USING PERIMETER TRAP CROPS TO MANAGE STRIPED CUCUMBER BEETLE AND BACTERIAL WILT

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The striped cucumber beetle, *Acalymma vittatum*, is the major insect pest of winter squash, pumpkin and other cucurbits in New England and throughout the Northeast. In addition to direct feeding damage, cucumber beetles vector the bacterium *Erwinia tracheiphila*, which causes bacterial wilt in cucurbits. Striped cucumber beetles over-winter in the brushy edges surrounding fields, and move into a crop from the field margins in early summer. Their arrival often coincides with emergence of winter squash and pumpkin crops. Typically, beetles spread rapidly throughout the field, and are managed with full-field pesticide sprays.

In Massachusetts, we have spent the past four years testing a perimeter trap cropping (PTC) system for managing cucumber beetle and bacterial wilt in butternut squash and other cucurbit crops. Perimeter trap cropping uses the relationship of the insect pest with its host crops to the advantage of the grower, to save on pesticide and money while protecting crop health. In a PTC system, a crop that is more attractive to the pest is planted around the outer edge of the main cash crop. No matter what directions they come from, insects encounter the trap crop first, and stop to feed. Pesticides applied to the border prevent further invasion of the main crop.

How the PTC system was developed

In New England, this system was first developed and tested by Jude Boucher of University of Connecticut, in summer squash and cucumber. Based on his success, we started working in 2003 to apply it to butternut squash, which is widely grown in Massachusetts. Small plot (50X50 feet) studies were done from 2003-2005 at our research farm, and on-farm studies, where we test the system in whole farm fields, were done in 2003, 2004 and 2006.

We used Blue Hubbard squash as the border trap crop, because it is highly attractive to beetles, emerges quickly as a strong seedling, the seed is not expensive, and the crop can be marketed. In both small plots and large fields, beetles concentrated in high numbers on Hubbard squash borders. Originally, we asked growers to apply insecticide to the border when we first saw any beetles arrive. Occasionally there was a delay in making the application, and the border was destroyed by feeding damage. The result was that beetles flowed into the main crop through this gap. In conventional fields without a trap crop, beetles rapidly spread throughout the field.

Many growers have begun to use a systemic neo-nicontinoid insecticide (e.g., imidacloprid) applied in the furrow at planting, so it seemed promising to try this as a border treatment. Growers drove their planter in a circle around the entire field, creating a complete border -- no matter what shape the field was – treated with Admire. This system was used in on-farm trials in 2004 and 2006. The main crop of PTC fields was planted without any insecticide treatment. Beetles feeding on treated borders died and piled up around the plants. This system proved very effective, protecting the main crop without a spray as long as the border was not destroyed by other factors. Conventional fields were treated at planting or sprayed as needed. The main butternut crop of the PTC system fared as well as the main crop of the conventional system – even though the PTC crop was never sprayed. The cost savings in pesticide was over 90%, depending on the size of the field (see Table 1). We also found that a foliar spray in the PTC border worked as well a systemic, as long as the application was made in time to prevent destruction of the border crop.

Partial Budget Analysis -- Perimeter Trap Cropping, Hadley, MA 2006

Conventional Management w/ full field systemic treatment

	acres	length	width	row ft whole field	Treated area (acres) (whole field)	Admire Pro used (oz) at 4 oz/A	cost (total) @ $8.20/oz	avg cost per acre
Field 1	14	1,000	610	87,120	14	56.0	$459.20	$32.80
Field 2	5	1,000	189	31,114	5	20.0	$164.00	$32.80

Perimeter Trap Crop Management with systemic in border only

	acres	length	width	row ft in perimeter	Treated area (acres) (perimeter only)	Admire Pro used (oz) at 4 oz/A	cost (total) @ $8.20/oz	avg cost per acre
Field 1	14	1,000	610	3,220	0.52	2.1	$16.97	$1.21
Field 2	5	1,000	189	2,378	0.38	1.5	$12.53	$2.51

Savings with PTC

		Savings/acre	Savings per Field	% Savings
Field 1	14	$31.59	$442.23	96%
Field 2	5	$30.29	$151.47	92%

Table 1. Cost analysis comparing cucumber beetle control with Admire-treated trap crop around butternut vs full-field Admire treatment. It is based on the following assumptions: 1) One row width perimeter, same row spacing as main crop (7 ft between rows, 14 inch in row); 2) Cost of systemic (Admire Pro, imidacloprid) = $287 per 35 oz bottle, $8.20 per oz.; 3) Rate used = 4 oz per acre or 1 oz per 1556 row ft @ 7 ft row spacing; 4) Systemic applied in furrow at planting; 5) No spray to main crop in PTC field; 6) Perimeter crop is sold; value is approximately the same per acre as main crop.

