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Inside this issue:

Can Flame Weeding be used for Early-Season Weed Control in Soybean?

Kurt Vollmer, Dwayne Joseph, and Alan Leslie
University of Maryland

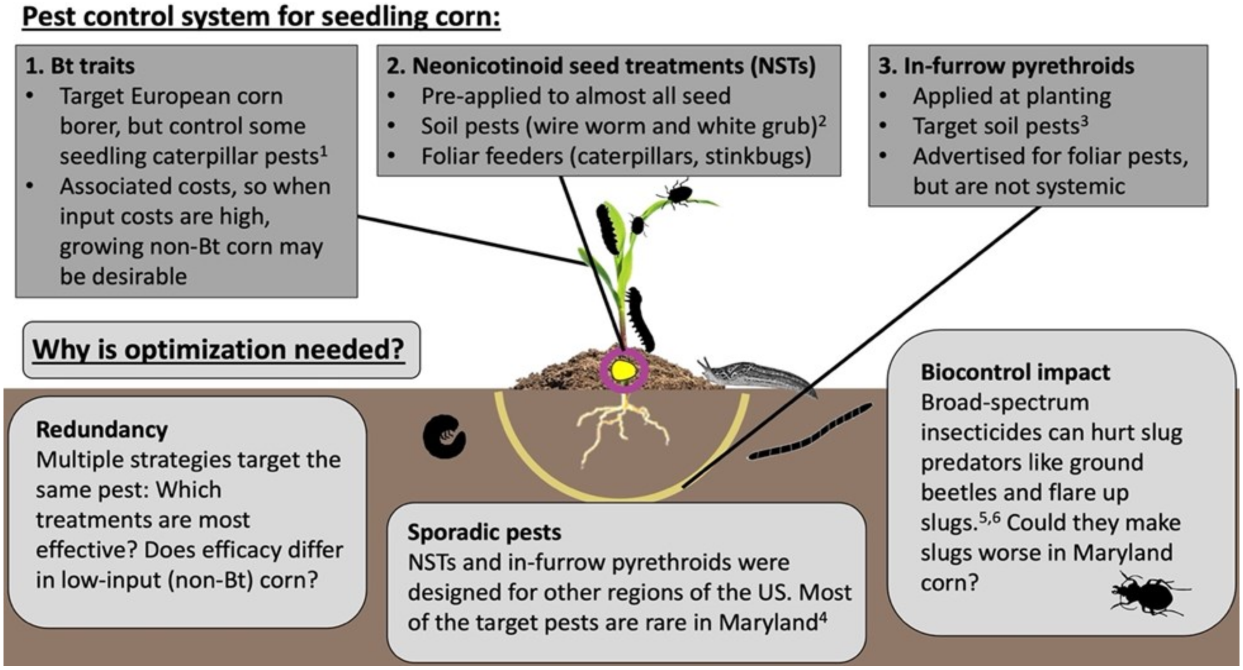
Figure 1. A flame treatment is applied to control emerged weeds in soybean.

Starting clean or weed-free is the key to a good weed control program, especially when noxious weeds, such as Palmer amaranth are present. While conventional growers can use soil-active herbicides to manage these weeds, control is more complicated in organic systems. Flame weeding is a non-chemical tactic that has been shown to control several grass and broadleaf weed species. The majority of flame weeding treatments are applied to emerged weeds; however, studies have also shown flame treatments to have detrimental effects on the seeds of certain weed species post-dispersal. Furthermore, seeds from species such as horseweed (marestail) and Palmer amaranth tend to germinate from shallower depths in the soil profile, and may be more readily controlled by flaming on or near the soil surface. Cultivation/tillage is another tactic that can be used to control weeds in both conventional and organic systems. However, cultivation can lead to additional weed emergence and cannot be used when the soil is wet. Flame weeding may help to supplement weed control when cultivation is not an option.

