

# MARK M. MAHADY & ASSOCIATES, INC.

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**Control of *Anguina pacificae* on a *Poa annua* Putting Green**  
**2009 Final Year-End Summary**  
**February 5, 2010**

<u>Treatments</u>	<u>Rate</u>	<u>Application</u>	<u>Application Schedule</u>
1) Fert Program+Primo (Check)	0.1 oz/M	L/3 GPM	Every 2 weeks Apr-Dec 2009
2) Agroneem Plus+Primo	48 oz+0.1 oz/M	L/3 GPM	Every 2 weeks Apr-Dec 2009
3) Neemix+Tril+Primo	9+9+0.1 oz/M	L/3 GPM	Every 2 weeks Apr-Dec 2009
4) Eartheart Program+Primo	Program	L/3 GPM	Every 2 weeks Apr-Dec 2009
5) ABC-1	TBD	TBD	Every 4 weeks Apr-Dec 2009
6) ABC-2	TBD	TBD	Every 4 weeks Apr-Dec 2009
7) C-Gro Inc.	Program	L/3 GPM	Every 4 weeks Apr-Dec 2009
8) BioFence	20 lb/M	Powder	3 consec. appl/2 week intervals
8) Primo	0.1 oz/M	L/3 GPM	2 consec. appl/2 week intervals
9) Orthene	5 lb/A	L/3 GPM	Every 2 weeks Apr-Dec 2009
10) Rotation Program A	Program	L/3 GPM	Every 2 weeks Apr-Dec 2009

<b>Spyglass</b>			<b>Pebble Beach</b>			<b>Del Monte</b>			<b>Spanish Bay</b>		
Not Used	10	8	Not Used	Not Used	4	7	1	4	2	7	Not Used
Not Used	2	6	3	10	5	Not Used	10	2	Not Used	3	8
9	7	5	6	1	7	6	5	Not Used	4	10	5
1	3	4	9	8	2	3	8	9	9	6	1

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◆ **Treatments Effects, Final Results: *Anguina pacificae* Gall Counts (Table 1)**

Column A (Table 1) presents the number of *Anguina* galls per treatment plot on the day of the first application, April 15, 2009. Column E presents the number of *Anguina* galls per treatment plot on December 15, 2009 and the **(percent control)** of *Anguina* galls when compared to the fertilized check plus Primo (Treatment #1).

Column F presents the total number of *Anguina* galls collected per treatment over the four sampling dates of 6/30, 8/25, 10/20 and 12/15/09. Those treatments with the **lowest *Anguina* gall count totals** are presented in **red**. Those treatments with the **greatest percent reduction in *Anguina* gall counts** when compared to the total of the fertilized check plus Primo (Treatment #1) are presented in **blue**.

**Table 1.** Treatment effects on *Anguina pacificae* gall counts. The Links at Spanish Bay, Pebble Beach, CA. 2009. Mark M. Mahady & Associates, Inc.

Treatments	Rate	A	B	C	D	E	F
		Anguina Galls 4/15/09 DOA1	Anguina Galls (% Control) <sup>2</sup> 6/30/09	Anguina Galls (% Control) 8/25/09	Anguina Galls (% Control) 10/20/09	Anguina Galls (% Control) 12/15/09	Total # Ang Galls 6/30 to 12/15/09
1) Fert Prog+Primo (CK)	0.1 oz/M	35.3 a <sup>5</sup>	47.0 ab (0.0%)	43.5 ab (0.0%)	38.8 ab (0.0%)	68.0 a (0.0%)	197.3 (0.0%)
2) Agron Plus+Primo	48 oz+0.1 oz/M	35.3 a	18.3 b (61.2%) <sup>2</sup>	34.0 ab (21.8%)	16.8 b (56.8%)	42.3 a (37.9%)	<b>111.4 (43.5%)</b>
3) Neem+Tril+Primo	9+9+0.1 oz/M	35.5 a	24.0 b (48.9%)	16.8 b (61.5%) <sup>3</sup>	10.3 b (73.5%)	38.0 a (44.1%)	<b>89.1 (54.8%)</b>
4) Earheart Prog+Primo	Program	34.0 a	26.8 b (43.1%)	41.8 ab (4.0%)	34.8 ab (10.3%)	57.3 a (15.8%)	160.7 (18.6%)
5) ABC-1	*	30.8 a	72.3 a (-53.7%)	45.0 ab (-3.4%)	36.5 ab (5.8%)	20.5 a (69.9%)	174.3 (11.7%)
6) ABC-2	*	35.8 a	27.3 b (42.0%)	45.8 ab (-5.2%)	35.5 ab (8.4%)	47.8 a (29.8%)	156.4 (20.7%)
7) C-Gro Inc.	Program	36.8 a	55.0 ab (-17.0%)	41.8 ab (4.0%)	25.8 b (33.5%)	47.8 a (29.8%)	170.4 (13.6%)
8) BioFence+Primo	20 lb/M+0.1 oz/M	33.0 a	39.0 ab (17.0%)	64.5 a (-48.3%)	29.5 b (23.9%)	41.8 a (38.6%)	174.8 (11.4%)
9) Orthene	5 lb/A	36.8 a	46.0 ab (2.1%)	32.0 ab (26.4%)	62.5 a (-61.3%)	54.3 a (20.2%)	194.8 (1.3%)
10) Rotation Program A <sup>1</sup>	Program	37.3 a	19.0 b (59.6%)	32.5 ab (25.3%)	30.8 b (20.6%)	74.5 a (-9.6%)	156.8 (20.5%)
LSD (P=.05)		35.15	25.59	23.78	20.60	30.52	
Standard Deviation		24.23	17.63	16.39	14.20	21.04	
CV		69.17	47.08	41.23	44.24	42.76	

