Incorporating a Total Crop Management Approach into Current Soybean IPM Programs – 2015- 2016

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Joanne Whalen, Extension IPM Specialist; Bill Cissel, Extension IPM Agent; Mark VanGessel, Extension Weed Specialist; Nathan Kleczewski, Extension Plant Pathologist; and Richard Taylor, Extension Agronomist

Currently, soybean IPM programs in Delaware, delivered by both private consultants and agribusiness and supported by University of Delaware Extension and Applied Research programs, have a multi-disciplinary approach including crop production, insect, weed, disease, and nematode management. This part of Delaware's Extension IPM Implementation project has two primary objectives: (1) to evaluate and demonstrate the role of small grain cover crops in weed and slug management, and maintenance/improvement of soil health, and (2) to gain a better understanding of the distribution and effects of soybean vein necrotic virus in Delaware including the impact on soybean yields, what practices favor the disease, and identification of effective management options.

I. Small Grain Cover Crops and Weed Management Demonstrations (Mark VanGessel)

On May 2, 2016, twelve fields planted with a small grain cover crop planted the previous fall were visited and assessed for density of winter annual weeds. Five field had not been sprayed yet with glyphosate, while the remainder had been sprayed and the cover crop was dead.

For those fields with living cover crop, the cereal rye was over 4 ft. tall, and those with barley or annual ryegrass was 14 to 24 inches. Percent ground cover averaged 15% for barley, 65% for annual ryegrass, and 60% for cereal ryegrass. Weed density was low for all the fields, with no apparent trend for any particular weed species more prevalent in one of the cover crops than another.

The fields with the cover crop desiccated had 30% ground cover when assessed on May 2. Five of these fields had been planted to cereal rye and two fields were seeded with wheat. Weed density was low, but it is difficult to assess how much of that was due to the cover crop or the herbicide to terminate the cover crop.

As observed in previous years, most of the fields had cover crops that were not managed to produce high volume of biomass, yet cover crop management appeared to have impacted winter annual weeds. Spraying a non-selective herbicide early in the spring to prevent excessive growth of the cover crop, resulted in excellent control of winter annual weeds. It was not the cover crop per se that contributed to winter annual control, rather it was the early herbicide application that was made in April to small, susceptible weeds. However, the cover crops were not expected to provide any suppression of summer annual weeds, such as Palmer amaranth, common ragweed, or large crabgrass.

To further explore the effect of cover crop management for weed control, replicated trials were conducted at the UD Research and Education Center 2015/2016. A trial examined the combination of three factors: level of rye biomass, timing of spring burndown application, and the benefit of residual herbicides. Two bushels of rye were seeded in the fall. The no-rye plots were sprayed with Select in December to remove the rye and high rye biomass received 60 lbs. of nitrogen in the spring. Timing of burndown (glyphosate applications) were May 9 or May 17. Residual herbicide with this trial was Envive. All combinations of these treatments were examined to determine their compatibility and which factor(s) would have the greatest impact on weed control.

The entire trial was sprayed with a postemergence application of Roundup plus Reflex on June 25.

At five weeks after spring herbicide applications Palmer amaranth control was when Envive used as part of the burndown treatment, with 98% control compared to 75% for only glyphosate plus 2.4-D. After the POST application of glyphosate plus Reflex, Palmer amaranth control was 100% when Envive was used at burndown and 96% without Envive. Levels or rye biomass or burndown application timing had no impact on final ratings for Palmer amaranth. Morningglory control was a rye cover crop was used compared to no cover crop.

These replicated trials demonstrated the benefit of a rye cover crop to help suppress annual weeds and thus improve overall weed control. A rye cover crop can help suppress annual weeds. But a rye cover crop may not eliminate the need for a preemergence herbicide. More research is needed to determine the value of a rye cover crop for reducing the risk of developing herbicide-resistant weed populations.

II. Influence of Fall Seeded Small Grain Cover Crops on Slugs and Impact on Soil Health - 2014-2016 (Joanne Whalen, Bill Cissel and Richard Taylor)

2014 Results: In 2014, eight soybean fields with a fall seeded small grain cover crop and six soybean fields without a cover crop were sampled using the shingle trapping method to monitor slug species composition and abundance and to determine what effect cover crops have on slug populations. At plant emergence, each field was also sampled to evaluate crop injury as a result of slug feeding. In addition, soil health measurements were taken to demonstrate the potential benefits of fall seeded cover crops on soil health.

Due to the low slug populations observed in 2014, only minor differences were recorded between the fields with a fall seeded cover crop compared to the fields without a cover crop for the average number of slugs per shingle trap and the percentage of soybean plants with slug feeding injury. The slight differences in soil health documented between fields with and without a small grain cover crop were most likely attributed to differences in soil type and farming practices and could not be attributed to the use of a cover crop.

2015 Results: We again evaluated the effect of fall seeded small grain cover crops on slug population levels, the ability to predict which fields will have damage and the potential soil health benefits. In the fall of 2014, the shingle sampling method was used in 8 fields with a small grain cover crop to determine if fall sampling would better predict potential slug problems in fields the following season. In the spring of 2015, thirteen fields with a cover crop and nine fields without a cover crop were sampled for slugs using the shingle trapping method, monitored for slug feeding injury on soybeans, and assessed for soil health.

