Summer Disease Management on *Poa annua*/Bentgrass Greens with New Fungicide Products

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Sponsors: BASF, Novartis, Rohm and Haas, Zeneca

Summary: In replicated field trials conducted on a poa/bentgrass putting green, fungicides were tested for efficacy and phytotoxicity against a variety of summer diseases. Key results include:

- An unseasonably cool summer produced unusual disease patterns, with *Rhizoctonia* causing the most significant damage to turf, and anthracnose causing only limited damage. Summer patch was observed, but caused insignificant damage to turf.

- Symptoms caused by *Rhizoctonia* spp. were well controlled by several of the products tested, including BAS 500, BAS 505, Heritage and Eagle. A rotation of Banner (2.0 oz/1000 sq ft) followed by monthly applications of Compass at the high rate (0.4 oz/1000 sq ft) also provided excellent control.

- It is possible that the high application volumes used in the study (3.5 gallons/1000 square feet), in combination with the fact that irrigation immediately followed fungicide applications may have interfered with the activity of Compass, whose mode of action is meso-stemic, rather than systemic.

- A rotation of Banner (3 bi-weekly applications in May/June) followed by high rates of Compass (2 monthly applications) performed significantly better against *Rhizoctonia* than season-long monthly applications of Compass at the same rate. It is likely that early season treatments with Banner helped to decrease the disease inoculum levels, allowing the Compass to perform better later in the season.

- Good control of *Rhizoctonia* lasted up to 6.5 weeks for BAS 500, BAS 505, Heritage and Eagle.

- Anthracnose, caused by *Colletotrichum graminicola* was well controlled by almost all of the treatments tested, with the exception of the low rate of BAS 505 (0.15 oz/1000 sq ft).

- No phytotoxicity was observed for the majority of products. However, BAS 505 produced moderate levels of phytotoxicity on most rating dates, with the higher rate (0.25 oz/1000 square feet) producing higher levels of damage than the lower rate (0.15 oz/1000 square feet). The observed damage was primarily to *Poa annua.* As a result, a gradual increase in bentgrass was observed in plots sprayed with BAS 505, particularly in the plots treated with the high rate. This type of gradual suppression of *Poa annua* may have commercial value to superintendents attempting to maintain pure bentgrass stands.

Materials and Methods:

Locations: Research plots were located on a putting green composed primarily of *Poa annua.* The location was selected on the basis of a history of summer patch infestations.

Experimental design and application: Plots measured 5 feet by 10 feet and treatments were replicated three times, in a randomized design as illustrated below.

Treatments were applied with a CO_2 backpack sprayer equipped with 8008 VS flat fan nozzles and delivering 3.46 gallons of water per 1000 square feet, with 28 psi at the boom. This application volume was achieved by making two passes through each replicate plot. Calibration of each nozzle was confirmed prior to application to be within 5% of the desired nozzle flow rate. Boom height was 17 inches above the ground. The spray swath was 5 feet. Speed was 3 mph. Spray bottles were agitated by shaking 20 times prior to charging with compressed CO_2. Spray lines were purged with CO_2 and then water prior to changing treatments. Application was followed by irrigation (approximately 1/10 inch of water)

Treatments: Treatment and application dates are listed below.

Evaluations: Plots were evaluated every two weeks for the following:

- Turf quality was determined on a visual basis using a 0 – 9 scale, where 0 = dead turf and 9 = best quality turf possible. Quality was a function of color, density and evenness.

- Percent damage due to disease was determined visually, and the identity of the disease organism was confirmed microscopically.

- Phytotoxicity

Data analysis: Data was subjected to analysis of variance, and treatment means were separated using Fisher's LSD, where $p<0.05$. Percent damage due to disease data was transformed prior to statistical analysis using the arcsine (square root of the proportion).

Results

Disease incidence:

Rhizoctonia was by far the most prevalent disease of the summer, with first symptoms noted in the non-treated check on June 3, and symptoms still in evidence on the last evaluation date of 8/17/99. Thus, *Rhizoctonia* first appeared approximately one month after this test was initiated, and continued for the next 10 weeks.

Anthracnose, caused by *Colletotrichum graminicola* was also identified from non-treated plots, but incidence was low and symptoms were present on only one sampling date – 7/15/99.

