EFFECTS OF MANAGED FERAL VEGETATION FIELD BORDERS ON INSECTS IN COTTON AND SOYBEAN FIELDS IN NORTH CAROLINA: AN INTERIM REPORT

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Abstract

The effects of 5m wide, feral vegetation field borders on insects and other arthropods in cotton and soybean fields were investigated through intensive sweep net sampling and visual inspections. Field borders appeared to enhance beneficial arthropod populations in cotton fields but had less effect on these organisms in soybeans. Lygus bug populations were higher in cotton fields with borders, as were bean leaf beetles in soybean fields with borders. Bollworm numbers and damage were significantly lower in fields of both crops with borders than fields without.

Introduction

The environmental impacts of agriculture are receiving increasing scrutiny by the general public. Issues of particular concern include the effects of agricultural practices on surface and ground water quality and on wildlife habitat. Field border filter strips have been recommended by conservation agencies to reduce nutrient and soil runoff from crop fields. These borders may also reduce off-target movement of agricultural pesticides, both by intercepting drift (Cuthbertson and Jepson 1988) and by reducing movement of soil with adsorbed pesticides. Field borders may be planted to perennial grasses or may consist of natural vegetation managed through mowing or selective application of herbicides. Borders with suitable vegetation composition can also greatly enhance small game and songbird habitat on agricultural land. However, growers may be reluctant to implement field borders without knowledge of the impact of these strips on crop production.

Little work specifically addressing the pest management implications of managed field borders has been done in North America; most North American work on this topic has concerned the distribution and dynamics of specific pest or beneficial species in relation to existing, unmanaged field margins (Brandenburg and Kennedy, 1982; Highland and Roberts, 1989; Landis and Haas, 1992; and others). However, field border vegetation manipulation has received some attention. Snodgrass and Stadelbacher (1989) investigated the impacts of fertility manipulations in grass and grass-legume combinations on ground beetle (Carabidae) and spider (Aranae) populations in roadside margins in Mississippi; they found little effect from different fertility regimens on these beneficial insects. Fleischer et al. (1989) studied the effects of mowing and herbicide application on the abundance of host plants for tarnished plant bugs *(Lygus linolaris*) in roadsides in cotton production areas.

We have been investigating the effects of feral vegetation borders 5 m wide on the insects in cotton and soybean fields in eastern North Carolina for the last two growing seasons. In the system we are assessing, the borders are maintained through targeted applications of herbicides to limit encroachment of woody vegetation. We have attempted to gather information on both the beneficial and pestiferous insects in these crops.

Methods and Materials

A large, multi-disciplinary project evaluating the impacts of herbicide maintained, herbaceous field borders on wildlife and water quality is currently under way in two areas in North Carolina and a third area in Virginia. Each of these three study areas consists of approximately 1,000 ha; within each area, field border treatments have been imposed on whole fields. Approximately half of the fields in each area have had a 5 m, herbaceous border established completely around the field perimeter. The remaining fields are farmed up to the ditch-bank or woods margin. Borders are maintained through targeted application of herbicide through a low volume, no-drift wipe-on applicator. This device applies systemic herbicide only to emergent woody vegetation (that extending above the desired border canopy height) and greatly reduces or eliminates the need for mowing. Borders have been established in these study areas for up to three years; broad-leafed perennials, perennial grasses, and woody vines appear to dominate these strips as they age.

A total of 10 fields of each crop were identified in Wilson and Edgecombe Counties of North Carolina; five fields of each crop have a 5 m herbaceous vegetation border around the field perimeter. All fields included within the study were tended by the same grower, and agronomic management within each crop was consistent across field border treatments.

Within each field, two sampling areas were established. Each area was approximately 100 m wide and ran perpendicular to a field border. Sampling was conducted at 0, 10, 20, and 30 m distances from the field edge. At each distance in each sampling area several sampling techniques were employed.

