Biorational Plant Protectants for Controlling Adult Japanese Beetles

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Nature of Work: Japanese beetles, *Popillia japonica* Newman, are destructive, polyphagous insects that feed on over 300 different plant species, including many ornamental landscape plants. Since their introduction into the United States, Japanese beetles have spread rapidly throughout the Eastern United States with isolated populations in the Western United States and Canada. Due to the large numbers of beetles often present and their continual movement as adults, eradication of Japanese beetles is not a practical solution. In addition, pesticide applications in many urban settings are complicated by the proximity to people, adherence to reentry restrictions, and public concerns about pesticides. An alternate approach would be to deter pests with the use of low toxicity plant protectants including organic plant derivatives. As public concerns about pesticides increase, these plant protectants may provide desirable alternatives.

Plant protectants can be very effective at controlling Japanese beetles. Some synthetic insecticides (e.g., Sevin) function as effective protectants/antifeedants for adult Japanese beetles and rarely impact pest populations. Development of low toxicity protectants would broaden the choices in managing Japanese beetles. Currently, there are several products available for controlling Japanese beetle. The objective of this study was to field test commercially available plant protectants, including selected botanical derivatives, for their efficacy of deterring Japanese beetles.

The experiment, a randomized complete block design with 10 individual tree replicates consisted of 10 treatments. Treatments included six products formulated from plant derivatives, one bacteria, one pyrethroid, carbaryl as a common synthetic control, and an untreated control (Table 1). The experiment was conducted at both the Horticulture Field Laboratory (HFL), Raleigh and the Mountain Horticulture Crops Research Station (MHCRS), Fletcher (near Asheville). Himalayan birch [*Betula utilis* var. *jacquemontii* (Spach) Winkl] which is a preferred host for Japanese beetles, was used as the host species (Ranney and Walgenbach, 1992). Trees were approximately 30 inches in crown diameter, 6.5 ft high and spaced 8 ft apart when planted in March 1997. Each tree received 0.3 liters (10 fluid ounces) of each treatment solution applied via a diaphragm-type backpack sprayer from a single hollow cone nozzle at 40 psi. A preliminary study determined this volume was adequate to wet the upper and lower leaf surfaces on each tree. Treatments were applied between 7:00 AM and 9:00 AM June 19 at HFL and June 25, 1997 at MHCRS. Treatments were reapplied two weeks after initial application. At HFL, climatic conditions at application were partly cloudy, 65-70ºF, and wind of 0-5 MPH. Conditions were similar at MHCRS except temperature was 60-65ºF. All damaged leaves were removed prior to initial treatment application. Visual ratings of percent defoliation (skeletonization) were conducted weekly for five weeks following initiation treatment application by two independent evaluators at each location. Few beetles remained after the fifth week. Data were averaged over both evaluators at each location and subjected to analysis of variance (ANOVA). Treatment means were compared using least significant difference with P = 0.05.

Results and Discussion: There was a significant treatment x location x time interaction so weekly evaluation data is presented for each location (Fig. 1). Two weeks after treatment initiation, Tame significantly reduced feeding injury compared to the untreated control at both locations (Figs. 1A and 1B). Five weeks after the initial application, Tame averaged 2% and 3% defoliation compared to 40% and 100% defoliation of the untreated control at HFL and MHCRS, respectively. Rotenone also reduced Japanese beetle damage compared to the untreated control from weeks two to five at both locations excluding week five at MHCRS. Rotenone averaged 10% defoliation at HFL after 5 weeks, whereas trees averaged 92% at MHCRS. At HFL, from 3 to 5 weeks after initial application, Neemazad and X-CLUDE also reduced feeding damage compared to the untreated control. However, the reduction in damage was minimal. At HFL, Hot Pepper Wax, Garlic Barrier, M-Trak, Sevin, and Triact were never different from the untreated control (data not shown). At MHCRS, none of the treatments excluding Tame and Rotenone were significantly different from the untreated control (data not shown). The differences in treatment response may have been due to the differences in insect pressure and rainfall. HFL received 5.8 inches (0.6 in. during weeks 1-2, 4.8 in. during week 5) during the study period, whereas MHCRS received 7.3 inches (4.0 in. during week 1, 1.9 in. during week 3). There were no symptoms of phytotoxicity on any of the trees.

Significance to Industry: Eradication of Japanese beetles is not a viable option. Japanese beetles, however, have an extremely wide host range. Therefore, it may be practical to deter feeding from ornamental plantings to unmanaged vegetation. Tame was a very effective Japanese beetle deterrent, whereas Rotenone was moderately effective.

