Evaluation of Mach 2 formulations and Application Strategies for Curative Control of Black Cutworms (*Agrotis ipsilon*) on Golf Course Turf

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Summary: In a replicated field trial on a bentgrass nursery at La Jolla Country Club, La Jolla, CA, the effect on black cutworm populations of formulation type, removal of turfgrass clippings, and post-treatment irrigation was evaluated. Key results include:

- Overall, performance of the SC formulation was better than that of the granular formulation of Mach 2. Regardless of the post-treatment management strategy employed, the SC formulation was as effective as the commercial standard (Talstar). However, the granular formulation of Mach 2 had consistently higher black cutworm populations than either Mach 2 SC or Talstar treated plots.
- Removal of clippings did not have a significant impact on the performance of either formulation of Mach 2, although there was a non-statistical trend in this direction for the granular, but not the SC formulation.
- Post-treatment irrigation had no impact on the performance of either Mach 2 formulation.

Materials and Methods:

Location: Research plots were located on a bentgrass nursery at La Jolla Country Club, La Jolla, CA. Turf was mowed slightly higher than greens height to encourage black cutworm infestations.

Experimental design and application: Plots measuring 5 feet by 12 feet were replicated four times in a randomized design (Figure 1). Sprayable treatments were applied with a CO_2 backpack sprayer equipped with 8008 VS flat fan nozzles and delivering 1.7 gallons of water per 1000 square feet, with 28 psi at the boom. 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 10 times prior to charging with compressed CO_2. Spray lines were purged with water and then CO_2 prior to changing treatments. Granular treatments were applied to each plot via hand held shakers with seven 11/64" holes drilled in the top

Within one hour of application, the designated plots were irrigated with 1/10-inch water. This selective irrigation was accomplished by spraying the designated plots with 18.9 liters of water each, delivered through the boom of the backpack sprayer described above. Water was applied by moving the sprayer up and down the length of the plot approximately 12 times. A flow meter was used to monitor the total volume of water applied to each plot (Figure 1).

Once turf had dried (3 – 4 hours post-irrigation), plots were mowed to a height of 3/8". Clippings from the designated plots were redistributed to those plots by hand.

Treatments: Treatments are listed in Table 1 below. A single curative application of each product was made on 9/10/98, when black cutworm populations reached an average of 4 larvae per 8 square feet.

Evaluations: Evaluations were made 4 and 11 days after application. Black cutworm populations were quantified by counting the number of larvae that appeared following application of an irritant solution of Lemon Joy applied through a hose end sprayer (Gilmour Insecticide and Fertilizer sprayer) that delivered ½ oz Lemon Joy per gallon of spray solution. To achieve this delivery rate, the hose end sprayer dial was set at 1 tablespoon, and the soap solution in the hose end sprayer consisted of a mixture of 2 parts water to 1 part Lemon Joy. The number of cutworms that appeared within 5 minutes of application of the irritant solution per 8 square feet of turf surface in each plot were counted and recorded using a rectangle of

aluminum screen frame measuring 2 feet by 4 feet to mark the counting area. To encourage optimal larval counts, turf was pre-irrigated with approximately 1/10" water prior to application of the irritant solution. The counting rectangle was placed in a different position on each evaluation date to avoid the possibility of erroneously lower counts due to any mortality that cutworms might suffer following exposure to the soap irritant solution. Data was subjected to an analysis of variance, and treatment means separated using Fisher's LSD, where $P<0.10$. In addition, a step-wise multiple linear regression analysis was conducted with factors (formulation type, clipping removal, use of post-treatment irrigation) added into the regression model if the probability that the partial correlation was due to chance was less than 0.05. A significant ($P<0.05$) negative correlation identified those factors, or combination of factors that caused significant reductions in black cutworm populations.

Results and Discussion:

Phytotoxicity: None of the products tested caused any damage to turf.

Effect of Post-Treatment Irrigation: The application, or lack of application of 1/10" irrigation had no significant effect on the performance of Mach 2 SC or G formulations (Tables 1 and 2). This is welcome news, since the requirement for post-treatment application can be difficult for superintendents to fulfill.