Summer patch, typically the most serious summer disease on poa greens, was detected via microscope on one date – 7/15/99 – but the symptoms caused were insignificant. Since this golf course typically suffers serious summer patch damage in areas that are not treated with fungicides, it is likely that the abnormally cool summer temperatures this year were primarily responsible for the lack of summer patch infestation. Examination of Figure 1 reveals that soil temperatures during the summer of 1999 were significantly cooler than for 1998 (as well as for previous years), a condition that we would expect to lead to decreased incidence of summer patch, as well as anthracnose.

Turf quality and phytotoxicity (Table 1, figures 2-4):

Turf quality ratings were affected by two major factors: phytotoxicity and disease incidence. In the case of phytotoxicity, significantly decreased turf quality was observed in plots treated with both rates of BAS 505 F (0.15 oz or 0.25 oz) beginning on 5/20/99 (two weeks after first treatment), and continuing until two weeks after the last fungicide application was made (7/15/99). The damage appeared to occur primarily to *Poa annua,* with no damage to bentgrass. The damage was also influenced by rate, with the higher rate causing increased levels of damage. By four weeks after the last fungicide application however, the turf had completely recovered in plots treated with the low rate of BAS 505, and had almost fully recovered in plots treated with the high rate of BAS 505. During this recovery period ((7/29 – 8/17), there appeared to be more bentgrass in the BAS 505-treated plots than in any of the other test plots. We have observed this phenomenon in previous field trials with the sterol inhibitor, tebuconazole, which was selectively injurious to poa. After an initial period of turf yellowing, caused by sterol inhibitor induced damage to poa, bentgrass density was able to increase, due to decreased competition with poa. It is likely that the same general interaction was occurring in the case of BAS 505. This property may have some commercial application for superintendents who wish to maintain pure bentgrass greens, and would be of particular value when poa infestations are light, making the observed phytotoxicity less dramatic.

Rhizoctonia control (Table 2, Figures 5-9):

Symptoms caused by *Rhizoctonia* spp. were well controlled throughout the trial by several of the products tested, including BAS 500, BAS 505, Heritage and Eagle. In addition, a rotation of Banner (3 bi-weekly applications at 2.0 oz/1000 sq ft), followed by two monthly applications of Compass at the high rate (0.4 oz/1000 sq ft) also provided excellent control of *Rhizoctonia.* A mixture of Compass plus Banner that was applied monthly also performed very well, but by the last rating date (8/17/99) which occurred 6.5 weeks after the last application, fungicidal activity had decreased, producing unacceptable results. It is likely that the residual activity of this combination was not sufficient to combat *Rhizoctonia* for more than three or four weeks. Residual activity of BAS 500, BAS 505, Heritage and Eagle resulted in excellent *Rhizoctonia* control, even 6.5 weeks after the last fungicide application. Residual activity of the Banner/Compass (0.4 oz/1000 sq ft) rotation was at least 4.5 weeks.

In contrast, a similar rotational plan that relied on Banner applications followed by Compass at a lower rate (0.25 oz/1000 sq ft) did not perform quite as well, particularly on the last rating date, 4.5 weeks after the last Compass application. This indicates that the higher Compass rate provided increased residual control.

Monthly applications of Compass (0.4 oz/1000 sq ft) made without pre-treatment with Banner provided only mediocre results. These results strongly suggest that under the conditions of this trial (see note on irrigation practices below), early–season treatment with Banner was critical for optimum performance, and that even a very high rate of Compass (0.4 oz/1000) was not sufficient for optimum control.

The best performing treatments in this trial all included at least one product with systemic activity. In contrast, the least disease control was observed for Compass when it was used by itself. It is possible that the high application volumes used in the study (3.5 gallons/1000 square feet), in combination with the fact that irrigation immediately followed fungicide applications may have washed the Compass off of the foliage, thus resulting in sub-optimal performance. The systemic nature of the other products tested in this trial made them less susceptible to interference by irrigation practices.

If the activity of Compass, particularly against foliar diseases such as *Rhizoctonia* is indeed negatively impacted by irrigation practices and/or high application volumes, then a warning to this effect should appear on product literature, especially in the arid Southwest, where frequent irrigations are typical.

