INTEGRATING COVER CROPS FOR WEED MANAGEMENT IN PLASTICULTURE SYSTEMS

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Plasticulture production systems have many benefits including improved weed control in the crop row; but weeds emerging between the rows can cause significant yield loss. Commercially acceptable weed control is difficult to achieve even with herbicides. Available herbicides often do not provide season-long weed control between rows of plastic. In addition, several weed species have evolved resistance to commonly used herbicides, including common ragweed, Palmer amaranth, and smooth pigweed. In order to remove weeds not controlled by herbicides, hand labor is often required.

Cover crops have been adopted in many production systems for various benefits, including weed control. However, fall planted cover crops are not easily integrated into plasticulture systems due to the constraints of laying plastic mulch in the spring. This project evaluated the utility of spring-seeded grass cover crops for row-middle weed management, as well as the effect of each cover crop on soil health.

Research objectives were:

- Evaluate the utility of a spring-seeded grass cover crop in combination with herbicides for weed control between rows of plastic mulch.
- Evaluate different grass cover crop species for optimal weed control characteristics such as growth and biomass production when seeded in the spring.
- Evaluate contributions of spring-seeded grass cover crop species to soil health.

Research summary:

The **first objective** evaluated spring-seeded cereal rye in combination with herbicides for controlling weeds between rows. Cereal rye was seeded in mid-April, immediately after laying plastic. Watermelon transplanting was delayed for 4 weeks to allow cereal rye to become established. Watermelon was transplanted in Delaware on May 17, 2017 and May 16, 2018, and in New Jersey on June 6, 2018. Herbicides (Dual Magnum at 1 pt/A plus Sandea at 0.67 oz/A) were applied as a shielded application at either transplanting or 2 WATrplt (weeks after transplanting). Cereal rye was terminated with Select Max (1 pt/A) plus NIS (0.25% v/v) 3 and 5 WATrplt in 2017, and 4 and 6 WATrplt in 2018.

Results: Although cereal rye biomass accumulation differed across sites, biomass did not differ with termination timing within each site. Cereal rye biomass was highest at the New Jersey site in 2017 (1,343 lb/A), followed by the Delaware site in 2017 (817 lbs/A), and the Delaware site in 2018 (272 lb/A).

At the Delaware site in 2017, common lambsquarters density was lower with rye treatments compared to no rye treatments when evaluated 4 WATrplt (Table 1). However, there were no treatment differences in common lambsquarters densities at the Delaware and New Jersey sites in 2018. At the Delaware site in 2017 and the New Jersey site in 2018, pigweed density was lower with cereal rye treatments at the 4 WATrplt assessment. There were no differences in Palmer amaranth density at the Delaware site in 2018.

By 6 WATrplt the level of cereal rye did not affect weed densities, but the presence of cereal rye reduced total weed biomass, regardless of herbicide application (Table 2). However, when cereal rye was absent, herbicides applied at transplanting in Delaware in 2018 and the 2 WATrplt application timing in New Jersey provided better control than no herbicide.

The Delaware site in 2017 had low yields across all treatments compared to Delaware in 2018 and New Jersey in 2018 (Table 3). The presence of cereal rye did not impact marketable watermelon yield, but differences in average marketable weight were observed. At the Delaware site in 2018, there was no difference in marketable fruit number with cover crop treatment, but average marketable weight was higher with no rye. At the New Jersey site in 2018 marketable fruit number and average marketable weights were higher with rye.

Table 1. Common lambsquarters and pigweed spp. density 4 wk after transplant.[a]

	Common lambsquarters			Pigweed spp.		
Cover crop	DE-2017	DE-2018	NJ-2018	DE-2017	DE-2018	NJ-2018
	plants/yd^2					
Cereal rye	3 b	3 a	2 a	22 b	3 a	4 b
No cereal rye	15 a	3 a	1 a	162 a	6 a	12 a

[a] Data averaged over herbicide treatment and rye termination timing. Means followed by the same letter are not significantly different according to Fisher's LSD (p =0.05).

Table 2. Total weed biomass 6 wk after transplant.[a]

Rye termination	Herbicide application	Total weed biomass DE-2017		DE-2018		NJ-2018	
		lb/yd^2					
4 WATrplt[b,c]	At_Trplt	0.01	b	0.1	c	0.01	c
4 WATrplt	2 WATrplt	0.03	b	0.05	c	0.01	c
4 WATrplt	no herbicide	0.00	b	0.24	bc	0.03	c
6 WATrplt[d]	At_Trplt	0.02	b	0.09	c	0.02	c
6 WATrplt	2 WATrplt	0.01	b	0.14	bc	0.02	c
6 WATrplt	no herbicide	0.04	b	0.26	bc	0.14	c
No rye	At_Trplt	0.11	ab	0.19	bc	1.15	a
No rye	2 WATrplt	0.18	a	0.39	ab	0.46	b
No rye	no herbicide	0.18	a	0.52	a	0.89	a

[a] Means followed by the same letter are not significantly different according to Fisher's LSD (p =0.05).
[b] Abbreviation: WATrplt, wk after transplant.
[c] Cereal rye terminated 3 wk after transplant in 2017.
[d] Cereal rye terminated 5 wk after transplant in 2017.