Optimizing Early Season Pest Management for Maryland Field Corn

Maria Cramer, PhD Candidate and Kelly Hamby, Entomology Extension Specialist
Department of Entomology, University of Maryland

Background



Research Questions

1. Are the NST Poncho 250® and the in-furrow pyrethroid Capture LFR® effective at controlling pests and increasing yield in high-input (Bt) or low-input (non-Bt) field corn in Maryland?
2. Do Poncho and Capture hurt slug predators and flare up slug damage?

Study Design

In order to capture the range of pest pressures and growing conditions in Maryland, we replicated our study across 3 UMD research farms (Keedysville, Beltsville, and Queenstown) and over 3 years (2020-2022). At each location we planted one field of a Bt hybrid and one field of a similarly-yielding non-Bt hybrid as early as possible in the growing season (Table 1). In 2020 our Bt hybrid was LC1196 VT2P (Local Seed, Memphis, TN) which expresses Cry1A.105/Cry2Ab2 proteins. In 2021 and 2022 we planted P1197YHR (Pioneer Hi-bred International. Johnston, IA) which contains Cry1Ab and Cry1F proteins. We planted P1197LR (Pioneer Hi-bred International, Inc. Johnston, IA) for our non-Bt hybrid all three years. All hybrids had excellent yield potential and were grown with standard no-till practices.

Table 1. 2020-2022 planting and seedling sampling dates at UMD research farms (both Bt and Non-Bt plots).

Year	Location	Planting date	Sampling dates
2020	Keedysville	May 18	June 8
	Beltsville	May 21	June 10
	Queenstown	May 13	June 3 and 4
2021	Keedysville	May 14	June 1 and 3
	Beltsville	May 17	June 2
	Queenstown	May 4	May 25 and 26
2022	Keedysville	May 26	June 10
	Beltsville	June 2	June 21
	Queenstown	May 12	May 31

In each field we established 3 replicates of 3 treatments at planting: 1) an **untreated control**, with bare seed and no in-furrow product, 2) an **in-furrow pyrethroid** treatment using Capture LFR® (active ingredient: bifenthrin, rate: 13.6 fl oz/acre), and 3) an **NST** treatment using Poncho® (active ingredient: clothianidin, rate: 0.25 mg/seed). Each replicate consisted of 24 rows of corn at 30 inch row spacing, and was 200 feet long.

Question 1: Are the NST Poncho 250® and the in-furrow pyrethroid Capture LFR® effective at controlling pests and increasing yield in high-input (Bt) or low-input (non-Bt) field corn in Maryland?

Data Collection

In order to evaluate how the treatments affected pest pressure, we visually sampled V2-V3 corn for types of pest damage (Figure 1), recording the number of plants and area damaged. We counted the number of healthy and stunted plants to determine if the treatments impacted stand. Because neonicotinoids can sometimes stimulate plant growth unrelated to pest damage[7,8], we measured plant height to determine if plant growth was impacted by either treatment. At the end of the growing season, we measured stand again and harvested the corn to collect yield data.