Regarding the question of the efficacy of mixtures vs. rotations of Banner and Compass, the results of this trial, and of our 1998 trials, indicate that rotations may provide better efficacy. Another advantage of the rotation is that it that is based on early-season applications of Banner and thus avoids the potential for high temperature/sterol inhibitor interactions, which can produce phytotoxicity. In contrast, mixtures of Banner plus Compass occur season-long, making it probable that Banner is applied under high temperature (greater than 80°F air temperature) conditions.

Anthracnose control (Table 3):

Good to excellent control of anthracnose, caused by *Colletotrichum graminicola* was achieved by almost all of the products tested, with the exception of the low rate (0.15 oz/1000 sq ft) of BAS 505. The stress to the turf caused by BAS 505 (see section on phytotoxicity above) may have induced a more serious infestation of anthracnose, which is a well-known stress-related disease. The fact that the higher rate of BAS 505 was effective indicates that the lower rate did not contain enough active ingredient to combat the disease.

Plot Plan: Green 15, SCGA Member's Club.

8	11	4	5	3	7	1	10	2	6	9
5	9	1	10	2	11	8	6	4	7	3
1	2	3	4	5	6	7	8	9	10	11

Treatments and Application Dates

	Treatment	**Rate/1000 sq ft**	**Application timing**	**Application Dates**
1	BAS 500 F EC	0.35 oz	Bi-weekly	5/7, 5/20, 6/3, 6/18, 7/2
2	BAS 500 F EC	0.70 oz	Bi-weekly	5/7, 5/20, 6/3, 6/18, 7/2
3	BAS 505 F WG	0.15 oz	Bi-weekly	5/7, 5/20, 6/3, 6/18, 7/2
4	BAS 505 F WG	0.25 oz	Bi-weekly	5/7, 5/20, 6/3, 6/18, 7/2
5	Heritage	0.4 oz	monthly	5/7, 6/3, 7/2
6	Compass plus Banner	0.25 oz + 2.0 oz	monthly	5/7, 6/3, 7/2
7	Banner/Compass rotation	2.0 oz/0.25 oz	Bi-weekly (Banner apps 1-3; Compass apps 4-6)	5/7, 5/20, 6/3, 6/18, 7/2, 7/15
8	Compass	0.4 oz	monthly	5/7, 6/3, 7/2
9	Banner Compass rotation	2.0 oz/0.4 oz	Three bi-weekly Banner apps, followed by 2 monthly Compass apps	5/7, 5/20, 6/3, 6/18, 7/15
10	Eagle WSP	1.2 oz	monthly	5/7, 6/3, 7/2
11	Non-treated check			

Table 1. Turf quality ratings, SCGA Member's Club, Murietta, CA. Values within the same column that are followed by the same letter are not significantly different (P<0.05). Quality was rated on a 0 – 9 scale, with 0 = worst possible turf and 9 = best possible turf. On each rating date, treatments performing better than the check are noted in green shaded boxes, while treatments performing worse than the check are noted in red shaded boxes. An asterisk (*) indicates that phytotoxicity (5-20%) was observed on that date for that treatment. Fungicide treatments were discontinued on 7/2/99 for all but treatments 7 and 9. For treatments 7 and 9, fungicide applications were discontinued on 7/15/99.

	Treatment	**Rate/1000 sq ft**	**Quality 7/2/99**	**Quality 7/15/99**	**Quality 7/29/99**	**Quality 8/17/99**
1	BAS 500 F EC	0.35 oz	7.3ab	7.2ab	7.3a	6.7abcde
2	BAS 500 F EC	0.70 oz	7.5a	7.2ab	7.7a	7.3ab
3	BAS 505 F WG	0.15 oz	6.3c*	5.5c*	7.7a	7.5a
4	BAS 505 F WG	0.25 oz	5.5d*	4.8c*	7.2a	6.5bcde
5	Heritage	0.4 oz	7.3ab	7.2ab	7.2a	7.0abcd
6	Compass plus Banner	0.25 oz + 2.0 oz	7.2ab	7.0ab	7.7a	6.3cde
7	Banner/Compass rotation	2.0 oz/0.25 oz	7.2ab	7.3a	7.8a	6.5bcde
8	Compass	0.4 oz	7.2ab	6.5b	7.2a	6.2de
9	Banner Compass rotation	2.0 oz/0.4 oz	6.8bc	7.0ab	7.8a	7.3ab
10	Eagle WSP	1.2 oz	7.3ab	7.0ab	7.8a	7.2abc
11	Non-treated check		6.3c	6.5b	6.5b	6.0e