Effect of Clipping Removal: Following mowing, clippings for each plot were examined to determine to what extent the Mach 2 granular formulation was being removed. Visual examination (see Figure 2 below) revealed that a significant number of granules were indeed removed if clippings were not returned to the plots. However, the effect of this removal on product performance was not significant (Tables 1 and 2), though there was a non-statistical trend that indicates that removal of clippings may negatively impact the performance of the granular (but not the SC) formulation (Table 1).

Effect of Formulation: The formulation type tested had a significant effect on product performance, with the SC formulation consistently resulting in better black cutworm control than the G formulation of Mach 2. The SC tended to perform better than the G formulation, regardless of the irrigation or clipping removal strategy used. This indicates that the G formulation may have some inherent flaw , which prevents it from contacting black cutworm larvae. For example, if the granule releases too slowly, there may be insufficient active ingredient present on the foliage and thatch at any given time to result in black cutworm mortality. And since contact activity, rather than systemic activity is most important for curative control of cutworms, this could be a problem. This explanation might also clarify why the G formulation has been used more successfully against larvae of the black turfgrass ataenius (see PACE 1998 report), a soil dwelling pest. In the case of ataenius, slow release may be a benefit, since populations are present throughout the summer, and since systemic activity within the root system is more important than contact activity.

Figure 1. Set-up of backpack sprayer and flow meter used to selectively deliver irrigation to plots treated with Mach 2.

Figure 2. Mower basket following mowing of plots treated with Mach 2 G. The presence of granules among the clippings indicates that a significant quantity of product is removed if clippings are not returned to the area.

Table 1. Black cutworm counts, 4 and 11 days after treatment. La Jolla Country Club, La Jolla CA. Treatments were made to a bentgrass green with populations of black cutworm on 9/10/98. Counts were made using an irritant soap solution to disclose black cutworm larvae. Counts reflect the mean number of cutworms (4 replicates) found in a 2 X 4-foot area. Values within the same column that are followed by the same letter are not significantly different (P<0.10).

					# BCW larvae/8 square feet	
	Treatment	**Watered in?**	**Clippings Removed?**	**Rate/ 1000 sq ft**	**9/14/98**	**9/21/98**
1.	Mach 2 SC	yes	yes	1.6 oz	0.25 a	1.5 ab
2.	Mach 2 SC	no	yes	1.6 oz	0.0 a	1.0 ab
3.	Mach 2 SC	yes	no	1.6 oz	0.25 a	0.25 a
4.	Mach 2 SC	no	no	1.6 oz	0.0 a	1.0 ab
5.	Mach 2 G	yes	yes	24.5 oz	0.25 a	5.5 cd
6.	Mach 2 G	no	yes	24.5 oz	0.75 ab	4.0 bc
7.	Mach 2 G	yes	no	24.5 oz	0.5 ab	3.0 abc
8.	Mach 2 G	no	no	24.5 oz	0.75 ab	3.0 abc
9.	Talstar G	no	yes	2.3 lb	0.0 a	0.25 a
10.	Talstar G	no	no	2.3 lb	0.0 a	0.25 a
11.	Check				1.25 b	7.5 d

Table 2. Significance of Mach 2 formulation type, clipping removal and post-treatment irrigation on black cutworm populations, using factor analysis. Step-wise multiple linear regression analysis was conducted, with factors (formulation type, clipping removal, post-treatment irrigation) added into the regression model if the probability was less than 0.05 that the partial correlation was due to chance. Values in the table below represent the correlation coefficient and the probability due to chance for each factor on the 9/21/98 rating date. A probability of 0.05 or less indicates that the interaction was statistically significant. A significant negative correlation coefficient (highlighted in green) indicates a beneficial interaction (i.e., a reduction in black cutworm numbers) between the factor in question and black cutworm populations.

Factor	Correlation Coefficient	Probability
SC formulation	-4.102	0.00
Granular formulation	-0.148	0.030
Clipping removal	-0.205	0.246
Post-treatment irrigation	0.054	0.762

Figure 1. Black cutworm study plot plan. Each plot measured 5 X 12 feet. Shaded plots received 1/10" irrigation following application of Mach 2.

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