However, their LD_{50} oral ratings may limit widespread use. Thus, continued testing of naturally occurring compounds or synthetic analogues is desirable to find less toxic alternatives.

Literature Cited:

1. Ranney, T.G. and J. Walgenbach. 1992. Feeding preference of Japanese beetles for taxa of birch, cherry, and crabapple. J. Environ. Hort. 10:177-180.

Table 1. Treatments applied to Himalayan birch trees.

Product	Pesticide	Rate
Untreated control	water	——
Hot Pepper Wax	3% capsaicin	4.0 fl oz/gal
Garlic Barrier	garlic extract	12.5 fl oz/gal
M-Trak	10% Bacillus thuringiensis var. san diego	3.0 fl oz/gal
Neemazad 4.5EC	azadirachtin	0.15 fl oz/gal
PT70 X-CLUDE	1.1% pyrethrin	2.0 fl oz/gal
Rotenone 5WP	rotenone	3.3 oz/gal
Sevin 4F	carbaryl	0.5 fl oz/gal
Tame 2.4EC	fenpropathrin (synthetic pyrethroid)	0.35 fl oz/gal
Triact 90EC	neem oil extract	0.85 fl oz/gal

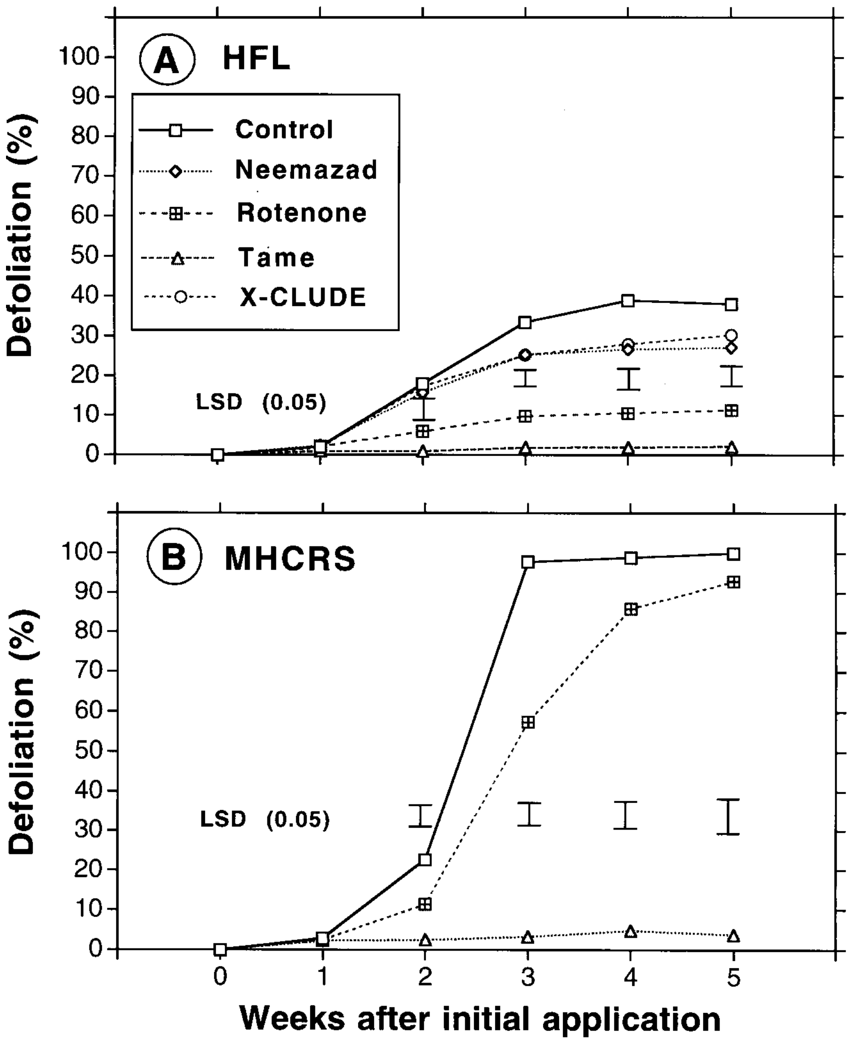

Fig. 1. Percent defoliation of foliage of Himalayan birch treated with different pesticides. Only treatments that differed from the control are presented.