NOTE: In addition to the incidence of phytotoxicity noted by asterisks above, moderate phytotoxicity was observed for treatments 3 and 4 on 5/20 and 6/3, and was observed for treatment 4 only on 6/18/99.

Table 2. Percent damage due to *Rhizoctonia*. Values within the same column that are followed by the same letter are not significantly different (P<0.05). For analysis of variance, percent disease damage data was transformed to the arcsine (square root of the proportion). Values shown in the table are non-transformed. On each rating date, the best performing treatments are indicated in green shaded boxes. Fungicide treatments were discontinued on 7/2/99 for all but treatments 7 and 9. For treatments 7 and 9, fungicide applications were discontinued on 7/15/99.

			Percent turf damage due to Rhizoctonia				
	Treatment	**Rate/1000 sq ft**	**6/3/99**	**7/2/99**	**7/15/99**	**7/29/99**	**8/17/99**
1	BAS 500 F EC	0.35 oz	0.0a	0.0a	0.0a	0.0a	0.0a
2	BAS 500 F EC	0.70 oz	0.0a	0.0a	0.0a	0.0a	0.0a
3	BAS 505 F WG	0.15 oz	0.0a	0.0a	0.0a	0.0a	0.0a
4	BAS 505 F WG	0.25 oz	0.0a	0.0a	0.0a	0.0a	1.7ab
5	Heritage	0.4 oz	0.0a	0.0a	0.0a	0.0a	0.0a
6	Compass plus Banner	0.25 oz + 2.0 oz	0.0a	0.7ab	0.0a	0.0a	6.7bc
7	Banner/Compass rotation	2.0 oz/0.25 oz	0.0a	0.0a	1.0ab	0.0a	4.3bc
8	Compass	0.4 oz	0.0a	1.7b	2.7b	0.0a	8.3bc
9	Banner Compass rotation	2.0 oz/0.4 oz	0.0a	0.0a	0.0a	0.0a	0.0a
10	Eagle WSP	1.2 oz	0.0a	0.0a	0.0a	0.0a	0.0a
11	Non-treated check		3.7b	9.7c	1.7ab	5.0b	10.0c

Table 3. Percent damage due to anthracnose. Values within the same column that are followed by the same letter are not significantly different (P<0.05). For analysis of variance, percent disease damage data was transformed to the arcsine (square root of the proportion). Values shown in the table are non-transformed. On each rating date, the best performing treatments are indicated in green shaded boxes, and treatments that performed significantly worse than the check are indicated in red shaded boxes. Fungicide treatments were discontinued on 7/2/99 for all but treatments 7 and 9. For treatments 7 and 9, fungicide applications were discontinued on 7/15/99.

	Treatment	**Rate/1000 sq ft**	**anthracnose 7/15/99**
1	BAS 500 F EC	0.35 oz	0.0 a
2	BAS 500 F EC	0.70 oz	0.0 a
3	BAS 505 F WG	0.15 oz	9.3 c
4	BAS 505 F WG	0.25 oz	0.0 a
5	Heritage	0.4 oz	0.7 ab
6	Compass plus Banner	0.25 oz + 2.0 oz	0.7 ab
7	Banner/Compass rotation	2.0 oz/0.25 oz	0.0 a
8	Compass	0.4 oz	0.7 ab
9	Banner Compass rotation	2.0 oz/0.4 oz	0.7 ab
10	Eagle WSP	1.2 oz	1.7 ab
11	Non-treated check		2.7 b

Figure 1. Soil temperatures (taken at a 6 inch depth) from 1998 and 1999. Note the significantly lower temperatures in 1999.