Overall, slug populations found under the shingles were low, regardless of whether a field was planted in a fall seeded small grain cover crop or not. Sampling for slugs using shingle traps in the fall did not appear to be more effective than spring sampling. Although slug pressure was low in all of the fields sampled, the percentage of slug damaged -plants was greater in the fields with a cover crop compared to fields without a cover crop. However, the level of damage and percent damaged plants was low in each of the fields sampled therefore the slug injury did not result in economic losses. Only minor differences were recorded for soil compaction between fields with and fields without a cover crop and not thought to be a result of the use of a cover crop. Soil respiration activity for the fields with a small grain cover crop was within the ideal range suggesting soils contained sufficient organic matter and micro-organism activity.

2016 Results: In the fall of 2015, the shingle sampling methods was used in 17 fields with a cover crop and 2 fields without a cover crop. In the spring of 2016, the shingle sampling method was used in 12 fields with a cover crop and 3 without a cover crop. At plant emergence in the spring, fifteen field with cover crops and 3 fields without cover crops were evaluated for slug damage and assessed for soil health.

(A) Fall Slug Sampling in Fields With and Without Small Grain Cover Crops – Surveys in Ohio documented that sampling for slugs using the shingle trapping method in the fall can be more effective than sampling in the spring. In the fall of 2015, 17 fields with a small grain cover crop and two with no cover were sampled using the shingle trapping method from mid-October to mid- November. Five shingle traps 1 ft^2 were randomly placed throughout fields and checked on a weekly basis, recording the number of gray garden and marsh slugs.

(B) Pre-Plant Spring Sampling for Slugs: In the spring of 2016, 12 fields with cover crops and 3 fields without cover crops, were sampling by randomly placing five shingle traps throughout fields in mid-March and checked on a weekly basis until late March.

Table 1. Slug sampling results: Average number of slugs by species using shingle trapping methods comparing fields with and without a small grain cover crop and fall sampling compared to spring sampling

Sampling Time	Cover Description	Average Number of Slugs per Trap[1] (Grey Garden and Marsh)
Fall	With Cover Crop	0.46
Fall	Without Cover Crop	0.09

Spring	With Cover Crop	0.81
Spring	Without Cover Crop	0.24

[1] Reported average number of slugs per shingle trap is averaged across all fields and sample dates

Overall, slug populations were higher in fields planted in a fall seeded small grain cover crop. Although data from Ohio indicated that fall sampling is better than spring sampling, our survey data resulted in higher numbers under shingle traps placed in fields in the spring. Warmer, wet conditions in March of 2016 resulted in earlier hatching of slug populations. It appears that weather could play a larger role in deciding which sampling time is most effective.

(C) Slug Injury on Soybean: Fifteen fields with a cover crop and three fields without a cover crop were sampled on a weekly basis for evidence of slug feeding damage on emerging and seedling soybean. Slug injury on soybean was measured by performing stand counts and by determining the percentage of plants with slug feeding injury. Stand counts were established by counting the number of plants per three linear row ft. in ten random locations throughout the field. These counts were converted to average plant populations per acre taking into account various row-spacing and used to document potential stand reductions as a result of slug feeding. The percentage of slug damaged plants was determined by counting the number of plants with new feeding damage in ten consecutive plants in ten random locations in each field.

Table 2. Slug injury on soybean: Comparison between fields with and without a small grain cover crop for the average number of plants per 3 ft. of row and percent of slug damaged plants

	Average Plant Population (plant per acre)[1]	% Slug Damaged Plants[1]
Fields with Cover Crop	141,251	7.6
Fields without Cover Crop	169,938	4.1

[1] Reported plant populations and percent slug damaged plants is averaged across all fields and sample dates

Overall, slug pressure was higher in soybeans in 2016. Plant populations were lower in fields with a cover crop compared to fields without a cover crop and in many cases was the result of slug feeding activity. The percentage of slug damaged plants was greater in the fields with a cover crop compared to fields without a cover crop. In some situations, although the level of damage and percent damaged plants was significant, plant populations were adequate and re-planting was not needed.

(D) Impact of Small Grain Cover Crop on Soil Health

The soil health benefits from adopting cover crops has been well documented in neighboring states but has not been fully evaluated in Delaware. The objective of this part of the survey was to evaluate the effects of fall seeded small grain cover crop on soil health. To measure soil health, soil compaction was measured in each field at depths of six, twelve, and eighteen inches using a penetrometer and reported as pounds per square inch (psi) at each depth. Soil respiration is a measure of carbon dioxide (CO_2) and is a good indicator of a soil's productivity, biological activity, and health. Soil respiration was measured in each of the fields using the Solvita soil basal respiration test and reported as Co_2 Color. Additional information on soil respiration and sampling methods can be found at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051573.pdf.

Table 3. Soil heath measurements: Comparison between fields with and without a small grain cover crop for compaction and Solvita soil respiration

	Compaction (psi)[1]			Solvita Soil Respiration Test[1]	
	6”	12”	18”	CO_2 Color	CO_2 Ppm
Fields with Cover Crop	261	299	309	3.83	21.58
Fields without Cover Crop	267	301	305	3.68	18.94

[1]Reported compaction and Solvita soil respiration test averaged across all fields

Only minor differences were recorded for soil compaction between fields with and fields without a cover crop at each of the depths evaluated. Overall, soil compaction was either at or approaching levels that restrict root growth at twelve and eighteen inches deep. Soil respiration activity for the fields with and without a small grain cover crop was within the ideal range suggesting soils contained sufficient organic matter and micro-organism activity. Studies following the same field over multiple years are needed to document the soil health benefits of cover crops.