Efficacy Evaluation of All-Natural Corn Gluten Blends in Turf for the Control of White Grubs

Michael Brownbridge
Vineland Research and Innovation Centre
Horticultural Production Systems

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SUMMARY
This project was established to provide critical information on the effectiveness of corn gluten-based formulations supplemented with neem seed cake for the control of white grub in turf. Lab tests completed in 2010 showed that the product inhibited feeding of chafer grubs; small scale field trials set up in Oct 2010 were concluded in spring 2011. Chafer grub numbers declined in plots treated with the corn gluten-neem seed cake blend, although observed effects were not statistically significant. Additional field trials were set up on a commercial sod farm in Sept 2011, incorporating a new formulation of the neem/corn gluten blend. Treatments were applied to infested turf to determine the utility of the product against an existing chafer grub infestation. Earlier application to turf in areas where there is a history of chafer infestation (June/July) may have additional benefits, and could be adopted at the home-lawn level, but this strategy was not incorporated into the current trials which focused on demonstrating efficacy. Use of the product on home lawns will be evaluated in 2012, with early applications being made at selected sites that were infested in 2011.

BACKGROUND
Ontario's Cosmetic Pesticide Ban left the general public and landscaping community with few proven tools to combat pests in turfgrass. The current 2-year study was developed in response to calls by lawncare and turf companies for research into the development of new products that are compliant with the pesticide ban. The primary objectives of the study, which started in April 2010, are to:

- Evaluate the efficacy of novel corn-gluten based products against European chafer grubs
- To assess possible beneficial interactions with other candidate products (biological controls) and determine their utility within an integrated management program for turf pests.

Three species of white grubs commonly infest lawns and amenity turf in Ontario but the European chafer, *Rhizotrogus majalis*, is the most common. Larvae preferentially feed on organic matter and the fibrous roots of grasses, causing serious turf damage, particularly during spring and early fall. Insecticides have traditionally been used for their control but the Ban severely restricts the control products available to the lawn-care industry.

Processed corn gluten meal is a 100% natural fertilizer. With an N-P-K rating of 10-0-0 it is actively used in turf production. The product is also a pre-emergent herbicide, suppressing

germination of dandelion and large crabgrass seed when used within a turf maintenance program. Neem seed cake is used as a fertilizer but also has insecticidal and anti-feedant properties (Schmutterer 1990, Lale and Abdulrahman 1999, Cowles 2004, Shah et al. 2008). **The trials proposed aim to combine neem with corn gluten, to develop a product with a range of beneficial attributes for turfgrass production *and* protection.**

Project outputs are targeted to Ontario's turfgrass and lawn care industries, with the goal of providing new turf protection products for application to lawns, turf, recreational areas and golf courses. There is also potential to apply promising technologies in commercial sod production.

References

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Shah FA, Gaffney M, Ansari MA, Prasad M, Butt TM 2008. Neem seed cake enhances the efficacy of the insect pathogenic fungus *Metarhizium anisopliae* for the control of black vine weevil, *Otiorhynchus sulcatus* (Coleoptera: Curculionidae). Biological Control 44: 111-115.

GOALS (2010-2011)

i. Susceptibility of chafer larvae and chinch bugs to a neem-corn gluten blend formulation determined;
ii. Effective neem concentration defined;
iii. Prototype neem-corn gluten blend formulation available for field evaluation.

Progress: Assay techniques were developed to quantify effects of the corn gluten-neem products and to evaluate compatibility with candidate biocontrol agents. Compatibility of these formulations with the fungal biopesticide Met52™ (*Metarhizium brunneum*) was demonstrated. Laboratory and greenhouse trials using field-collected European chafer larvae confirmed the activity of the corn gluten-neem formulation. Larvae fed on the corn gluten granules but there were obvious anti-feedant effects with those formulations containing the neem seed cake (Table 1). Based on these results, field trials were carried out against using the 100% neem seed cake granules and the 70:30 corn gluten-neem blend. Chafer trials were set up in Oct 2010, testing the corn gluten-neem blend alongside other biopesticides, including nematodes (*Heterorhabditis bacteriophoria* – Nemasys G) and fungi (Met52). Several treatments, including the corn gluten-neem blend, had a measurable (although not statistically significant) effect on chafer grub populations and performance on par with or better than the standard insecticide treatment, Merit (Figure 1). Results of these trials were presented to the turf industry at the Landscape Ontario IPM Symposium in Jan 2011 and at the Ontario Turfgrass Symposium in Feb 2011. An article (*Beating the Ban*) was also produced for the summer edition of 'Sports Turf Manager' magazine.

