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Using "Soft" Pesticides to Conserve Natural Enemies in Washington Potato Fields

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Several major insect pests attack potatoes in the Pacific Northwest, including aphids, spider mites, Colorado potato beetles, and wireworms. Organophosphate and other broad-spectrum pesticides are available to control these pests, but may be lost in the future as the Food Quality Protection Act is implemented. Also, these broad-spectrum pesticides kill not only pests but also beneficial insects and spiders, and so are not compatible with biological control. For these reasons potato growers in Washington are interested in new, more selective (a.k.a. "softer") pesticides.

Softer pesticides could allow the conservation of native natural enemies in potato fields. Increased densities of predators will slow the rate of pest resurgence following pesticide application, and thus can lead to fewer total pesticide applications in a season. The goal of our research, funded by the Washington State Potato Commission, is to improve biological control in Washington by learning more about how we might conserve beneficial insects through the use of softer pesticides.

Our field work in 2001 had two parts: 1) Intensive sampling of the predator communities in potato fields treated with soft and hard pesticides, and 2) cage experiments where we reproduced predator communities typical of fields treated with soft and hard pesticides, and then measured the predators' impact on green peach aphids.

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Potato Regional IPM Project

The potato regional IPM program is a cooperative effort between university and private researchers, growers, and the Washington State Potato Commission. The regional IPM program is a large-scale comparison of whole potato fields, where some of the fields are treated with hard pesticides and others are treated with newer, more selective pesticides. The “hard” fields were treated with Methamidophos (Monitor) for aphids and Esfenvalerate (Asana) for Colorado potato beetles, while the “soft” fields were treated with Pymetrozine (Fulfill) for aphids and Spinosad (Success) for Colorado potato beetles.

We intensively sampled predator populations in eleven production potato fields that were part of the Regional IPM program. Broad-spectrum pesticides were applied to eight of the fields and selective pesticides were used on the remaining three. As an additional comparison we also sampled predators from three certified organic fields, for a total of fourteen fields sampled.

Using a D-vac machine, which is essentially a giant vacuum cleaner that is powerful enough to suck up insects, we collected predators from 100 randomly selected plants in each field on each of two sample dates. The first sample from each field was collected in July, and the second sample was collected in August. Thus, we had one sample from each field that was collected around the time of canopy closure and a second sample after canopy closure.

We found that four predators were very common: big-eyed bugs, damsel bugs, ground-dwelling dwarf spiders, and a second group of spiders that hunt in the plant canopy. (Big-eyed bugs and damsel bugs have been featured in “Bug of the Month” articles in *AENews.* See http://www.aenews.wsu.edu/Oct01AENews/Oct01AENews.htm#BugOMonth and http://www.aenews.wsu.edu/Dec01AENews/Dec01AENews.htm#BugOfTheMonth , respectively.) Both big-eyed and nabid bugs were significantly more abundant in the soft pesticide & organic fields than in fields treated with broad-spectrum pesticides (Figure 1). Densities of dwarf spiders did not significantly differ among the three treatments. Spiders other than dwarf spiders were most abundant in organic fields.

Overall, predator densities were highest in soft and organic fields and very low in fields treated with broad-spectrum pesticides. Soft pesticide and organic fields had similar predator densities. However, the predator composition of the three types of fields also differed (Figure 2A-C). Broad-spectrum fields were dominated by dwarf spiders (Figure 2A), while big-eyed bugs were the most abundant predators in selective pesticide fields (Figure 2B). Organic fields were similar to conventional soft-pesticide fields in community composition, except that big-eyed bugs made up an even larger fraction of the predator community and spiders other than dwarf spiders were relatively common (Figure 2C).

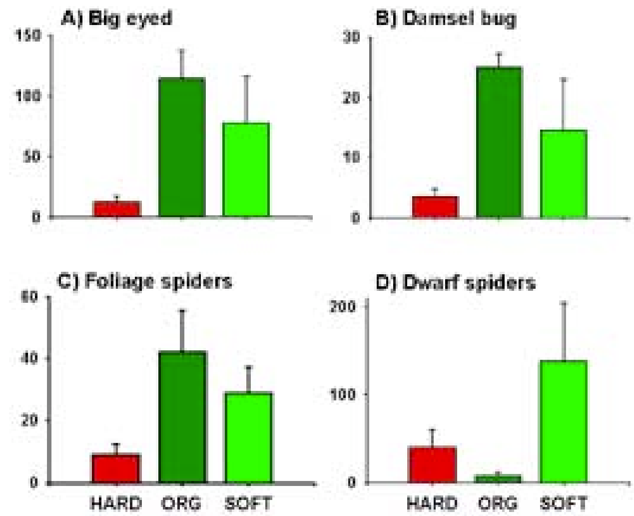

Figure 1. Densities of A) big-eyed bugs, B) damsel bugs, C) dwarf spiders and D) other spiders in hard, soft and organic potato fields. 100 plants were sampled in each field at each of two sample dates. Big-eyed and damsel bug densities, and spiders other than dwarf spiders, were most abundant in soft and organic fields and less common in broad-spectrum fields. Dwarf spiders were most abundant in fields treated with soft pesticides. Predators were as much as 10X more abundant in fields treated with soft pesticides, compared to those treated with broad-spectrum pesticides.