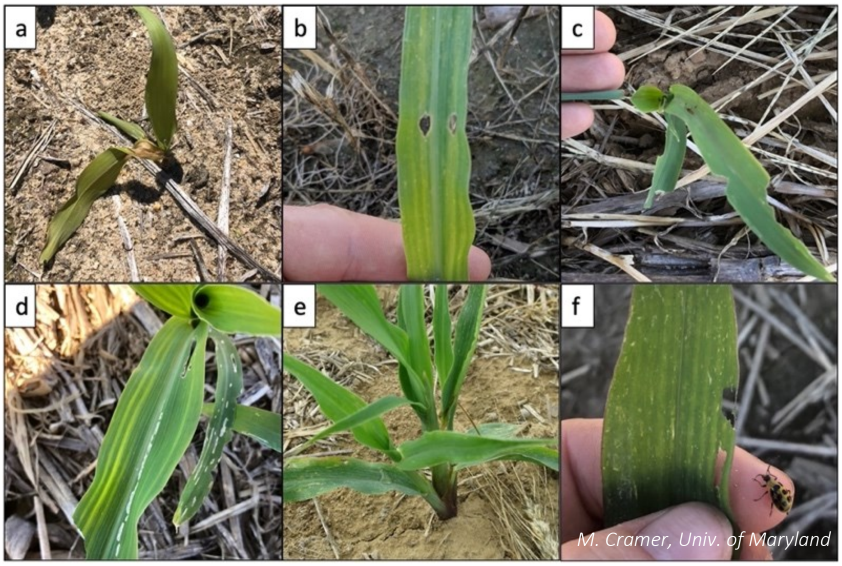


Figure 1. Diagnostic seedling pest damage: a) soil pest, b) cutworm, c) armyworm, d) slug, e) stinkbug, f) miscellaneous feeding damage from a spotted cucumber beetle.

Results and Takeaways for Question 1

Poncho reduced insect damage more consistently than Capture LFR (in both Bt and non-Bt corn) and increased Bt corn stand. Capture LFR sometimes reduced insect damage (in non-Bt corn), but never improved stand.

We compared the number of seedlings with any type of pest damage between treatments and found that Poncho decreased damage about 62% in Bt corn and about 66% in non-Bt corn (Figure 2a and 2b). Compared to the control, Capture did not reduce damage in the Bt corn, but did reduce damage by about half in the non-Bt. Poncho increased stand about 8% compared to control in the Bt corn (25,731 ± 456 plants per acre and 23,623 ± 714 plants per acre, respectively), but did not improve it for non-Bt. Capture did not impact stand for either Bt or non-Bt corn.

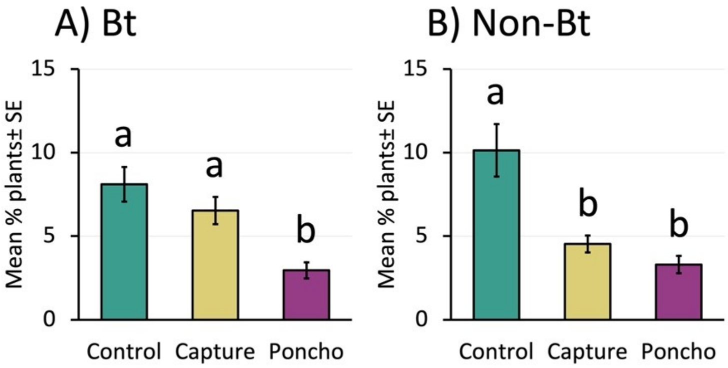


Figure 2. Mean % ± SE of seedling A) Bt and B) non-Bt corn plants damaged by pests. Data were collected across three UMD research farms from 2020-2022. Within each graph, treatment bars with different letter above them are significantly different from each other.

There were no yield benefits from using either insecticide in either corn. This was likely due to a lack of economic pest pressure.

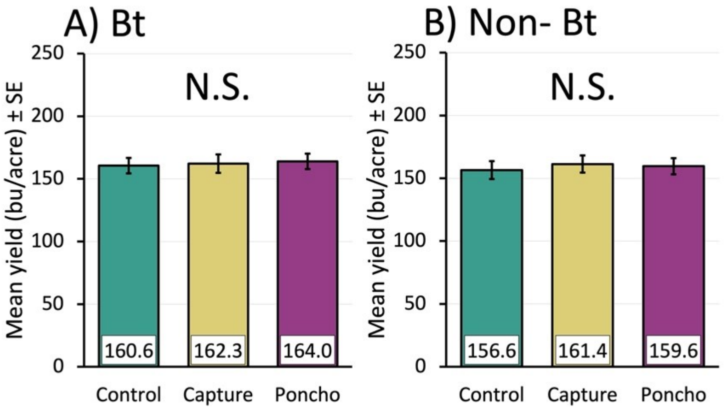


Figure 3. Mean yield ± standard error in bushels per acre corrected to 15.5% moisture of A) Bt corn and B) non-Bt corn. Yield data from 2020-2022 across three UMD research farms. Treatments did not significantly impact yield.