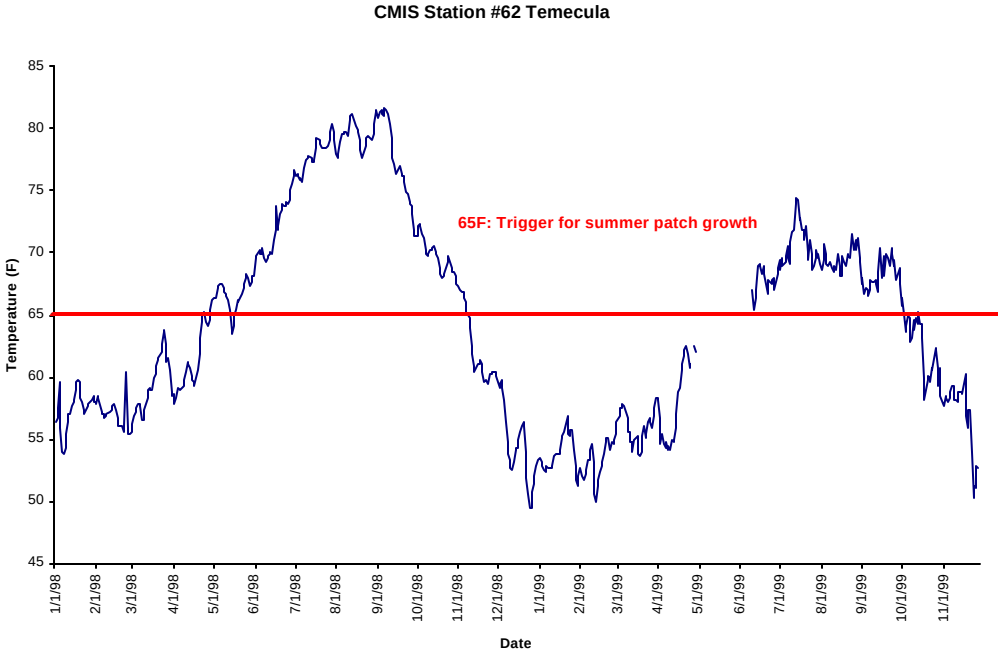

Figure 2. Untreated (treatment 11) vs. BAS 505F at 0.15 oz/1000 sq ft (treatment 3). Note the decrease in seedheads and the slightly yellowed turf in treatment 3. The product had been applied twice at this point, on 5/7/99 and 5/20/99.

