Turgrass Entomology Research 2006

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David Smitley
Department of Entomology
Michigan State University

I. Biological Control of Japanese Beetle In Michigan.

At each of the 10 golf course study sites Japanese beetle grubs were collected in the spring and fall from 16 locations along the edge of the original fairway (inoculated or control, depending on the golf course), and from 16 locations along a different fairway from 50 to 150 m away. Forty grubs from each fairway were dissected to determine percent infection by *Ovavesicula popilliae* and milky disease. Japanese beetle adults were collected from each golf course in late July and early August using a standard Japanese beetle trap baited with eugenol. Adults were examined for *Istocheta* eggs.

***Results in 2006*:** *O. popilliae* infection of Japanese beetle grubs continued to increase at sites where it was introduced in 1999 and 2000 (Table 1). At Orchard Lake and Willow golf courses, where *O. popilliae* appeared to have originated as a result of our introductions into a 100 m^2 plot area in 1999 and 2000, the infection of grubs has spread up and down the entire length of a fairway and infected grubs are now being found in the adjacent fairway. Infection levels at those sites have now increased to >30%, a level expected to have a significant impact on the density of grubs in that population. The impact of *O. popilliae* infection on Japanese beetle populations was measured by determining the survival of grubs from fall of 2005 to spring of 2006 (Table 2). At golf courses where more than 5% of the grubs were found to be infected, the decrease in grub density from fall to spring was 57.4% compared with 28.2% at sites where no *O. popilliae* was found (Table 3, Figure 1).

Table 1. Infection of Japanese beetle grubs with *O. popilliae* in 2005 and 2006 at golf course study sites where introduction and control sites were first sampled in 2000. *O. popilliae* apparently established naturally in the Kalamazoo and Battle Creek area (Binder Park, Eastern Hills and Kalamazoo CC) but in Southeast Michigan it was only found where we introduced it in 1999 and 2000 (Orchard Lake, Willow, Bloomfield Hills). Fairways where *O. popilliae* was introduced in 2000 are indicated with a '+'.

Golf course site	*O. popilliae* Introduction site	*O. popilliae* % infection 2000	*O. popilliae* % infection 2005	*O. popilliae* % infection spring 2006	*O. popilliae* % infection fall 2006
Medalist #5			11	0	0
Medalist #4	+	0	0	0	0
Binder Park #18			51	53	52
Binder Park #6		0	31	28	44
Eastern Hills #7			43	42	13
Eastern Hills #5	+	20	17	22	24
Kalamazoo CC #15			17	13	64
Kalamazoo CC #1		6	20	11	41
Bloomfield Hills #13			0	0	0

Bloomfield Hills #6		0	0	0	0
Willow #9	+	0	7	6	43
Willow #10			0	0	8
Orchard Lake #10			0	0	0
Orchard Lake #15	+	0	13	9	30

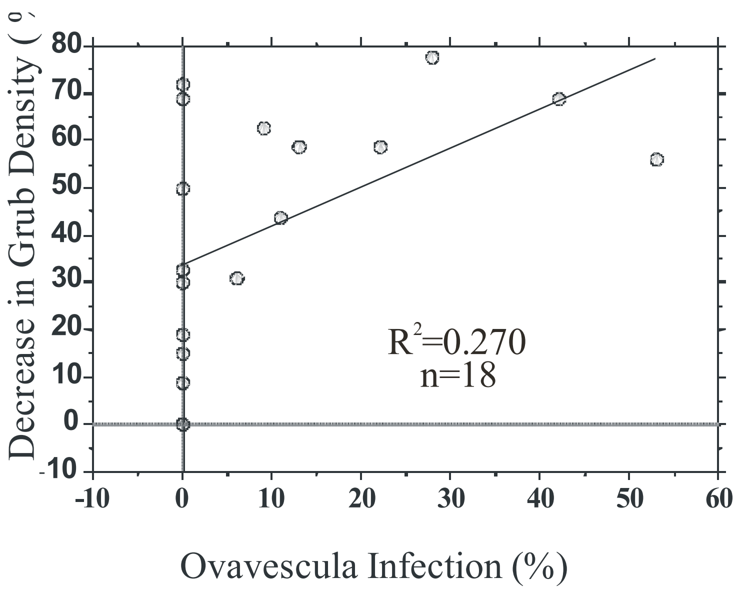
Table 2. Density of Japanese beetle grubs in fall of 2005, spring of 2006, and decrease in density over the winter in relation to % *Ovavesicula* infection.