Key Outcome:

- Prototype neem-based formulation identified for future field validation trials
- Efficacy demonstrated against European chafer

Table1. European chafer larvae feeding assay: Mean % weight-gain (±SE) of larvae presented with carrot cubes (Control), corn gluten or corn gluten-neem blend pellets. Results were analyzed by ANOVA. Larval mortality rates were not significantly different among treatments.

	Control	100% Gluten	30% Neem	70% Neem	100% Neem	*F*-value & *p*-value
% weight-gain						
n	39	37	41	41	35	*F* [4, 188] = 5.76
Mean	13.3±1.5	12.2±1.9	4.4±2.6	4.9±2.7	0.98±2.2	*p* = 0.0002 *
Larval mortality						
total *n*	45	48	48	48	47	
dead	6	11	7	7	12	
%	13.3	22.9	14.6	14.6	25.5	

* Significantly different at α = 0.05

GOALS (2011-2012)

1. Validate the efficacy of a refined neem-corn gluten formulation against white grubs under field conditions
2. Engage with the PMRA towards registration of the product for commercial use if promising effects confirmed.
3. Extend findings to the turf industry.

Progress: Locating suitable and untreated (with insecticides) sites for these research trials remained a challenge, so that some of the treatment regimes proposed could not be made. The corn gluten-neem product was applied against late second instar European chafer, effectively assessing the efficacy of the product as a curative treatment for the pest. Field trials were established at an infested turf site in Newmarket. Initial grub densities were >100 grubs/1x0.3m turf strips. All treatments were applied in late September 2011, testing a refined formulation of the 30:70 corn gluten:neem blend alongside other biopesticides, including nematodes (Nemasys G and *Steinernema glaseri*) and a spray treatment of Met52. Preliminary data (populations 3 and 6 weeks after treatment) are presented below (Fig. 2); a final assessment of efficacy will be made in May 2012.

Currently, Amaizeingly Green initiating registration procedures with the PMRA on the blended product and have engaged with a major lawn care company to commercialize the product for lawn turf use.