Cotton Insects

Insects of particular interest in cotton included thrips, plant bugs, stink bugs, bollworms, foliage feeding caterpillars, aphids, beneficial insects including big-eyed bugs (*Geocoris* spp.), minute pirate bugs (*Orius insidiosus*), damsel bugs (*Nabis* spp.), Coccinellids, lacewings, and spiders. At crop

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emergence, thrips populations were assessed by whole plant sampling of 5 seedlings at each distance in each transect. Plants were excised at ground level and placed in jars with soapy water; these samples were washed and the thrips counted later in the lab. Sweep net samples (15 sweeps per sample) were taken weekly, season long, beginning when the plants had two true leaves. Once the plants in each field reached reproductive growth stages, weekly examinations of flower buds and fruit for damage were conducted (20 fruiting forms per sample), and 20 terminals per sample were examined weekly for bollworm complex eggs. Spider mite incidence and aphid infestation (rating) were assessed weekly but will not be reported here.

Pit-fall traps were placed twice during the growing season in the border (where present) and at 20 and 40 m from the field margin to measure ground-dwelling insects; however, the resultant samples have not been processed at the time of this writing.

Insecticide use in the cotton fields was limited to aldicarb at planting and one application of a pyrethroid in August in response to bollworm pressure.

Soybean Insects

Insects of particular interest in soybean included bean leaf beetle (*Cerotoma trifurcata*), foliage-feeding caterpillars, three-cornered alfalfa hopper (*Spissistilus festinus*), the beneficial insects listed above, and spiders. Sweep net samples were taken weekly, season long. Once crop plants reached reproductive growth stages, pods were examined weekly for damage from chewing insects. Weekly estimates of spider mite occurrence were also made but will not be reported here.

Pit-fall traps were placed twice during the growing season in the border (where present) and at 20 and 40 m from the field margin to measure ground-dwelling insects; however, the resultant samples have not been processed at the time of this writing.

The 1998 growing season was the second year of three years in the study. Data were subjected to analysis of variance using PROC GLM in SAS (SAS Institute, 1990) to determine if field borders contribute to differences in abundance of any of the pest species or of beneficial species. We also tested for differences over time, distance from the field edge or border, and for interactions between these factors.

Results

Insect numbers were substantially higher in both crops in 1998 than in 1997. The average number of arthropods collected in sweep net samples was substantially higher in soybeans than in cotton.

Cotton

Several taxa of beneficial arthropods were influenced by the presence or absence of field borders. Spiders were significantly more abundant in cotton fields with borders for most of the season (Figure 1) and rebounded to significantly higher numbers after an insecticide spray. They were more abundant in fields with borders at all distances surveyed (Figure 2). Big-eyed bugs were more abundant in fields with borders than fields without borders prior to the insecticide application but did not recover significantly faster after the insecticide in these fields (Figure 3). Significantly more big-eyed bugs were found in the bordered fields at 10, 20, and 30 m, but there was no difference between the treatments in numbers of these insects at the crop edge (Figure 4). Minute pirate bugs were more abundant in fields with borders season long (Figure 5); significantly more were found away from the edge in bordered fields (Figure 6). No clear relationships between the border treatments could be discerned with coccinellid beetles, nabids, or green lacewings, although all were more abundant in fields with borders during some portion of the season.

Lygus bugs were more abundant in fields with borders than in fields without borders (Figures 7), while green stinkbugs were not significantly different between the border treatments. Bollworm larvae and eggs (Figure 8) were significantly more abundant in fields without borders than fields with borders. Damage to squares and small bolls in fields without borders was approximately double that in fields with borders on August 21 (Julian Date 233, Figure 9).

Soybeans

Several beneficial insects appeared to respond somewhat differently to field borders around soybean fields compared to cotton fields. No significant differences were observed with respect to border treatments for spiders, big-eyed bugs, minute pirate bugs, or ladybird beetles; however, nabids were significantly more abundant in fields with borders (Figure 10).