Willow MetroPark	Fall 2005 # of Grubs	Spring 2006 # of Grubs	Decrease in grubs 2005-2006	% decrease in grub density	% Infection
#9	6.25	4.31	1.94	31%	6%
#10	3.25	1.00	2.25	69%	0%
-					
Orchard Lake					
#15	1.69	0.63	1.06	63%	9%
#10	3.81	2.56	1.25	33%	0%
-					
Bloomfield Hills					
#6	1.25	0.88	0.38	30%	0%
#13	2.13	1.81	0.31	15%	0%
-					
Pine Valley					
SM	3.13	3.19	-0.06	-2%	0%
#4	3.63	2.94	0.69	19%	0%
-					
Cracklewood					
#4	1.50	1.69	-0.19	-13%	0%
#6	5.94	5.38	0.56	9%	0%
-					
KCC					
#15	1.81	0.75	1.06	59%	13%
#1	3.38	1.88	1.50	44%	11%
-					
Eastern Hills					
#5	2.13	0.88	1.25	59%	22%
#7	4.38	1.38	3.00	69%	42%
-					
Medalist					
#4	1.25	0.63	0.63	50%	0%
#5	2.69	0.75	1.94	72%	0%
-					
Binder Park					
#4	4.38	1.94	2.44	56%	53%
#6	3.19	0.69	2.50	78%	28%

Table 3. Impact of Ovavesicula infection on survival of Japanese beetle grubs from fall 2005 to spring 2006.

Activity of *O. popilliae*	**No. of sites**	Mean % *O. popilliae* infection	Decrease in grub density (%)
Plots with no *O. popilliae*	10	0	28.2
Plots with > 5% infection	8	23	57.4

Figure 1. Decrease in Japanese beetle grub density from fall of 2005 to spring of 2006 in relation to percent infection by *Ovavesicula popilliae* at golf course study sites in Michigan.



Project activities:
In 2007, Japanese beetle populations, pathogens infection and parasite activity will be monitored again as described for 2006. Survival from fall of 2006 to spring of 2007 will be analyzed to determine the impact of *O. popilliae* infection. Survival will be compared at sites with and without *O. popilliae.* Because *O. popilliae* appears to be having a significant impact on populations of Japanese beetle, adults from each study site will also be collected and dissected to determine % infection and reduction in egg production due to *O. popilliae* infection.

Impacts: Over 130 people from 20 different counties in Michigan came to our Japanese beetle biocontrol field day in late October to collect infected grubs and take them back their own part of the state. The Kansas Department of Agriculture has initiated a new biocontrol program based on this work. They will be coming to collect infected grubs in May of 2007 to introduce them into Kansas. Populations of Japanese beetle have already decreased enough at some sites in the Kalamazoo and Battle Creek areas that we are no longer seeing defoliation of linden trees and some superintendents are no longer treating all their fairways with Merit Insecticide to prevent grub damage. If what we have seen over the last 5 years is indicative of what we can expect in the future, sites where O. popilliae has been introduced will become heavily infected within 5 years and population of Japanese beetle will begin to decrease, until at 10 years after introduction insecticides may no longer be needed to protect linden trees from defoliation or fairway turf from dying in large patches.

Figure 2. Adult Japanese beetle on a rose petal (A), *T. vernalis* larva feeding on a Japanese beetle grub (B), and *I. aldrichi* depositing an egg on the pronotum of a Japanese beetle.