<sup>1</sup> Rotate Neemix (6 oz/M) + Trilogy (9 oz/M) then Cleary's 3336 (8 oz/M: a maximum of 4 applications per year). Add Primo (0.1 oz/M) in all applications. Utilize N-Control as the nitrogen source for root-knot nematode suppression.

<sup>2</sup> Percent control as calculated versus the fertilized check plus Primo (Treatment #1).

<sup>3</sup> **Blue highlights** denote those treatments with the greatest percent reduction in *Anguina* gall counts or percent control of *Anguina* galls.

<sup>4</sup> **Red highlights** denote those treatments with the lowest *Anguina* gall count totals over four sampling events.

<sup>5</sup> Means followed by the same letter do not differ significantly (P=0.05, Student-Newman-Keuls).

Table 2 shows the final treatment rankings.

<b>Table 2.</b> Treatment rankings based on the percent reduction in the total number of <i>Anguina pacificae</i> galls. The Links at Spanish Bay, Pebble Beach, CA. 2009. Mark M. Mahady & Associates, Inc.			
<u>Treatment</u>	<u>Rate</u>	<u>% Reduction in Total Number of Anguina Galls<sup>1</sup></u>	<u>Ranking</u>
Neemix + Trilogy + Primo	9 + 9 + 0.1 oz/M	54.8% <sup>1</sup>	1
Agroneem Plus + Primo	48 + 0.1 oz/M	43.5%	2

<sup>1</sup> Percent reduction in Anguina galls as compared to the total number of galls found in the fertilized check plus Primo (Treatment #1) over four sampling dates on 6/30, 8/25, 10/20 and 12/15/09.

Key observations to date include the following:

1. Higher rates of azadirachtin based treatments such as Neemix (9 oz/1000 ft<sup>2</sup>) + Trilogy (9 oz/1000 ft<sup>2</sup>) and Agroneem Plus (48 oz/1000 ft<sup>2</sup>) showed the most encouraging results for reduction of Anguina induced turfgrass injury symptoms. It is important to note that Neemix contains a much higher concentration of azadirachtin (154.2 grams/gallon) than Agroneem Plus (4.8 grams/gallon). At the 48 oz/1000 ft<sup>2</sup> product rate, Agroneem Plus delivers 1.8 grams of azadirachtin/1000 ft<sup>2</sup>. As a comparison, Neemix applied at 9 product oz/1000 ft<sup>2</sup> delivers 10.8 grams of azadirachtin per 1000 ft<sup>2</sup>, a 6x factor.
2. When compared to the fertilized check plus Primo (Treatment #1), the following treatments showed positive trends for Anguina gall reduction: Neemix + Trilogy + Primo MAXX (54.8% gall reduction) and Agroneem Plus + Primo MAXX (43.5% gall reduction).
3. Treatment #3, Neemix + Trilogy + Primo was the only treatment to show continuous reductions in Anguina gall counts on sampling dates from April through October. However, it should be noted that this trend ended with the December 15, 2009 sampling event. Anguina gall counts for the Neemix + Trilogy + Primo treatment increased almost four-fold from the October to December. It is not known how these increases in Anguina gall production will influence overall turf quality and levels of Anguina induced turfgrass injury during the 2009-2010 winter season.