Bean leaf beetles were significantly more abundant in fields with borders. No differences in abundance between border treatments were detected for green cloverworms, stinkbugs, three-cornered alfalfa hoppers or lygus bugs. Numbers of bollworm larvae were significantly higher in fields without borders than in those with borders (Figure 11). We observed the same relationship in bollworm numbers during the 1997growing season.

Discussion

Field borders composed of feral, herbaceous vegetation appeared to enhance populations of several important beneficial arthropods in cotton, while the effects of field borders on beneficials were less clear in soybeans. The observation of lower bollworm populations in both crops in the presence of field borders in 1998 is extremely

intriguing; in 1997 in this study, we observed a similar occurrence in soybean fields in the same area. In that year, we noticed a large pulse of big-eyed bugs in the field border treatment fields approximately 2 weeks before peak bollworm larval numbers. In the 1998 growing season, we did not notice any obvious pulses in potential bollworm egg and small larvae predators; however, several do appear to peak coincident with bollworm larvae, and these predators are significantly more abundant in fields with borders. The apparent reduction in bollworm numbers in fields with borders may be substantial enough to alter insecticide treatment decisions.

Lygus bug numbers in cotton fields were positively affected by the presence of a border in cotton fields. This could be expected, since many of the herbaceous plants found in the managed borders are suitable hosts for lygus (unpublished data). There was a tendency towards higher numbers of stink bugs in fields with borders, although the differences between treatments were not significant. Both these pests may require closer scrutiny in cotton fields with managed feral vegetation field borders.

Surveillance for bean leaf beetles in soybean fields with managed borders may need to be more intense.

Acknowledgements

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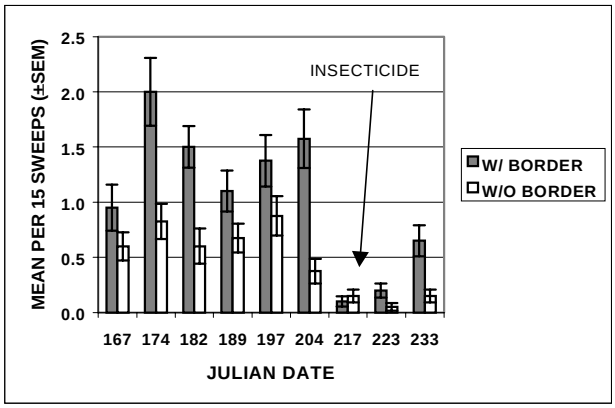

Figure 1. Occurrence of spiders in cotton over time in fields with and without borders.

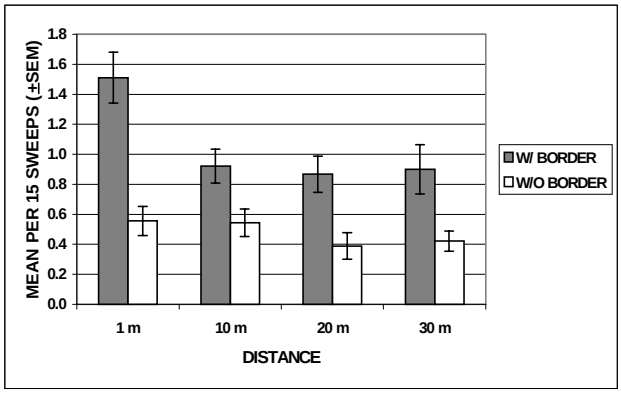

Figure 2. Occurrence of spiders at varying distances from the field edge in cotton with or without field borders.

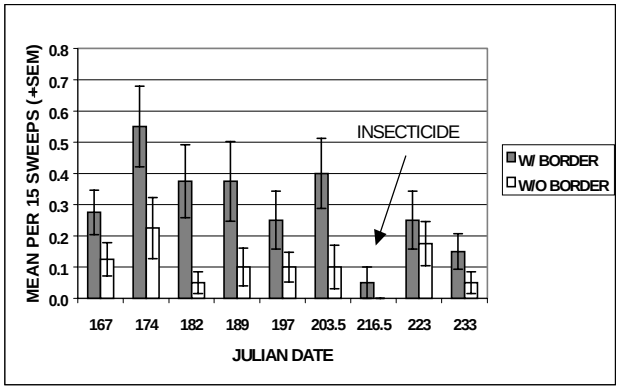

Figure 3. Occurrence of *Geocoris* in cotton over time in fields with and without borders.