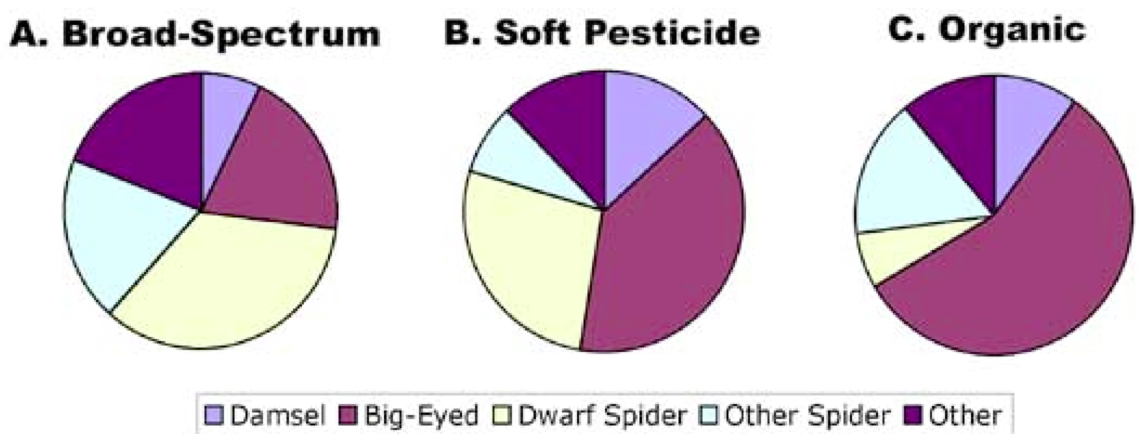

Figure 2. Proportional makeup of the generalist predator community in potato fields treated with A) broad-spectrum pesticides, B) selective pesticides, and C) certified organic fields. Hard pesticide fields were dominated by dwarf spiders, while the most abundant predators in selective and organic fields were big-eyed bugs.

Cage Experiments

We conducted a field experiment in which we manipulated natural enemies to determine their impact on green peach aphids. Our field experiments were conducted in a potato field at the WSU Othello Research Station in Othello, Washington. In this experiment we manipulated predator densities to achieve the following three treatments: 1) predators removed (treatment O), simulating predator densities typical of hard pesticide fields; 2) predators added at the average predator density, determined as the average number of each predator collected in production fields during our field sampling (AVG), simulating typical predator densities in fields treated with soft pesticides; and 3) high predator density added, determined as the mean of the three highest densities recorded during our field sampling (HIGH); simulating predator densities typical of organic fields. After releasing or removing predators, we introduced thirty aphids to each cage. Once a week for three weeks, we monitored aphid densities by carefully hand searching and counting aphids on each potato plant. We found that predators slowed the rate of aphid increase 90% in the two predator treatments (Figure 3).

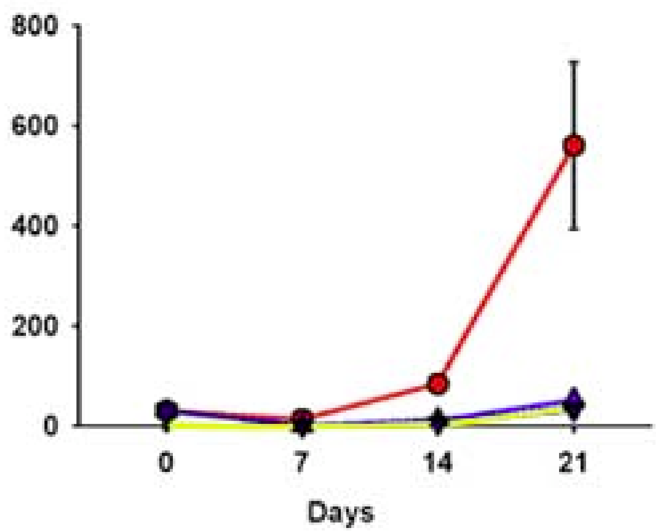

Figure 3. Green peach aphid populations in large field cages with predators removed (red line), average predator densities (light blue line), or with high predator densities (yellow line). Aphids increased very rapidly when predators were removed, but slowly when predators were present. Predators used were at densities typical of fields treated with soft pesticides.

(continued)

Summary

The selective pesticides we examined were very effective in conserving predators. Predator densities were as much as ten times higher in fields receiving soft instead of hard pesticides. In most cases predator densities in soft fields were similar to those in organic fields. Our cage experiments demonstrated that predator densities in soft and organic fields are high enough to greatly slow the rate of aphid increase. However, predator densities in fields treated with broad-spectrum pesticides are probably too low to have much impact on aphids. Because predators are very effective at slowing the rate of aphid increase, conserving predators through the use of selective pesticides may allow growers to reduce the total number of sprays needed each year.

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