Non-Bt and Bt yields were the same across treatments (Figure 3A and 3B). This was probably because pest pressure was so low. Even though Poncho and Capture decreased pest damage, pests were below treatment thresholds—for example, armyworm damage in the control ranged from 0% to 5.4% of Bt plants, and 0% to 22.9% of non-Bt plants, in both cases below the treatment threshold of 35%[9]. Cutworm damage was similarly low ranging from 1% to 6.3% in Bt control and 0.5% to 3.8% in non-Bt control, also below the treatment threshold of 10% feeding damage[9].

Takeaway: Pest pressure and yield were similar between the Bt and non-Bt varieties, and non-Bt yielded well without any insecticides. In general, without pre-existing pest problems in a given field, at-planting insecticides are unlikely to pay off in Maryland.

Question 2: Do Poncho and Capture hurt slug predators and flare up slug damage?

Data Collection

To assess the effect of treatments on slug biocontrol agents, we measured slug predatory ground beetles and predation. We measured predatory beetles with pitfall traps for three consecutive weeks. Because the predators that eat slugs also attack caterpillars, we used sentinel caterpillars to see how much predation was occurring (Figure 4). We placed sentinel caterpillars in the plots overnight, collected them the following morning, and assessed signs of damage from predators. To determine if slugs were flared up by the treatments, we measured slug abundance once a week for 6 weeks beginning between 14 to 21 days after planting and measured slug-damaged seedlings during V2-V3.

Figure 4. Sentinel caterpillars placed in field overnight and collected in the morning to determine predator activity.

Results and Takeaways for Question 2

Predation on sentinel caterpillars was not decreased by insecticides.

We measured the percent of sentinel prey that were damaged by predators overnight (Figure 5) and saw no relationship between treatment and predation rates (Figure 6). This suggests that the insecticides did not decrease predator activity in treated plots. We did generally see some level of predation all weeks at our locations, indicating that predators are usually present in seedling corn.

Figure 5. Top: predators feeding on sentinel prey. Bottom: examples of damaged prey proportions. Images: M. Cramer, University of Maryland.

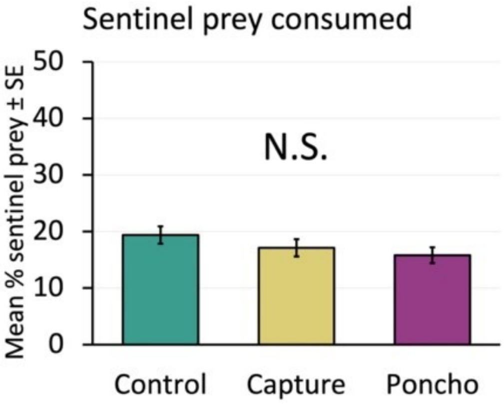


Figure 6 (left). Mean ± SE % sentinel prey caterpillars consumed across three UMD research farms from 2020-2022. Control, Capture, and Poncho did not significantly differ.

Predator abundance was not altered by insecticides.

When we measured the weekly counts of ground beetles, we found similar results between treatments. This was true when we looked at all ground beetles (predators, omnivores, and seed-eaters), as well as when we looked only at predatory beetles (Figure 7A and 7B).

Slug natural enemies did occur throughout the study, suggesting that biocontrol could be more intentionally leveraged.

