The Year of Phytotoxicity

By Jeff Gregos, *Departments. of Plant Pathology and Horticulture, University of Wisconsin-Madison*

We have known for years that PCNB can cause leaf-tip burn when applied for snow mold in the fall. We also know that it can be more severe if there is a warming trend following applications. It has been shown in the past that if temperatures get above 55°F, phytotoxicity from a PCNB application will be increased. But, what about other chemicals?

In the past no observations have been noted on a regular basis for other chemicals causing phytotoxicity. Additionally, this was a year that we did not see that late season rise in temperatures. But what was observed this past winter was open ground (no snow cover or limited) with sub-zero temperatures. This would probably have been chalked up as coincidence, but this was observed at every site that the snow mold trials were conducted, each with slightly different weather conditions. This year included seven sites: O. J. Noer Facility, Pine Hills Country Club, Eau Claire Country Club, Sentryworld, and Gateway Golf Club, all in Wisconsin; and Northland Country Club and Giants Ridge Golf Resort, both in Minnesota.

Most snow mold fungicides are applied around the time of winter dormancy. At this time most of the physiologic processes of the plant have either slowed down or ceased for the year. So, most would think that there would be little or no affect from a fungicide application. But, for some reason this year has presented something quite different. While most golf courses would not note this effect, due to the applications over an entire green or fairway, in research plots where there are 81 different treatments, the differences are striking. In

Table 1, all 81 treatments evaluated this year are included with ratings for phytotoxicity from three sites in Wisconsin. There is wide range of phytotoxicity observed among the treatments. While all treatments cannot be discussed some interesting observations will be presented below.

An example of the increased phytotoxicity this winter from snow mold applications. (The lighter colored turf is the snow mold plot at Pine Hills CC, the fairway (darker turf) around the plot was treated with PCNB alone)

Treatments 1-3 are similar with the exception of timing. Like wise treatment 4-6 are similar, but 4-6 use Iprodione instead of Concorde in treatments 1-3. While there is not much difference observed at the Noer Facility or Sentryworld (both nearly 100% bentgrass stands), there is a difference observed at Pine Hills where there is a higher annual bluegrass population. This is an interesting fact in that we generally associate annual bluegrass with slow green-up in the spring. But, for some reason it would appear that there is an adverse reaction between these mixtures and creeping bentgrass. At Pine Hills C C the annual bluegrass is less affected then creeping bentgrass when Iprodione is used in the mix instead of Concorde.

A noteworthy chemical for the reduction of phytotoxicity would be Chipco Signature. Whether it is just the pigment in the formulation, or possibly the net result of the chemical (has been shown to induce physiological processes in the plant), the turf plants tend to have a greener color in the spring. Even when there is some senescent tissue, a green cast is present, which would indict the green pigment. This is amazing that this greening can last upwards of 6 months under winter conditions. A prime example of the affects of Signature can be seen in treatments 21 and 22. The only difference between the treatments is the addition of Signature and, at two of the three sites there is a significant difference observed, with the treatment including Signature having less phytotoxicity. In general the treatments that included Signature did not display much of any signs of phytotoxicity.

Another treatment that had some differences was that of Banner MAXX. Treatment 27 was applied generally around the second week of November, while treatment 67 was in the third week of October. At most sites the earlier application had significantly reduced phytotoxicity. This was also observed in some of the mixtures that included Banner MAXX, with the early applications resulting in less damage due to phytotoxicity.

Finally, as usual the PCNB tip-burn was observed. Since PCNB is pretty much a staple in most of our snow mold management plans, this is difficult to overcome. But one topic that seems to surface every time I discuss PCNB is the root-pruning incidence. While I have not studied this in depth in a research study, I have done literature reviews and have had many discussions with other researchers on the topic. I have only been able to find one article on the topic of root pruning by PCNB and that was on