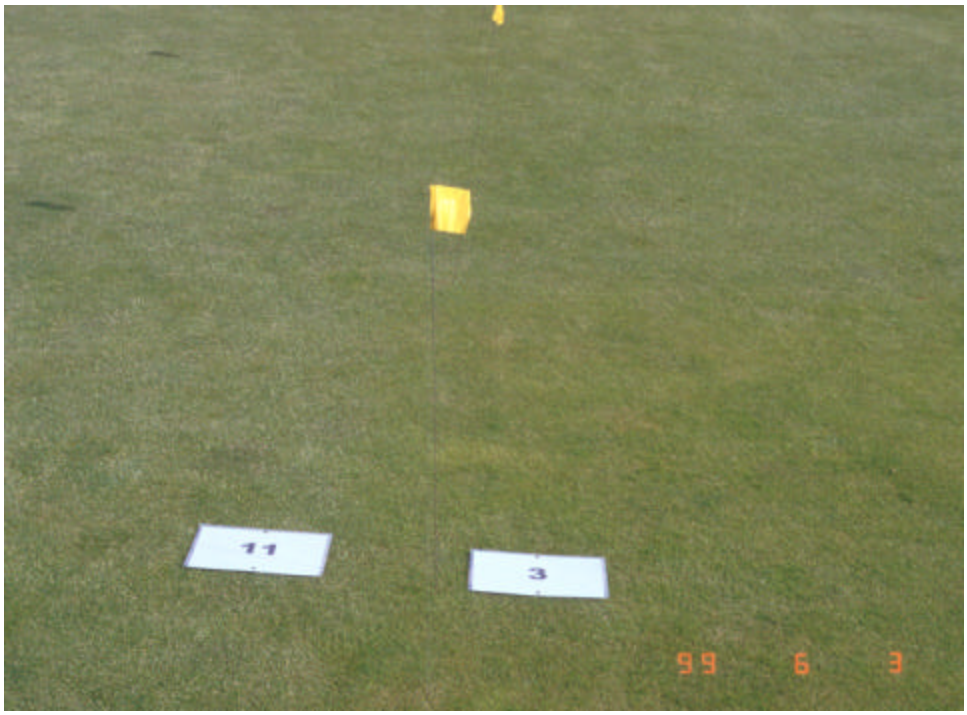

Figure 3. BAS 505 (0.25 oz/1000 sq ft), 7/2/99. Note the thinning, discolored turf in the treatment area. At this point, BAS 505 had been applied 4 times (5/7, 5/20, 6/3, 6/18).

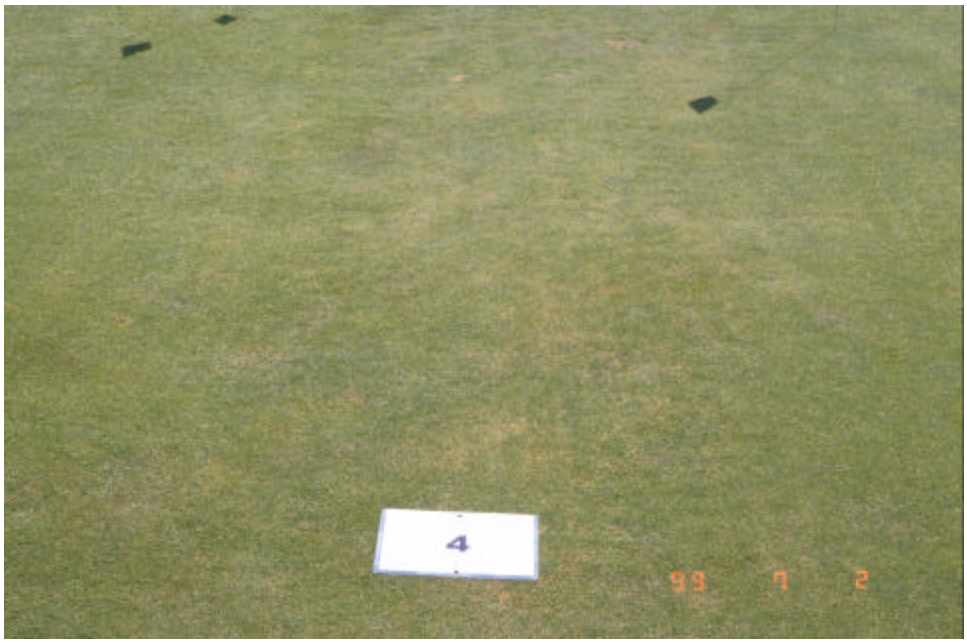

Figure 4. Recovery of plots treated with BAS 505 (treatment 4) on 8/17/99, 6.5 weeks after the last fungicide application. Treatment 5 (left-hand plot) was treated with Heritage at 0.4 oz/1000 sq ft.

