Incorporating a Total Crop Management Approach into Current Soybean IPM Programs

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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 insect, weed, disease and nematode management**.** This primary object of this program is evaluate and demonstrate the role of small grain cover crops in weed management, slug management and maintenance/improvement of soil health.

(I) Weed Management Results – 2014 Demonstrations

In the spring of 2014, seven fields with cover crops seeded in the fall and with the intention of planting soybeans were visited in early May. Three of the fields did not manage the cover crops in a manner that would have impacted summer annual weed control (cover crop density too low and/or cover crop terminated too early before soybean planting). One of the fields was seeded with rye and two with triticale. Four fields (all with the same farmer), seeded with cereal rye, were being managed for weed management. Rye was > 4 ft tall and well tillered. Winter annual weeds were present, ranging from 1 to 6 species. Postemergence weed control was used in all four fields, however, Palmer amaranth was present late in the growing season. Final assessment of rye on summer annual weeds is still pending.

In addition, a replicated trial was conducted at the UD Research and Education Center to examine the benefit of a cereal rye cover crop for weed management with full-season soybeans. Rye was planted at 2 bu/A in the fall of 2013. Half the plots received 40 lbs of N on March 11 in order to achieve two levels of rye biomass. The rye crop was terminated on May 9 with glyphosate and soybeans were planted with 15-inch planter on May 29. In addition, some plots received a residual herbicide to supplement weed control from the rye. The addition of nitrogen increased rye biomass by 82% when measured at planting. The higher rye biomass improved early-season control of summer annual weeds, but a postemergence herbicide was needed. The entire trial was sprayed with Roundup plus Reflex on July 9 for postemergence weed control. The use of an effective residual herbicide improved Palmer amaranth control to >85%, while with only rye for weed suppression control was <57%. Late-season weed control and yields have not been recorded.

(II) Slug Monitoring and Management Results – 2014

In spring of 2014, eight fields with small grain cover crop and six fields without cover crop were sampled using shingle trapping methods and searching under crop residue on a weekly basis from mid-April until mid-May to measure slug species composition and population densities; and to determine what influence fall seeded small grain cover crops have on slugs. After plant emergence, slug feeding injury on soybean was assessed by establishing stand counts and determining the percent of plants with slug

damage. Soil health measurements were collected from three fields with cover crop and six fields without to document the potential benefits of adopting cover crops.

(A) Pre-Plant Sampling for Slugs : In each field sampled, five shingle traps 1 ft^2 were randomly placed throughout the field and checked on a weekly basis, recording the number of adult and juvenile gray garden and marsh slugs, the predominant slug species of economic importance in Delaware. The number of slug eggs was also recorded. At each sampling location, a 1 ft^2 area was searched under crop residue for slugs and eggs to compare to shingle trapping methods.

Table 1. Average number of slugs and eggs using shingle trapping and residue sampling methods in fields with and without fall seeded small grain cover crops

	Avg. # of Marsh Slugs		Avg. # of Gray Garden Slugs		
Sampling Method	Juvenile	Adult	Juvenile	Adult	Slug Eggs
Fields with Cover Crop					
Shingle Trap	0.13	0.59	0.00	0.01	0.07
Crop Residue 1ft^2	0.06	0.20	0.02	0.03	0.01
Fields without Cover Crop					
Shingle Trap	0.03	0.36	0.00	0.00	0.00
Crop Residue 1ft^2	0.07	0.15	0.00	0.00	0.01

Number of slugs and eggs averaged across all fields and sampling dates, evaluating influence of small grain cover crop on slugs and comparing efficiency of shingle trapping and residue sampling to estimate slug pressure.

Overall, slug populations were low, regardless of whether a field was planted in small grain cover crop or not. The differences between shingle trapping and searching under crop residue for slug and egg counts were minor and not thought to be significant. Greater differences may be possible in years when slug populations are higher.

(B) In- season Slug Injury on Soybean: Six fields with small grain cover crop and ten fields without 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 determined by counting the number of plants per three linear row ft in ten random locations throughout the field and used to document potential stand reductions as a result of slug feeding. The percentage of slug feeding injury was determined by counting the number of plants with new feeding damage in ten consecutive plants in ten random locations in each field.

Slug pressure was low in all of the fields surveyed, and no reductions in stand counts from slug feeding damage were recorded. The percentage of soybean with slug feeding injury averaged across all sample dates and fields were similar for the fields with small grain cover crops (8%), compared to the fields without cover crops (7%).

(III) 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. Therefore, the objective of this aspect of the project was to evaluate the effects of fall seeded small grain cover crop on soil health. In five random locations in each field surveyed, soil compaction, water infiltration rate, percent crop residue, and soil bulk density was determined. Soil compaction was measured at depths of eight, sixteen, and twenty-four inches using a penetrometer and reported as pounds per square inch (psi) at each depth. Water infiltration rates were measured using methods outlined in USDA Soil Quality Test Kit Guide, and percent crop residue was determined using line transect methods. Soil bulk density was established for each field using the cylindrical core method and reported as grams/centimeter3. Soil health was evaluated in three fields with small grain cover crops and in six fields without.

Table 2. Soil health measurements demonstrating the potential benefits of fall seeded small grain cover crop on soil compaction, water infiltration rate, percent crop residue, and soil bulk density

Compaction (psi)			Infiltration Rate		Soil Bulk Density
8	16	24	min:sec	% Crop Residue	(g/cm3)
Fields with Cover Crop					
291	271	279	10:23	76	1.3
Fields without Cover Crop					
252	240	255	9:30	82	1.3

Soil health measurements averaged across all fields with and without fall seeded small grain cover crop

Initial results show minor differences between fields with and without a small grain cover crop. However, soil health measurements were only sampled on three fields with a cover crop and on six fields with out and the observed differences likely have more to do with soil type and farming practices among the fields sampled than the use of a cover crop. Additional work will be done in 2015 and 2016 to evaluate the effect of cover crops on soil health.