Trt No.	Treatment Name	Rate Rate	Unit	Timing	Noer Phyto Apr-13-03	Pine Hills Phyto Apr-11-03	Sentry Phyto Apr-09-03
1	Insignia	0.9	OZ/M	Early	3 d-g	3 def	3 efg
	Concorde	5	OZ/M	Early			
	Propiconazole	3	FL OZ/M	Early			
2	Insignia	0.9	OZ/M	Late	3.3 c-f	2.67 ef	3 efg
	Concorde	5	OZ/M	Late			
	Propiconazole	3	FL OZ/M	Late			
3	Insignia	0.9	OZ/M	Ea/La	2.7 efg	2.33 f	2.67 fgh
	Concorde	5	OZ/M	Ea/La			
	Propiconazole	3	FL OZ/M	Ea/La			
4	Insignia	0.9	OZ/M	Early	2.3 fg	3.67 b-e	3.33 def
	Iprodione	4	FL OZ/M	Early			
	Propiconazole	3	FL OZ/M	Early			
5	Insignia	0.9	OZ/M	Late	2.3 fg	4 a-d	2.33 gh
	Iprodione	4	FL OZ/M	Late			
	Propiconazole	3	FL OZ/M	Late			
6	Insignia	0.9	OZ/M	Ea/La	2 g	4 a-d	2.33 gh
	Iprodione	4	FL OZ/M	Ea/La			
	Propiconazole	3	FL OZ/M	Ea/La			
7	Bayleton	2	OZ/M	Late	3.3 c-f	4 a-d	2.83 e-h
	Compass	25	OZ/M	Late			
	Turfcide 400	8	FL OZ/M	Late			
8	Bayleton	2	OZ/M	Late	2.7 efg	3.33 c-f	3.67 cde
	Compass	0.25	OZ/M	Late			
	Daconil Ultrex	3.2	OZ/M	Late			
9	Signature	4	OZ/M	Ea/La	3.3 c-f	4.67 ab	5 a
	Bayleton	2	OZ/M	Late			
	Compass	0.25	OZ/M	Late			
10	Signature	4	OZ/M	Ea/La	4 a-d	5 a	5 a
	Bayleton	2	OZ/M	Late			
	Chipco 26 GT	4	FL OZ/M	Late			
11	Signature	4	OZ/M	Ea/La	5 a	5 a	5 a
	Chipco 26 GT	4	FL OZ/M	Late			
	Turfcide 400	8	FL OZ/M	Late			
12	Signature	8	OZ/M	Late	5 a	5 a	5 a
	Chipco 26 GT	4	FL OZ/M	Late			
	Turfcide 400	8	FL OZ/M	Late			
13	Signature	8	OZ/M	Late	5 a	5 a	5 a
	Chipco 26 GT	4	FL OZ/M	Late			
	Daconil Ultrex	3.2	OZ/M	Late			
	Turfcide 400	8	FL OZ/M	Late			
14	Signature	8	OZ/M	Late	4.7 ab	4.67 ab	5 a
	Chipco 26 GT	4	FL OZ/M	Late			
15	Chipco 26 GT	4	FL OZ/M	Late	3.3 c-f	3.33 c-f	2.33 gh
	Daconil Ultrex	3.2	OZ/M	Late			
	Turfcide 400	8	FL OZ/M	Late			
16	Chipco 26 GT	4	FL OZ/M	Late	4.7 ab	3.67 b-e	2.67 fgh
	Turfcide 400	8	FL OZ/M	Late			
17	Chipco 26 GT	4	FL OZ/M	Late	3.3 c-f	4 a-d	2.67 fgh
	Chipco Triton	0.3	OZ/M	Late			
	Turfcide 400	8	FL OZ/M	Late			
18	Chipco 26 GT	4	FL OZ/M	Ea/La	2.7 efg	3.33 c-f	2 hi
	Daconil WeatherStik	5.5	FL OZ/M	Ea/La			
	Turfcide 400	8	FL OZ/M	Ea/La			
19	Signature	8	OZ/M	Ea/La	5 a	5 a	5 a
	Chipco 26 GT	4	FL OZ/M	Ea/La			
	Daconil WeatherStik	5.5	FL OZ/M	Ea/La			
	Turfcide 400	8	OZ/M	Ea/La			
20	Signature	4	OZ/M	E/M/L	4.7 ab	4.67 ab	5 a
	Chipco 26 GT	4	FL OZ/M	Mi/La			
	Turfcide 400	8	FL OZ/M	Mi/La			
21	Chipco 26 GT	4	FL OZ/M	Mi/La	5 a	5 a	5 a
	Signature	8	OZ/M	Mi/La			
	Turfcide 400	8	FL OZ/M	Mi/La			
22	Chipco 26 GT	4	FL OZ/M	Mi/La	3.3 c-f	4 a-d	2 hi
	Turfcide 400	8	FL OZ/M	Mi/La			
23	Chipco 26 GT	4	FL OZ/M	Mi/La	5 a	5 a	5 a
	Signature	8	OZ/M	Mi/La			
24	Chipco 26 GT	4	FL OZ/M	Ea/La	3.7 b-e	4 a-d	2.33 gh
	Chipco Triton	0.3	OZ/M	Ea/La			
	Turfcide 400	8	FL OZ/M	Ea/La			
25	Compass	0.25	OZ/M	Ea/La	3 d-g	2.67 ef	2.33 gh
	Bayleton	2	OZ/M	Ea/La			
	Turfcide 400	8	FL OZ/M	Ea/La			