#### ◆ **Treatments Effects, Final Results: Root Knot Nematodes in Soil (Table 3)**

Column A (Table 3) presents the number of root knot nematodes per treatment plot on the day of the first application, April 15, 2009. Note the variation in population counts ranging from a low of 0.965 to a high of 2.905. Column B presents the number of root knot nematodes per treatment plot on June 30, 2009 and the **(percent control)** of root knot nematodes when compared to the fertilized check plus Primo (Treatment #1). Column E presents the number of root knot nematodes per treatment plot on December 15, 2009 and the **(percent control)** of root knot nematodes when compared to the fertilized check plus Primo.

Column F presents the total number of root knot nematodes collected per treatment over the four sampling dates of 6/30, 8/25, 10/20 and 12/15/09. Data from the first sampling date (4/15/09) was not included in this total so that the influence of treatments on root knot populations could more easily be identified. Those treatments with the lowest **root knot nematode count totals** for the June, August, October and December sampling dates are presented in **red**. Those treatments showing the **greatest reduction in root knot nematode counts** or percent control of root knot nematodes when compared to the fertilized check plus Primo (Treatment #1) are presented in **blue**.

Although population counts of root knot nematodes are moderate to low, and it is often difficult to correlate the influence of specific treatments on population counts of root knot nematodes, it would appear that Treatment #8, BioFence + Primo MAXX (43.3% control) and Treatment # 10, Rotation Program A (31.4% control) showed the greatest potential to reduce total root knot nematode counts when compared to Treatment #1, the Fertilized Check plus Primo MAXX.

**Table 3.** Treatment effects on root knot nematode counts. The Links at Spanish Bay, Pebble Beach, CA. 2009. Mark M. Mahady & Associates, Inc.

Treatments	Rate	A	B	C	D	E	F
		Root-Knot Nematodes 4/15/09 DOA1	Root-Knot Nematodes 6/30/09 (% Control) <sup>2</sup>	Root-Knot Nematodes 8/25/09 (% Control)	Root-Knot Nematodes 10/20/09 (% Control)	Root-Knot Nematodes 12/15/09 (% Control)	Total # Root-Knot 6/30/09 to 12/15/09
1) Fert Prog+Primo (CK)	0.1 oz/M	1.730 a <sup>5</sup>	2.065 a (0.0%)	2.995 a (0.0%)	1.398 a (0.0%)	8.883 b (0.0%)	15.341 (0.0%)
2) Agron Plus+Primo	48 oz+0.1 oz/M	2.718 a	1.328 a (35.7%) <sup>2</sup>	4.260 a (-42.2%)	3.098 a (-121.6%)	14.500 b (-63.2%)	23.186 (-51.1%)
3) Neemix+Tril+Primo	9+9+0.1 oz/M	1.090 a	0.463 a (77.6%)	4.158 a (-38.8%)	5.198 a (-271.9%)	9.490 b (-6.8%)	19.309 (-25.9%)
4) Earheart Prog+Primo	Program	2.718 a	1.910 a (7.5%)	3.198 a (-6.8%)	3.995 a (-185.9%)	8.703 b (2.0%)	17.806 (-16.1%)
5) ABC-1	*	2.403 a	2.110 a (-2.2%)	6.878 a (-129.6%)	8.530 a (-510.4%)	9.520 b (-7.2%)	27.038 (-76.2%)
6) ABC-2	*	2.905 a	2.958 a (-43.2%)	3.018 a (-0.8%)	1.795 a (-28.4%)	7.633 b (14.1%)	15.404 (-0.4%)
7) C-Gro Inc.	Program	2.090 a	2.340 a (-13.3%)	2.063 a (31.1%)	6.195 a (-343.3%)	9.333 b (-5.1%)	19.931 (-29.9%)
8) BioFence+Primo	20 lb/M+0.1 oz/M	0.965 a	1.633 a (20.9%)	2.070 a (30.9%)	2.830 a (-102.5%)	2.163 b (75.7%)	8.696 <sup>3</sup> 43.3% <sup>4</sup>
9) Orthene	5 lb/A	1.665 a	2.243 a (-8.6%)	5.705 a (-90.5%)	5.730 a (-310.0%)	31.598 a (-255.7%)	45.276 (-195.1%)
10) Rotation Program A <sup>1</sup>	Program	1.065 a	1.043 a (49.5%)	2.785 a (7.0%)	3.278 a (-134.5%)	3.418 b (61.5%)	10.524 31.4%
LSD (P=.05)		2.5818	2.5308	4.4918	6.5805	12.9392	
Standard Deviation		1.7794	1.7442	3.0957	4.5352	8.9175	
CV		91.97	96.42	83.38	107.870	84.74	

<sup>1</sup> Rotate Neemix (6 oz/M) + Trilogy (9 oz/M) then Cleary's 3336 (8 oz/M: a maximum of 4 applications per year). Add Primo (0.1 oz/M) in all applications. Utilize N-Control as the nitrogen source for root-knot nematode suppression.

