382	0.44	Foliage dark green and large. No crop thinning due to rain.
Indar, 2 oz./acre	19,228	1.56	Rain caused lodging and thinning of the crop occurred.
Quadris, 9 fl. oz./acre	20,091	[redacted]	Rain caused lodging and thinning of the crop occurred.

Experiment 2

Following harvest, the crop remains were trimmed and the second crop cycle was started. In this experiment the three treatments remained the same as in experiment 1. The first application was made on February 13 and the second on February 23, 2006. The crop was harvested on March 8, 2006. A single rain event occurred on February 26. The amount of rain fall was 0.9 inches. The results are shown below in Table 2.

Table 2

Treatment	Yield, bunches/acre	Leaf spot count Spots per bunch	General observations
Folicur, 7.2 fl.oz./acre	48,600	0.13	Darker green foliage and stocky plants. With dense canopy.
Indar, 2 oz. / acre	31,237	0.47	
Quadris, 9 fl.oz./acre	35,636	[redacted]	

Experiment 3

Following the second crop harvest the crop remains were trimmed and the third crop cycle started. Treatments in this experiment were changed. Each treatment consisted of two applications of fungicide to control the disease, as was in the two previous experiments. However, each of the two applications consisted of different fungicides. Treatments are given in Table 3.

Table 3

Treatment (bed #)	First application	Second application
1	Indar, 2 oz./acre	Quadris, 9 fl. oz./acre
2	Indar, 2 oz./acre	Folicur, 7.2 fl. oz./acre
3	Indar, 2 oz./acre	Switch, 11 oz./acre
4	Folicur, 7.2 fl. oz./acre	Quadris, 9 fl. oz./acre
5	Folicur, 7.2 fl. oz./acre	Indar, 2 oz./acre
6	Folicur, 7.2 fl. Oz./acre	Switch, 11 oz./acre
7	Quadris, 9 fl. oz./acre	Switch, 11 oz./acre

The first applications were made on March 17, 2006 and the second applications were made on March 28, 2006. The crop was harvested on April 13, 2006. The results are shown in table 4 below.

Table 4

Treatment (bed #)	First application	Second application	Yield, Bunches/acre	Leaf spot count, Spots/bunch
1	Indar, 2 oz./acre	Quadris, 9 fl. oz./acre	31,211	1.8
2	Indar, 2 oz./acre	Folicur, 7.2 fl. oz./acre	33,000	0.4
3	Indar, 2 oz./acre	Switch, 11 oz./acre	34,263	0.1
4	Folicur, 7.2 fl. oz./acre	Quadris, 9 fl. oz./acre	32,895	0.1
5	Folicur, 7.2 fl. oz./acre	Indar, 2 oz./acre	37,000	0.5
6	Folicur, 7.2 fl. Oz./acre	Switch, 11 oz./acre	37,500	0.0
7	Quadris, 9 fl. oz./acre	Switch, 11 oz./acre	32,455	[redacted]

When Quadris was the only fungicide used, the disease control was the poorest as compared to the other treatments (Tables 1, 2, 4). The number of leaf spots per bunch in the first crop was 2.44 and increased to 4.13 leaf spots per bunch. In the third crop when Quadris application was followed by an application of Switch, 10 days later the leaf spot declined to 2.7 spots per bunch. It should be pointed out that these levels are not excessive with respect to product quality. However, it seems to indicate that a resistance management program needs to be pursued before resistance may start to show.

The results of all three experiments have been summarized in Table 5. Folicur application appeared to be very effective in increasing yields as well as reducing the incidence of leaf spot.

The color of the foliage was also improved. A deep green color is indicative of better quality. It appears that one to two applications of Folicur per crop alternate with Quadris or Switch would be an effective measure to control the leaf spot disease thus improves crop health.

Treatment	Yield, bunches/acre	Leaf spots per bunch
Folicur @ 7.2 fl. oz./acre (two applications)	[illegible]	[illegible]
Indar @ 2 oz./acre (two applications)	25233 *	1.02 **
Quadris @ 9 fl. oz./acre (two applications)	27864 *	3.29 **
Indar @ 2 oz./acre & Quadris @ 9 fl. oz./acre	31,211	1.8
Indar @ 2 oz./acre & Folicur @ 7.2 fl. oz./acre	33,000	0.4
Indar @ 2 oz./acre & Switch @ 11 oz./acre	34,253	0.1
Folicur @ 7.2 fl. oz./acre & Quadris @ 9 fl. oz./acre	32,895	0.1
Folicur @ 7.2 fl. oz./acre & Indar @ 2 oz./ acre	37,000	0.6
Folicur @ 7.2 fl. oz./acre & Switch @ 11 oz./acre	37,500	0
Quadris @ 9 fl. oz./acre & Switch @ 11 oz./acre	32,455	2.7

*Yields are average of crop 1 and crop 2. Other yield data represents crop 3.
** Data represents averages of crop 1 and crop 2. Other leaf spot data are from crop 3.

The effects of four fungicides used in these experiments either alone or alternate with the others are summarized in Table 6. Data shows that Folicur was the most effective fungicide to control the Cercospora leaf spot disease in watercress. However, the applications should be limited to one or two (maximum) per crop.

Table 6. Effect of fungicide treatments on yields and Cercospora leaf spot in watercress.

Fungicide	**Yield, bunches/acre**	**Leaf spots per bunch**
Folicur	36,972	0.28
Indar	30,928	0.83
Quadris	24,140	1.98
Switch	34,739	0.93

Summary

In summary, Folicur fungicide needs to be pursued for registration for use on watercress. Indar appears to be the second best fungicide. The added advantage of higher yields and darker green foliage in plots treated with Folicur is very significant from the stand point of the watercress growers.

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