Other trap crops and main crops

Growers need alternatives to Blue Hubbard for the perimeter crop, since the market for Hubbard squash is limited. Since pumpkin and other winter squash types are also widely grown, it would be useful if PTC worked in those crops as well. The PTC system works only when there is a difference in attractiveness between the perimeter and the main crop. We conducted two variety trials to evaluate the attractiveness of various winter squash, pumpkin and gourd crops and cultivars to striped cucumber beetle (see Table 2). We found that crops of the species *Cucurbita maxima* were significantly more attractive (more beetles, and more feeding damage) than *Cucurbita pepo* or *Cucurbita moschata* crops. There were variations within species and among cultivars, but the results suggest that selecting a *C. maxima* is the best option for the trap crop. Buttercup and kabocha squashes, which have a strong market demand in New England, were evaluated as perimeter crops in farm fields in 2006 and were as effective as Hubbard squash. Many of the specialty and giant "pumpkin" types are actually *C. maxima*, including Prizewinner, Big Max, Valenciano, and Cinderella pumpkins (Table 2). We have worked with fields of mixed standard pumpkins surrounded by Prizewinner or Blue Hubbard with good success. We have also seen success with Blue Hubbard around a mix of various winter squashes and pumpkins that were all *C. pepo* and *C. moschata*, in smaller scale diversified operations. Seed catalogues should indicate the species for each crop and cultivar they sell.

One other factor to consider is the susceptibility of the perimeter crop to bacterial wilt. Some *C. maxima* crops (e.g. Turks Turban) are very susceptible, and are easily infected when fed upon by infected beetles. They die quickly, and could serve as a disease reservoir by infecting any beetles that feed and move on into the main crop. Fortunately, Hubbard and buttercup types are *not* highly susceptible to wilt.

Growers are increasingly using transplants for winter squash and pumpkin. To use PTC on transplants, start enough trap-crop transplants to surround the main crop. Make sure the

perimeter crop plants are at least as big as the main crop. Apply a systemic insecticide as a transplant drench to the flats of the border crops, about 24 hours before transplanting.

Tips for making it work

The following recommendations will help to make the perimeter trap crop system effective, and will reduce any risks associated with trying this novel approach on your farm:

•Rotate to a field that has not had vine crops for 2-3 years, to reduce the striped cucumber beetle populations and make sure all come from *outside* the field (a small proportion of cucumber beetles overwinter *in* the field). Don't expect PTC to control overwhelming populations without any full field sprays – although it might!

•Plant the trap crop in good soil, so that it completely encircles the cash crop without gaps. No matter what the field shape, make sure the border crop surrounds it. Breaks for spray lanes are not a problem, but larger gaps will allow beetles to flow in, as if you had 'opened the door'.

•Use two trap crop rows on field borders where high pressure is expected (next to woods or near previous cucurbit fields).

•Make sure trap crop comes up before or at the same time as main crop.

•Check the field regularly both before and after beetles arrive. Scout both the border and the main crop while you are getting to know the system. The critical period is before the 5-leaf stage.

•Spray the perimeter as soon as beetles appear on the trap crop. Do not wait to reach a threshold in the border. If a systemic was applied, scout to be sure it is working (look for dead beetles near the plants).

•Use a pre-determined action threshold for main crop sprays (e.g. 2 beetles per plant).

•Keep the perimeter in good shape. If perimeter has large gaps or is destroyed by feeding, tractors, flooding or other problems, you may need full-field sprays.

•Try one field first and get to know the system gradually.

Table 2. Pumpkin and squash crops and species tested for attractiveness to cucumber beetle, UMass 2004

Cultivar Name	Type	Species
Red Kuri	Hubbard	*Cucurbita maxima*
Blue Hubbard	Hubbard	*Cucurbita maxima*
Ambercup	buttercup	*Cucurbita maxima*
Prizewinner	Giant pumpkin	*Cucurbita maxima*
Valenciano	White pumpkin	Cucurbita maxima
Cinderella	Specialty pumpkin	*Cucurbita maxima*
Big Max	Giant Pumpkin	*Cucurbita maxima*
Waltham Butternut	butternut	*Cucurbita moschata*
Calabaza	Latino pumpkin	*Cucurbita moschata*
Table Ace	acorn	*Cucurbita pepo*
Delicata	Delicata	*Cucurbita pepo*
Rocket	mid-sized pumpkin	*Cucurbita pepo*
Magic Lantern	mid to large sized pumpkin	*Cucurbita pepo*
Ornamental Gourd	Small mixed gourd	*Cucurbita pepo*
Speckled Swan gourd	specialty gourd	*Lageneria siceraria*