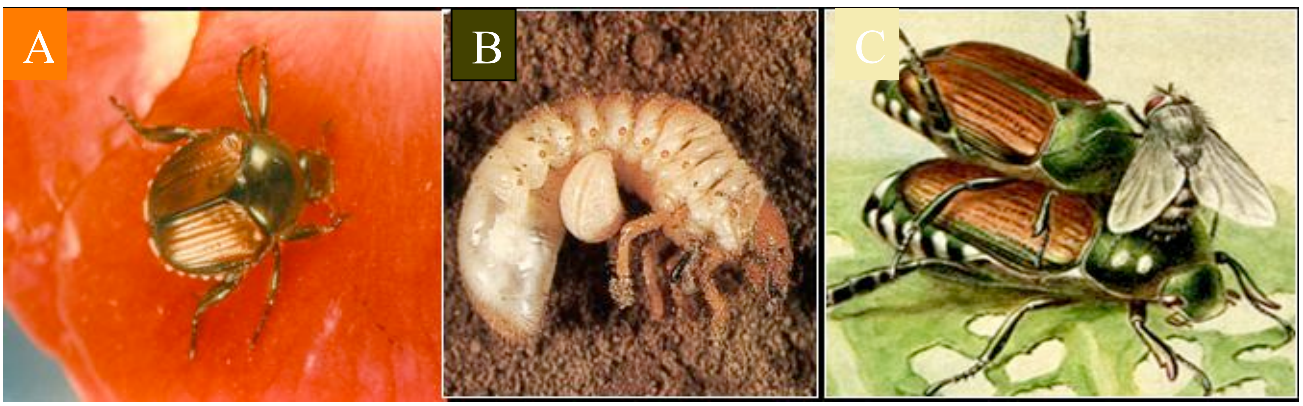
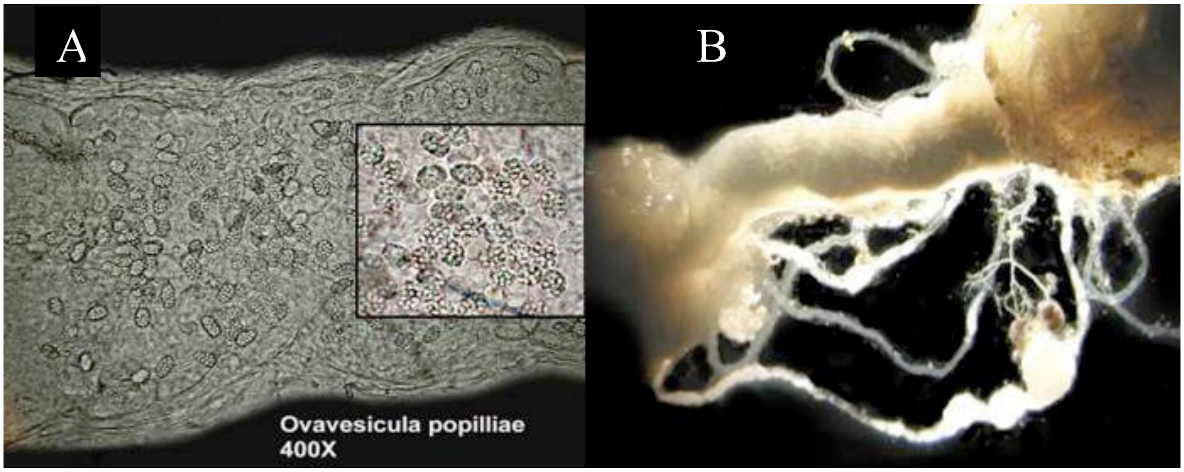


Figure 3. *O. popilliae* infection of Japanese beetle can be diagnosed by the presence of raspberry-like spores in the malpighian tubules (A). Heavy infection causes knotting, swelling and dysfunction of the tubules (B).

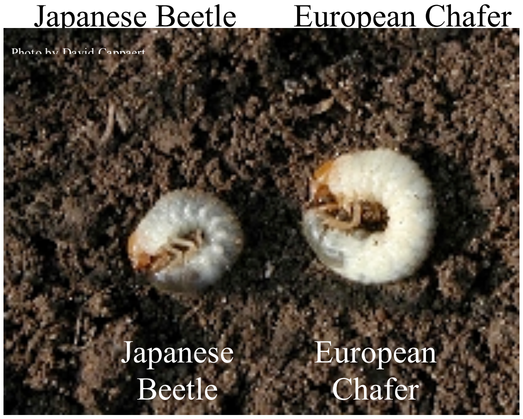


Grub Control Research at Michigan State University, 2006

David Smitley and Terrance Davis, Department of Entomology, Michigan State University

Japanese Beetle

European Chafer



Materials and Methods

An area of non-irrigated rough at The Country Club of Jackson in Jackson County, MI was used for this test. The area in which the test was conducted has been infested with European chafer grubs for more than 14 years and Japanese beetle for the last 12 years. The treatments were all replicated 6 times and consisted of 4 ft x 4 ft plots that were separated by a 2 ft-wide buffer strip. Treatments were applied on one of the following dates: 16 May, 13 Jul, 29 Aug, 22 Sep or 27 Sep. Liquid treatments were applied at 50 psi through a single nozzle hand-held R & D Sprayers® CO_2 sprayer with an 8003 nozzle at a rate of 175 gal/acre of finished spray. Granular treatments were applied with a hand-held "shaker". All treated plots were watered with 1/4" of irrigation after all applications were made that day. The plots were sampled on 25 Sep, 4 Oct or 17 Oct by digging 2 ft^2 from each plot. All grubs were collected, taken to the lab and identified under a microscope. The mean number of European chafer and Japanese beetle grubs found in each treatment are reported in the following four tables.