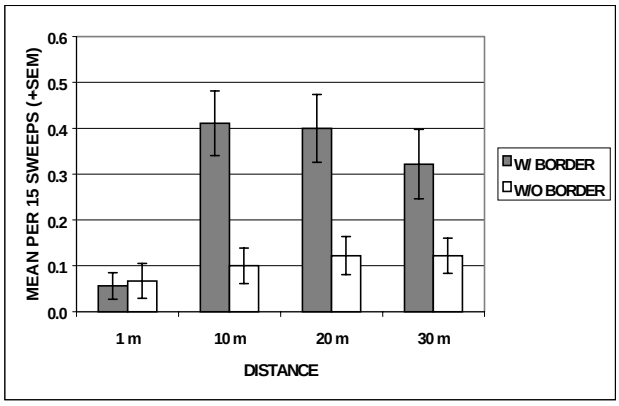

Figure 4. Occurrence of *Geocoris* at varying distances from the field edge in cotton with or without field borders.

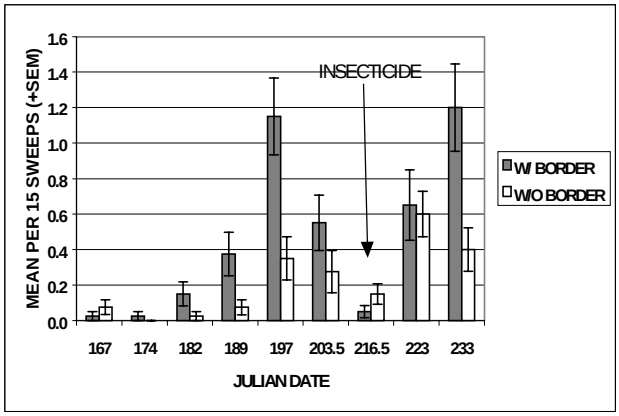

Figure 5. Occurrence of *Orius* in cotton over time in fields with and without borders.

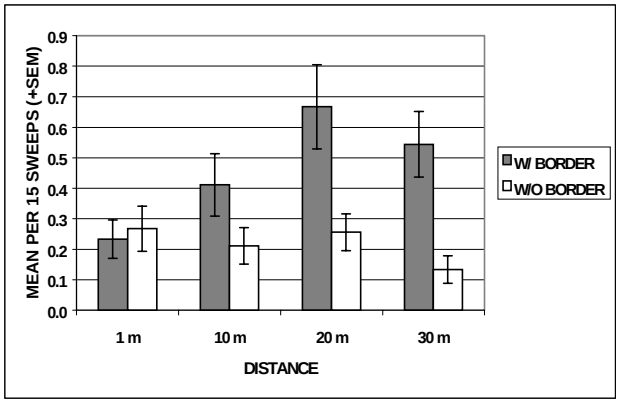

Figure 6. Occurrence of *Orius* at varying distances from the field edge in cotton with or without field borders.

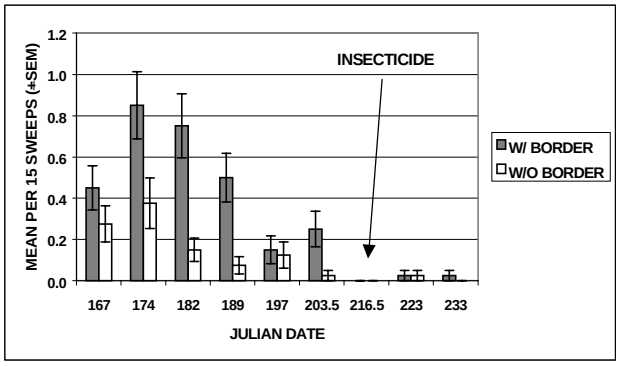

Figure 7. Occurrence of *Lygus* in cotton over time in fields with or without borders.