<sup>2</sup> Percent control as calculated versus the fertilized check plus Primo (Treatment #1).

<sup>3</sup> Red highlights denote those treatments with the lowest total root knot nematode counts combined over four sampling events.

<sup>4</sup> Blue highlights denote those treatments with the greatest percent reduction in total root knot nematode counts or percent control of root knot nematodes when combined over four sampling dates and compared to Treatment #1, the fertilized check plus Primo.

<sup>5</sup> Means followed by the same letter do not differ significantly (P=0.05, Student-Newman-Keuls).

◆ **Specific Poa Biotypes from Individual Golf Course Locations**

Dynamic differences in Poa susceptibility to *Anguina* injury appeared from golf course to golf course on this site during 2008. Similar trends were observed in 2009. The Poa biotypes from Pebble Beach and Spyglass showed a much higher degree of *Anguina* induced turfgrass injury than Poa biotypes from Del Monte and Spanish Bay. Curiously, average *Anguina* gall counts generated on the five nematode sampling dates (April 15, June 30, August 25, October 20 and December 15, 2009) showed that Spanish Bay (2,655 total *Anguina* galls) and Del Monte (1,820 total *Anguina* galls) exhibited greater total gall counts for these five sampling dates than Spyglass (1,709 total *Anguina* galls) and Pebble Beach (1,599 total *Anguina* galls), and yet exhibited consistently higher quality turf.

Why *Poa* biotypes from Spanish Bay and Del Monte show dynamically less *Anguina* induced turf damage than *Poa* from Spyglass or Pebble Beach with higher average *Anguina* gall counts per plot is unknown at this time. Possible factors may include a) genetic makeup of the *Poa*, b) *Poa* tillering potential, c) plant influence on *Anguina* reproductive capacity and stage development, and d) presence of bacteria or fungi in soil or on plant tissue that inhibit or reduce *Anguina* viability.

Spyglass			Pebble Beach			Del Monte			Spanish Bay		
Not Used	10	8	Not Used	Not Used	4	7	1	4	2	7	Not Used
Not Used	2	6	3	10	5	Not Used	10	2	Not Used	3	8
9	7	5	6	1	7	6	5	Not Used	4	10	5
1	3	4	9	8	2	3	8	9	9	6	1

4/15/09 Total *Anguina* Galls: 266  
 6/30/09 Total *Anguina* Galls: 253  
 8/25/09 Total *Anguina* Galls: 392  
 10/20/09 Total *Anguina* Galls: 306  
 12/15/09 Total *Anguina* Galls: 492

**Spyglass Total Galls 1,709**

4/15/09 Total *Anguina* Galls: 223  
 6/30/09 Total *Anguina* Galls: 329  
 8/25/09 Total *Anguina* Galls: 414  
 10/20/09 Total *Anguina* Galls: 270  
 12/15/09 Total *Anguina* Galls: 363

**Pebble Beach Total Galls 1,599**

4/15/09 Total *Anguina* Galls: 297  
 6/30/09 Total *Anguina* Galls: 459  
 8/25/09 Total *Anguina* Galls: 354  
 10/20/09 Total *Anguina* Galls: 301  
 12/15/09 Total *Anguina* Galls: 409

**Del Monte Total Galls 1,820**

4/15/09 Total *Anguina* Galls: 615  
 6/30/09 Total *Anguina* Galls: 457  
 8/25/09 Total *Anguina* Galls: 470  
 10/20/09 Total *Anguina* Galls: 409  
 12/15/09 Total *Anguina* Galls: 704

**Spanish Bay Total Galls 2,655**

◆ **Summary**

Multiple applications of those products containing the active ingredient azadirachtin (Neemix and Agroneem Plus) showed the lowest *Anguina* gall counts. The program of Neemix (9 oz/1000 ft<sup>2</sup>) + Trilogy (9 oz/1000 ft<sup>2</sup>) + Primo MAXX (0.1 oz/1000 ft<sup>2</sup>) was the top performing treatment with a 54.8% reduction in *Anguina* gall counts when compared to the fertilized check plus Primo MAXX.

Multiple applications of BioFence + Primo MAXX and Rotation Program A showed the lowest total counts of root knot nematode. BioFence + Primo MAXX exhibited 43.3% control of root knot nematode and Rotation Program A 31.4% control when compared to the fertilized check plus Primo MAXX.

All treatment applications, visual evaluations and nematode sampling events for the 2009 *Anguina* field trial have now been completed. This document represents the final data summary for key treatment performance relative to *Anguina* and root knot nematode counts. The final report with the presentation of all summarized data is scheduled for completion by March 2010.