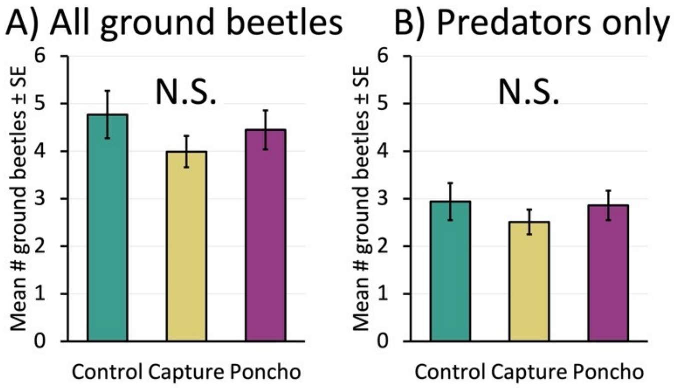


Figure 7. Mean ± SE count of A) all ground beetles, and B) specifically predatory ground beetles, caught per week in pitfall traps across three UMD research farms from 2020-2022. No significant differences.

The two most abundant ground beetle species in our study were both predators. One of these species, *Chlaenius tricolor* (Figure 8) is a slug predator that consumes slugs in agricultural ecosystems[5,10]. Although its abundance was not affected by treatments, it was present at all locations in all years, suggesting that it is a particularly important slug natural enemy in Maryland crops.

Figure 8. *Chlaenius tricolor*, a slug predator that was found throughout the study. Photo credit: ©Molanic 2023: https://www.inaturalist.org/photos/314013175.

Neither insecticide increased slug abundance or slug damage.

If treatments had negatively affected predators, we would expect to see more slugs and damage in the insecticide plots. However, when we compared slug counts between treatments, we found that the insecticide treatments were not different from the control (Figure 9). Slug damage to the seedling corn was also similar across the control and insecticide treatments (Figure 10).

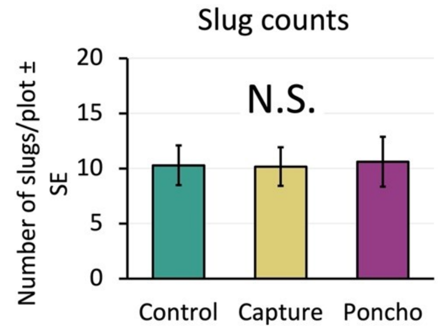


Figure 9. Mean number of slugs per replicate plot ± SE the week closest to seedling sampling across three UMD research farms from 2020-2022. No significant differences.

While slugs can be damaging in many crops, the worst slug damage in our study did not affect corn stand or yield, suggesting that corn is generally tolerant of slug damage at the levels we observed in this study.

Slug damage was scarce across years and locations except in 2021 at Keedysville. Even in that case where a high proportion of seedlings (42% ± 4% on average) were damaged by slugs, we did not see an associated decrease in stand or yield. Corn seedlings were able to outgrow the slug damage as the weather warmed, even when they appeared severely defoliated. The seedling resilience we observed is supported by work on hail damage in corn which shows that as long as the growing point is intact, corn can regrow from complete defoliation[11].

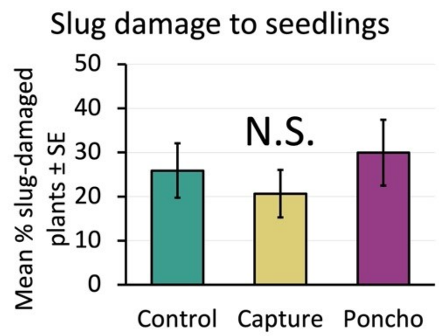


Figure 10. Mean ± SE % of corn seedlings damaged by slugs across three UMD research farms from 2020-2022. Control. No significant differences.

Even though we did not see non-target effects in this study, both pyrethroids and neonicotinoids can decrease natural enemies in crop fields[6,12–14].

Acknowledgments

We would like to thank the farm managers and staff of WYEREC, WMREC, and CMREC Beltsville for their expertise and assistance. We would also like to thank the Hamby lab's many undergraduate researchers for helping complete this project with all their hard work.

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