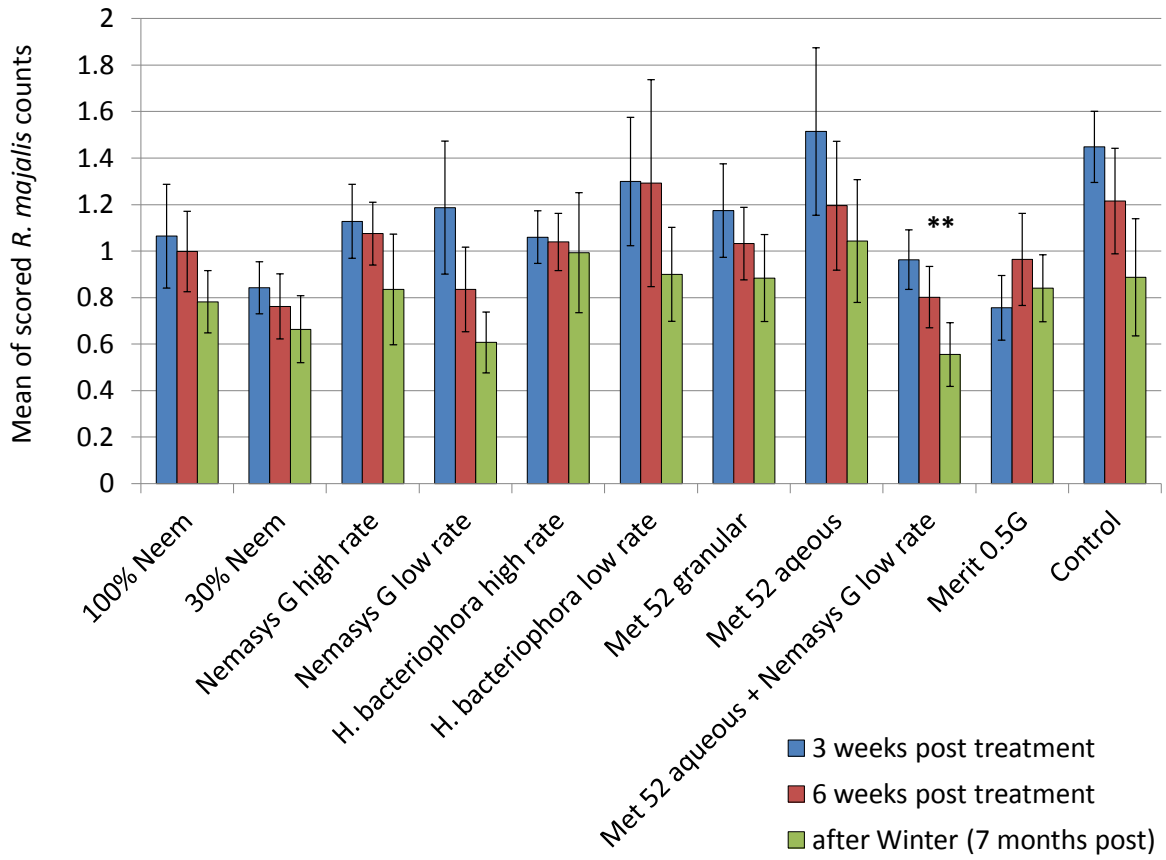

Fig. 1. *R. majalis* larval population change over three post-treatment sampling periods (Oct 2010-May 2011). The scores were assigned by dividing the post-treatment counts by the pre-treatment counts; scores of <1 indicate an effect on the chafer population. Means calculated from 6 replicate plots per treatment. ****** A significant difference in *R. majalis* larval population among the three sampling dates (one-way ANOVA, $F_{[3, 20]} = 3.12$, $p = 0.049$).

Key Anticipated Outcomes:

- Effects of a refined neem-corn gluten formulation against white grubs validated under field conditions
- PMRA engaged towards registration of the product for commercial use
- Knowledge transferred to industry through workshops and other communication pathways (Landscape Ontario IPM Symposium, Ontario Turfgrass Symposium, Sports Turf Manager)

Conclusions

To date, the corn gluten:neem blend has not demonstrated a major curative effect on chafer grubs. However, as-applied it seems to have had a more chronic effect on the larvae and its use may increase their susceptibility to natural pathogens and environmental factors. Use of the product may promote the efficacy of applied biocontrol agents such as nematodes and fungi. These effects have been observed in experimental trials but remain to be confirmed in a home lawn or turf production setting. The product has other benefits, in terms of it functioning as a fertilizer and (owing to the corn gluten content) a pre-emergent herbicide. Refinements are

obviously needed to optimize use rates and timing. However, as a granular product it is readily applied using existing equipment and appears to have a role to play in an integrated lawn management program. The findings highlight difficulties all turf and lawn care companies have in dealing with subterranean pests: that of predicting and detecting infested sites early enough to allow preventative treatments to be applied to best effect. With information gained from 2010/11 trials, in 2012 we propose to apply one selected treatment as a fertilizer/preventative treatment to home lawns and/or turf where high grub populations were observed in 2011, anticipating subsequent infestations in 2012. These will be applied in June to correspond with normal lawn fertilization activities and to coincide with chafer adult emergence and egg-laying; additional treatments will be applied in late August, targeting the developing young larvae.

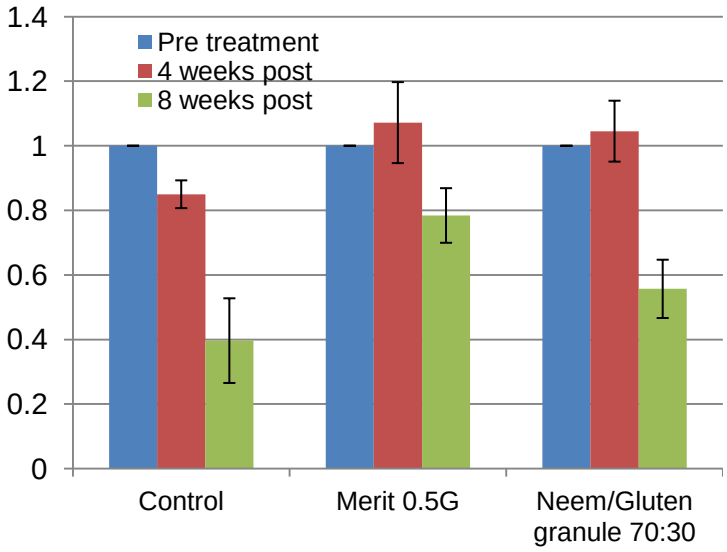

Fig. 2. *R. majalis* larval population change 4 and 8 weeks post-treatment (Oct – Nov 2011). The scores were assigned by dividing the post-treatment counts by the pre-treatment counts; scores of <1 indicate an effect on the chafer population. Means calculated from 6 replicate plots per treatment.

Contribution to Education and Training

Undergraduate student training

- Paul Côté (Undergraduate student, University of Waterloo, ON) – summer technician fulltime May 1 to August 31, 2011
- Scott McGinley (Undergraduate student, University of Waterloo, ON) – coop student fulltime Sept 5 to Dec 22, 2011