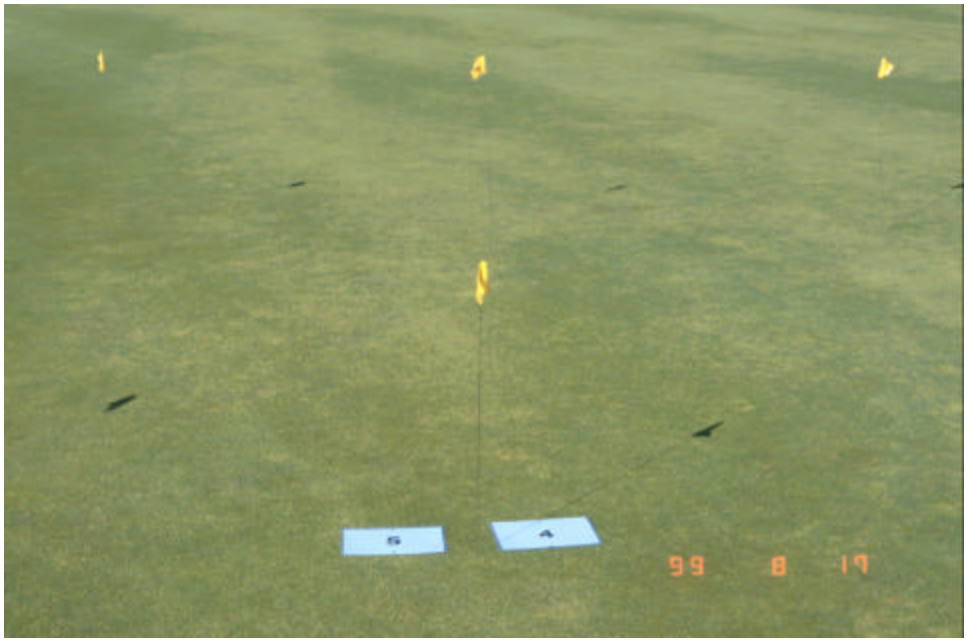

Figure 5. Efficacy of Eagle (treatment 10) for control of *Rhizoctonia.* 7/2/99. The adjacent non-treated plot, which appears on the right-hand side of this photo, sustained approximately 7% damage due to *Rhizoctonia.* The yellow rings that appear in this plot are typical of *Rhizoctonia* infections.

Figure 6. A mixture of Compass plus Banner (treatment 6) provided suppression, but not complete control of *Rhizoctonia,* as evidenced by this small, partial, ring of diseased turf. 7/2/99.

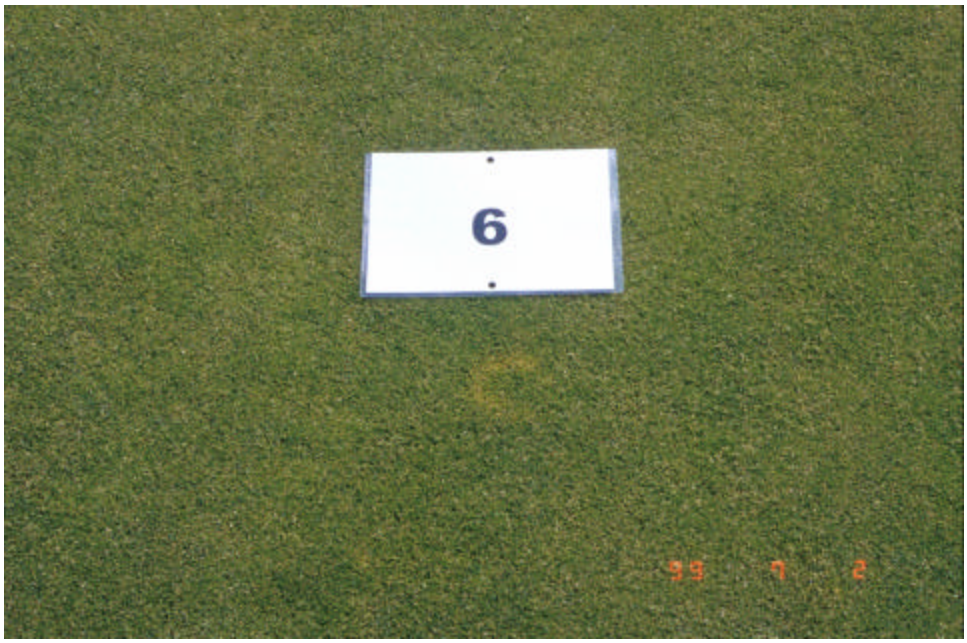

Figure 7. A mixture of Compass plus Banner (treatment 6) did not provide significant residual activity 6.5 weeks after the last application. 8/17/99.