Results and Conclusions

Timing of Merit and Arena - Testing in 2006 demonstrated that both products are outstanding when applied in May, June or July. Combining results from 2006 with previous years shows very good but less reliable results in August and poor control in September.

Timing of Mach II - Excellent grub control (>80%) when applied in June or July.

Allectus versus Merit - Both products gave outstanding control (>90%) of Japanese beetle grubs when applied in May, July or late August.

EC & JB - Products containing imidacloprid or clothianidin gave excellent control of EC and JB when applied from May to early August. Mach II worked better on JB than on EC. Mach II worked best when applied in July. Sevin worked better on EC than on JB.

Homeowner Products - All of the homeowner products containing imidacloprid or halofenozide gave excellent grub control when applied in July (>80%). Products containing trichlorfon (Dylox) or carbaryl (Sevin) reduced grub counts by 65% when they were applied in late August. Triazicide (touted as a superior replacement for Diazinon) failed to control grubs in this test.

New Products - DPX E2Y45 looks like another excellent grub control product. It should be available in 2008 or 2009. Although not in our test this year, Meridian has shown excellent grub control in the past and will be labeled for turf in 2007.

Homeowner Products	**Rate**	**ai/A**	**Date**	**Type**	**All Grubs**
Merit 75	6.4 oz/A	0.3 lb	7/13/2006	spray	0.2 a
Complete Killer 0.2G	3.0 lb/1000 ft2	0.26 lb	8/29/2006	granular	0.5 a
Season-Long Grub Control 0.2G	2.87 lb/1000 ft2	0.25 lb	7/13/2006	granular	0.8 a
Grub Stop Once and Done 1.5G	3.0 lb/1000 ft2	1.96 lb	7/13/2006	granular	1.8 ab
24 hour grub control 6.2G	3.0 lb/1000 ft2	8.10 lb	8/29/2006	granular	3.5 bc
Sevin Lawn Insect Granules 2G	9.0 lb/1000 ft2	7.84 lb	8/29/2006	granular	3.5 bc
Grub Stop Once and Done 1.5G	3.0 lb/1000 ft2	1.96 lb	8/29/2006	granular	4.0 bc
Triazicide Insect Killer 0.1G	1.2 lb/1000 ft2	.05 lb	8/29/2006	granular	10.7 c
Untreated Check					10.1 c

Arena Applications on May 8, July 13 and September 22, 2006					
Merit 75	6.4 oz/A	0.3 lb	7/13/2006	spray	0.0 a
Arena 50 WDG	8 oz/A	0.25 lb	5/8/2006	spray	0.0 a
Arena 50 WDG	10.9 oz/A	0.34 lb	7/13/2006	spray	0.0 a
Merit 75	6.4 oz/A	0.3 lb	5/8/2006	spray	0.3 a
Arena 50 WDG	8 oz/A	0.25 lb	9/22/2006	spray	6.8 b
Arena 50 WDG	8 oz/A	0.25 lb	9/27/2006	spray	8.8 b
Untreated Check					8.4 b

Merit, Arena and DPX E2Y45 for Grub Control					
Merit 75	6.4 oz/A	0.3 lb	7/13/2006	spray	0.0 a
Arena 50 WDG	10.9 oz/A	0.34 lb	7/13/2006	spray	0.0 a
DPX E2Y45 1.67 SC	8 fl oz/A	0.104 lb	5/8/2006	spray	0.2 a
DPX E2Y45 1.67 SC	16 fl oz/A	0.209 lb	5/8/2006	spray	0.3 a
Dylox 6.2 G	130 lb/A	8 lb	9/22/2006	granular	0.7 a
Untreated Check					8.4 b