26	Daconil WeatherStik	5.5	FL OZ/M	Late	3.7 b-e	4 a-d	4 bcd
27	Banner Maxx	4	FL OZ/M	Late	2 g	2.67 ef	2 hi
28	Medallion	0.5	OZ/M	Late	4.3 abc	4 a-d	3.67 cde
29	Heritage	0.4	OZ/M	Late	5 a	4 a-d	3.67 cde
30	Banner Maxx	4	FL OZ/M	Late	2.7 efg	3 def	3.33 def
	Medallion	0.5	OZ/M	Late			
31	Daconil WeatherStik	5.5	FL OZ/M	Late	4 a-d	4 a-d	4 bcd
	Medallion	0.5	OZ/M	Late			
32	Banner Maxx	4	FL OZ/M	Early	2.7 efg	3.33 c-f	2.67 fgh
	Medallion	0.5	OZ/M	Late			
	Daconil WeatherStik	5.5	FL OZ/M	Late			
33	A13705B	2.5	FL OZ/M	Early	2.7 efg	4 a-d	3 efg
34	A13705B	2.5	FL OZ/M	Mid	4.7 ab	3 def	3.33 def
35	A13705B	2.5	FL OZ/M	Late	2.7 efg	4 a-d	3.67 cde
36	Anderson Daconil	15.1	LB/M	Late	2.7 efg	4 a-d	4.33 abc
	Anderson Bayleton	12.5	LB/M	Early			
	Anderson Fungicide V	5.95	LB/M	Late			
37	Anderson Daconil	15.1	LB/M	Snow	3.3 c-f	3.33 c-f	4.33 abc
	Anderson Bayleton	12.5	LB/M	Snow			
	Anderson Fungicide V	5.95	LB/M	Snow			
38	Anderson Fungicide X	7.21	LB/M	Early	3 d-g	4.33 abc	4.67 ab
	Anderson Bayleton	12.5	LB/M	Late			
	Anderson Fungicide V	5.95	LB/M	Late			
39	Anderson Fungicide X	7.21	LB/M	Snow	3 d-g	4.33 abc	4.33 abc
	Anderson Bayleton	12.5	LB/M	Snow			
	Anderson Fungicide V	5.95	LB/M	Snow			
40	Anderson Fungicide X	7.21	LB/M	Early	4.3 abc	3.67 b-e	4.67 ab
	Anderson Daconil	15.1	LB/M	Late			
	Anderson Fungicide V	5.95	LB/M	Late			
41	Anderson Fungicide X	7.21	LB/M	Snow	4.3 abc	4.33 abc	4.33 abc
	Anderson Daconil	15.1	LB/M	Snow			
	Anderson Fungicide V	5.95	LB/M	Snow			
42	Anderson 1215	12.5	LB/M	Early	4.3 abc	4.33 abc	4 bcd
	Anderson Daconil	15.1	LB/M	Late			
43	Anderson 1215	12.5	LB/M	Snow	3.3 c-f	4 a-d	4.67 ab
	Anderson Daconil	15.1	LB/M	Snow			
44	Anderson 1121	5.05	LB/M	Early	5 a	4.67 ab	4.67 ab
	Anderson FF II	6.36	LB/M	Late			
45	Anderson 1121	5.05	LB/M	Snow	5 a	4.33 abc	5 a
	Anderson FF II	6.36	LB/M	Snow			
46	Anderson 1121	5.05	LB/M	Early	2 g	4.33 abc	4.67 ab
	Anderson 10-0-14 PCNB	6.36	LB/M	Late			
47	Anderson 1121	5.05	LB/M	Snow	3.3 c-f	2.67 ef	1.17 i
	Anderson 10-0-14 PCNB	6.36	LB/M	Snow			
48	PCNB + Novex 9-0-19	6	LB/M	Late	5 a	5 a	4.67 ab
49	Lesco 18 Plus	4	FL OZ/M	Late	4.3 abc	3.67 b-e	2.67 fgh
	Lesco Revere 4000	8	FL OZ/M	Late			
	Lesco Manicure	3.2	OZ/M	Late			
50	Turfcide 400	16	FL OZ/M	Late	4.3 abc	4 a-d	3 efg
51	Turfcide 400	12	FL OZ/M	Late	3.7 b-e	4.33 abc	3.67 cde
52	Turfcide 400	8	FL OZ/M	Late	5 a	4.33 abc	4 bcd
53	Turfcide 400	4	FL OZ/M	Late	4.3 abc	5 a	3.67 cde
54	Chipco 26 GT	2	FL OZ/M	Mi/La	3.7 b-e	3.67 b-e	2.67 fgh
	Daconil WeatherStik	2.75	FL OZ/M	Mi/La			
	Turfcide 400	4	FL OZ/M	Mi/La			
55	Chipco 26 GT	2	FL OZ/M	Late	3.7 b-e	3 def	3 efg
	Daconil WeatherStik	2.75	FL OZ/M	Late			
	Turfcide 400	4	FL OZ/M	Late			
56	FF II 14-3-3	104	OZ/M	Late	4.3 abc	4.67 ab	4.33 abc
57	Calogran	128	OZ/M	Late	4.3 abc	4.33 abc	4.67 ab
58	Calodor	3	OZ/M	Late	4 a-d	3.67 b-e	2.33 gh