Table 3. Number and average weight of marketable watermelon.[a]

Rye Termination	Marketable yield DE-2017		DE-2018		NJ-2018		Marketable weight DE-2017		DE-2018		NJ-2018	
	fruit/A						lb/fruit					
4 WATrplt[b,c]	13	b	2,400	a	1,900	a	9.9	a	14.6	b	12.6	a
6 WATrplt[d]	88	a	2,500	a	1,800	a	9.3	a	14.6	b	12.1	a
No rye	63	ab	2,800	a	100	b	9.5	a	15.7	a	10.4	b

[a] Data averaged over herbicide treatment and rye termination timing. Means followed by the same letter are not significantly different according to Fisher's LSD (p =0.05).
[b] Abbreviation: WATrplt, wk after transplant.
[c] Cereal rye terminated 3 wk after transplant in 2017.
[d] Cereal rye terminated 5 wk after transplant in 2017.

The **second objective** evaluated the growth of different cereal cover crop species when seeded in early spring. Annual rye, cereal rye, spring barley, spring oats, and sorghum sudangrass were seeded at time of laying plastic mulch (5 weeks prior to transplant in 2017 and 4 weeks prior to transplant in 2018). A no cover weed free and a no cover untreated check was included for comparison. This study was only conducted in DE. Watermelon was transplanted on May 30, 2017 and May 15, 2018. Cover crops were terminated with Select Max (1 pt/A) + NIS (0.25% v/v) 2 and 4 WATrplt in 2017, and 4 and 6 WATrplt in 2018. Cover crop biomass production and weed suppression were evaluated.

Results: Spring oats produced more biomass than the other spring-seeded grass species (Table 4). However, cover crops alone were not sufficient to compete with fast-growing species such as Palmer amaranth. In 2017, all cover crop treatments except annual rye had lower Palmer amaranth biomass compared to no cover when evaluated 2 WATrplt. However, based on visual control no treatment provided more than 73% control. Palmer amaranth control continued to decline throughout the season. In 2018, Dual Magnum (1 pt/A) was applied after cover crop emergence, but prior to weed emergence to improve weed control. All cover crop treatments had lower total weed biomass compared to no cover, but biomass was higher with sorghum sudangrass compared to other species.

The site in 2017 yielded no marketable fruit, regardless of treatment. In 2018, the average number of marketable fruit ranged from 1,200 to 1,700 melons/acre and average marketable weight ranged from 14 to 16 lb/fruit, but the effect of cover crop and termination timing was not significant.

The **third objective** evaluated the contributions cover crop species in the second objective to soil health. Soil health measurements consisting of soil water content, bulk density, volumetric water content, porosity, soil water filled pore space, and water infiltration were taken immediately prior to each termination date and at harvest.

Results: While differences in treatment were observed, they were not consistent across sample timings and year. For example, soil bulk density was lower following the second termination of annual rye and sorghum sudangrass compared to the no cover treatments, in 2017, but there were no differences at the same timing in 2018. Furthermore, there were no differences in soil bulk density after harvest both years.

Table 4. Cover crop and weed biomass.[a]

Species	Cover crop biomass 2017[d]		Cover crop biomass 2018 3 WATrplt[e]		Cover crop biomass 2018 5 WATRplt		Palmer amaranth biomass[b] 2017		Total Weed biomass[c] 2018	
	lb/A									
Annual rye	2,123	bc	428	c	669	c	277	ab	62	c
Cereal rye	1,535	c	607	c	321	c	9	b	37	c
Spring barley	3,123	b	1,570	b	1,624	b	214	b	51	c
Spring oats	4,407	a	2,052	a	3,533	a	116	b	16	c
Sorghum sudangrass	2,409	bc	214	c	303	c	152	b	285	b
No cover	----	--	----	--	----	-	544	a	549	a

[a] Means for the same year followed by the same letter are not significantly different according to Fisher's LSD (p =0.05).
[b] Palmer amaranth biomass collected 2 wk after transplant in 2017.
[c] Total weed biomass averaged over cover crop termination timing.
[d] Cover crop biomass averaged over cover crop termination timing in 2017.
[e] Abbreviation: WATrplt, wk after transplant.

Conclusions: The use of spring-seeded grass cover crops did not eliminate the need for additional weed control. However, in both studies, cover crops helped to reduce weed density and biomass. As a result, fewer, smaller weeds may be more effectively controlled with herbicides or other means. Additional research is needed to determine how this system may be integrated with other techniques to manage weeds throughout the entire growing season.

Cover crops did not have a consistent impact on the soil health parameters measured in this study.

Acknowledgement: This project was funded by the Northeastern IPM Center through Grant #2014-70006-22484 from the National Institute of Food and Agriculture, Crop Protection and Pest Management, Regional Coordination Program.