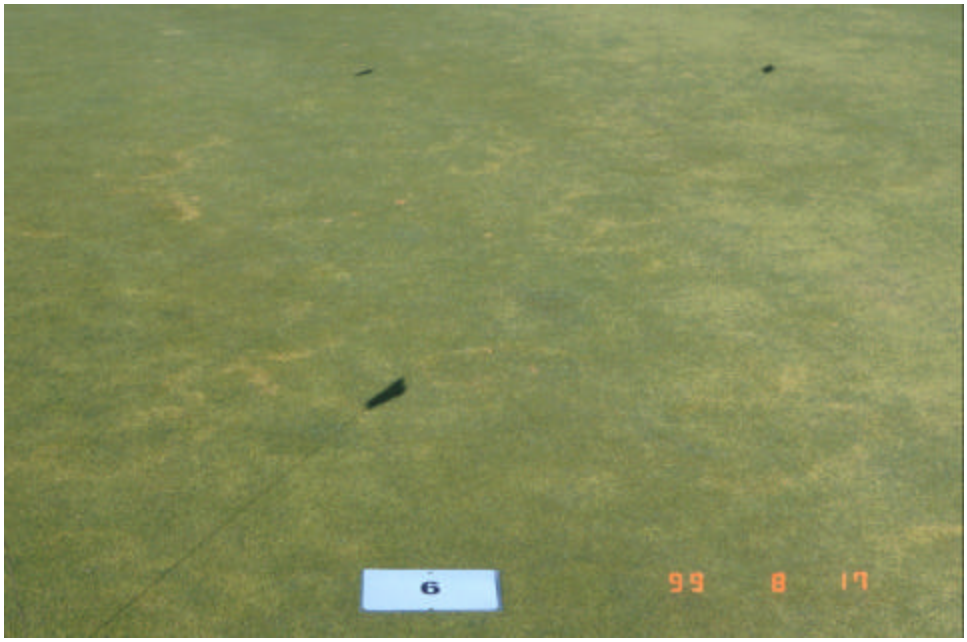

Figure 8. A rotation of bi-weekly applications of Banner, followed by bi-weekly applications of Compass at 0.25 oz/1000 sq ft (treatment 7, to the right) provided better control of *Rhizoctonia* than monthly applications of a high rate of Compass (0.4 oz/1000 sq ft) (treatment 8, to the left) 8/17/99. This indicates that early-season applications of Banner may be critical for optimum disease control.

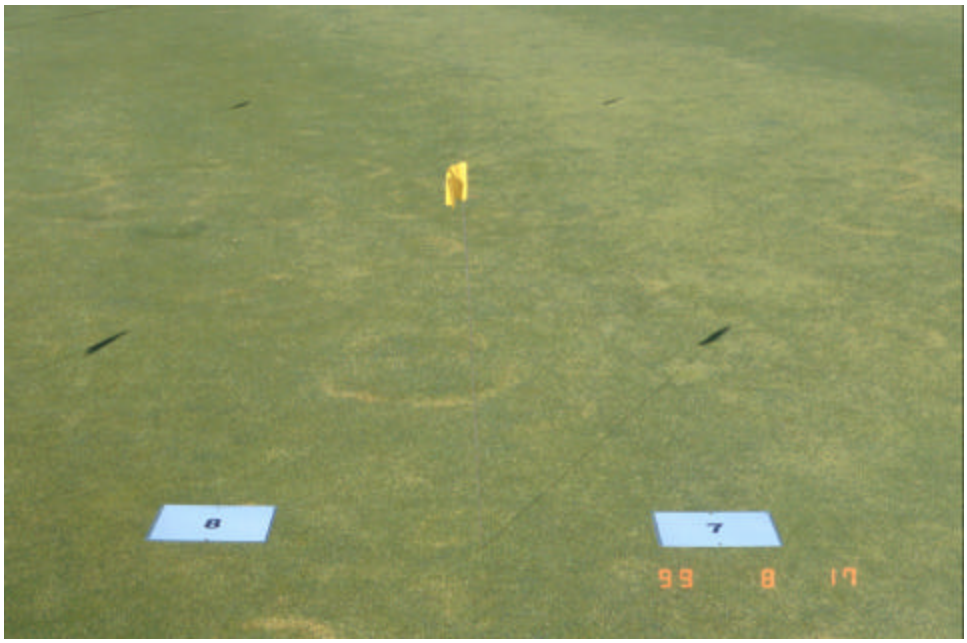

Figure 9. A rotation (treatment 9, right) of bi-weekly applications of Banner followed by monthly applications of Compass at the high rate (0.4 oz/1000 sq ft) provided excellent control of *Rhizoctonia.* 7/2/99. A non-treated plot infested with *Rhizoctonia* appears to the left.