59	Terraneb	9	OZ/M	Late	4.3 abc	4.33 abc	3.33 def
60	Bayleton	2	OZ/M	Early	4 a-d	4.33 abc	3.67 cde
	Prostar	4.5	OZ/M	Early			
61	Bayleton	2	OZ/M	Late	3.7 b-e	4.33 abc	3 efg
	Prostar	4.5	OZ/M	Late			
62	Heritage	0.4	OZ/M	Early	3 d-g	4 a-d	3.33 def
	Banner Maxx	4	FL OZ/M	Early			
63	Heritage	0.4	OZ/M	Late	2.7 efg	3.67 b-e	3 efg
	Banner Maxx	4	FL OZ/M	Late			
64	Compass	0.25	OZ/M	Early	4 a-d	3.67 b-e	4 bcd
	Prostar	4.5	OZ/M	Late			
65	Insignia	0.9	OZ/M	Late	4.3 abc	4.33 abc	4 bcd
66	Terraclor	8	OZ/M	Late	4.7 ab	4.33 abc	4 bcd
67	Banner Maxx	4	FL OZ/M	Early	3 d-g	3 def	3.67 cde
68	Bayleton	2	OZ/M	Late	4 a-d	4.67 ab	3.67 cde
69	Chipco 26 GT	4	FL OZ/M	Late	4.7 ab	3.33 c-f	3.17 d-g
	Daconil WeatherStik	5.5	FL OZ/M	Late			
70	Honor	0.2	OZ/M	Late	4 a-d	4.67 ab	4 bcd
71	Compass	0.25	OZ/M	Late	4.3 abc	4.67 ab	3.67 cde
72	Heritage	0.4	OZ/M	Late	4 a-d	4 a-d	3.33 def
	Daconil WeatherStik	5.5	FL OZ/M	Late			
73	Compass	0.25	OZ/M	Late	3.3 c-f	4.33 abc	3.33 def
	Daconil WeatherStik	5.5	FL OZ/M	Late			
74	Honor	0.2	OZ/M	Late	3 d-g	4.33 abc	3.67 cde
	Daconil WeatherStik	5.5	FL OZ/M	Late			
75	Insignia	0.9	OZ/M	Late	4 a-d	4 a-d	3.33 def
	Daconil WeatherStik	5.5	FL OZ/M	Late			
76	Daconil Ultrex	3.2	OZ/M	Late	4 a-d	4.67 ab	3.33 def
77	Prostar	4.5	OZ/M	Late	5 a	3.83 bcd	5 a
78	Chipco 26 GT	4	FL OZ/M	Late	4 a-d	4.67 ab	3 efg
79	Chipco Triton	0.3	OZ/M	Late	3.3 c-f	4.67 ab	3.67 cde
80	Spotrete	8	OZ/M	Late	4.3 abc	4.33 abc	3.33 def
81	Untreated Control				4.7 ab	5 a	4.67 ab
	LSD (P=.05)				1.2	1.15	0.98
	Standard Deviation				0.8	0.7	0.61
	CV				20	17.6	16.7

Table 1. Phytotoxicity (Scale of 1-5, with 5= no phytotoxicity and 1=death) of three snow mold trials from around Wisconsin. Early applications were applied around the 3rd week of October, mid-applications were applied the last week of October, and the later applications were applied the 2nd week of November.

beans. There is no current evidence out there to support the possibility of root pruning at this time. Yes, we have seen some incidence of increased take-all patch, but this was not observed under controlled situation and numerous other possibilities could play a factor.

These results may be just a condition of this previous winter. But they will provide us some insight if they are observed in the future. This will also help us to adjust application timing for some of the products, as we did observe differences. So if you are having delayed spring green-up, realize that you are not alone. Also realize that it may not be just the weather, but could include some phytotoxicity issues from you fall application for snow mold.

Additionally, if anyone would like a copy of the results from the snow mold studies this year, please feel free to send me an email (jsg@plantpath.wisc.edu) requesting a copy.