Merit and Allectus Applications on May 5, July 13 or Aug 29, 2006					
Allectus 0.81 SC	3.6 pt/A	0.2 lb/0.16 lb	7/13/2006	spray	0.0 a
Merit 2F	1.25 pt/A	0.3 lb	7/13/2006	spray	0.0 a
Allectus 0.81 SC	3.6 pt/A	0.2 lb/0.16 lb	5/8/2006	spray	0.3 ab
Merit 2F	1.25 pt/A	0.3 lb	8/29/2006	spray	0.5 ab
Merit 2F	1.25 pt/A	0.3 lb	5/8/2006	spray	1.0 b
Allectus 0.81 SC	3.6 pt/A	0.2 lb/0.16 lb	8/29/2006	spray	1.2 ab
Untreated Check					16.2 c

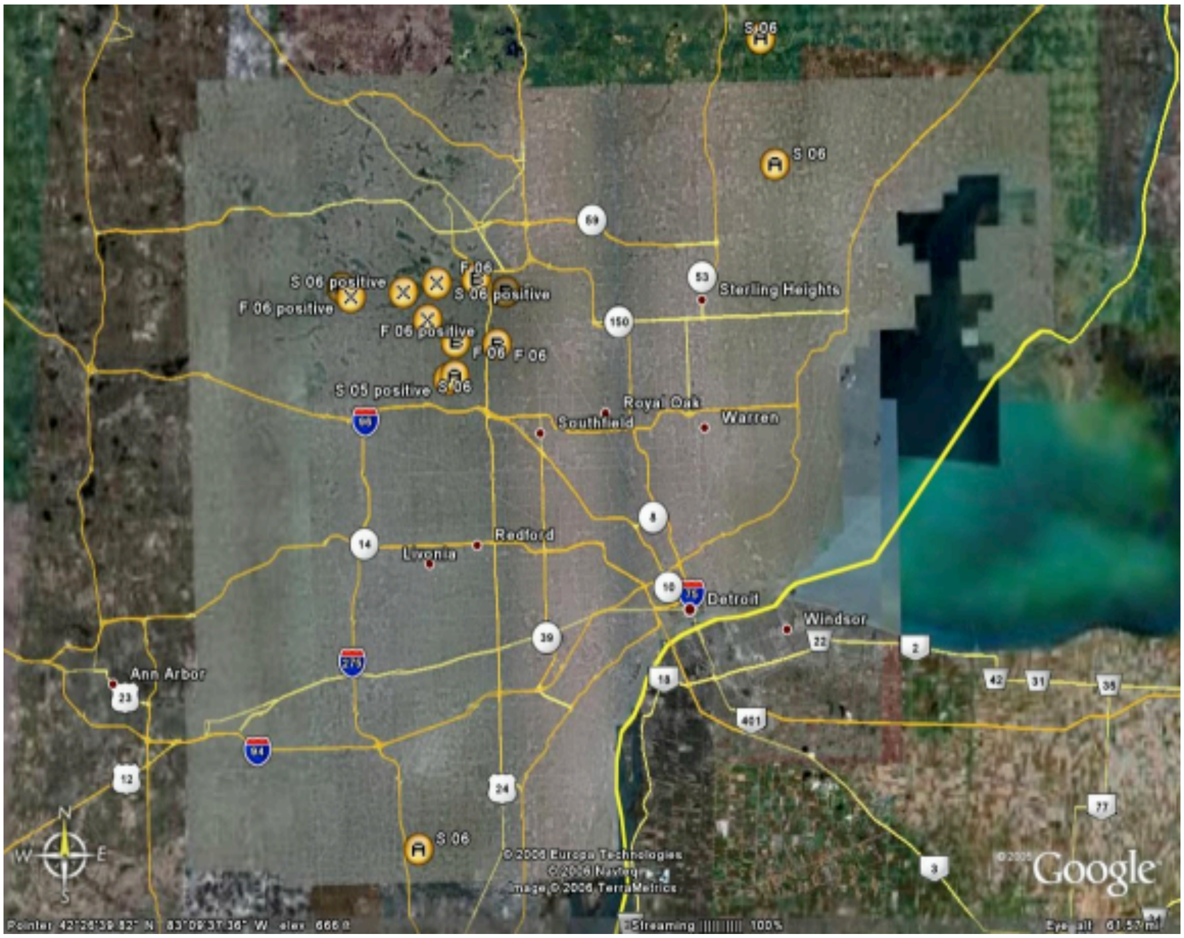


Figure 4. Results of a survey for European crane fly in the Detroit area. Sites marked with an X were positive. Sites marked with an A or a B were negative.