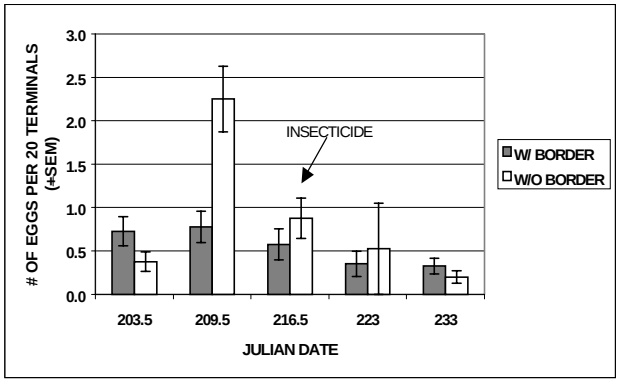

Figure 8. Occurrence of bollworm eggs on cotton over time in fields with or without field borders.

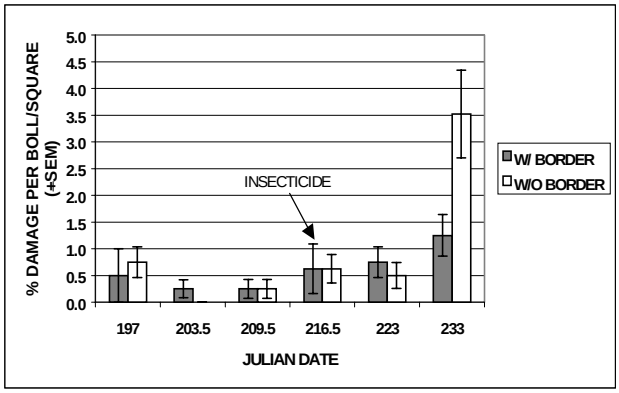

Figure 9. Occurrence of boll/square damage in cotton over time in fields with or without borders.

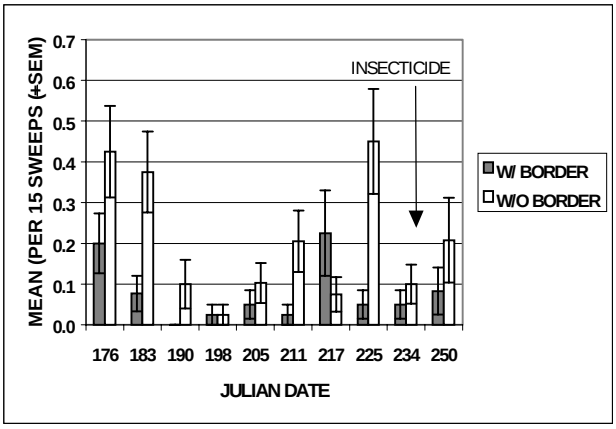

Figure 10. Occurrence of *Nabis* in soybeans over time in fields with or without borders.

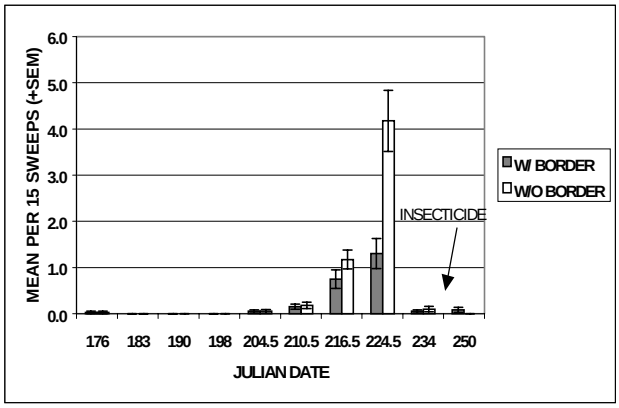

Figure 11. Occurrence of corn earworms in soybeans over time in fields with or without borders.