

Effect of Cover Crops for Weed Pest Management in Organic Vegetables

Dr. Kathleen Delate and A. McKern
Depts. of Horticulture & Agronomy
Iowa State University

Introduction

Weeds constitute a major challenge for organic vegetable growers. Organic weed management options include tillage, mulches, flame burning, and allelopathic crops, such as rye (*Secale cereale*). In 2003 and 2004, we examined the effect of a rye cover crop on weed populations, crop stand and yield of organic green beans and peas at the Neely-Kinyon Research Farm in Greenfield, Iowa. In addition to the weed-suppressive effect of winter rye, the cover crop can be used to meet certified organic requirements for soil-building practices (USDA-AMS, 2003).

Materials and Methods

Winter rye was no-till drilled into the rye treatment plots at a rate of 1 bushel/acre on October 15, 2003. Plots were seeded with peas on June 2 and with beans on June 11, 2004, at a spacing of 1 in. by 30 in. rows. Four sub-plots of each pea and green bean cultivar were planted in each main treatment block. Plot size was 5 x 20 ft. The main treatments in the 2004 project included the following:

- Rye cover crop tilled into soil prior to vegetable planting; and
- A control (no rye).

Sub-treatments include two cultivars of each crop: Contender and Jade green beans and Green Arrow and Little Marvel peas (Johnny's Seeds, Albion, Maine).

Weed populations were surveyed in green bean plots on June 22, and July 6, 19, and 30, 2004, by counting the number of grass and broadleaf species in three random locations within each plot. Stand counts were taken in green bean plots on June 22, and July 6 and 19, by counting the number of emerged seedlings and plants within a 1-meter length in three random locations within each plot. All green beans were harvested within each plot when beans were mature (≥ 4 in. in length) on July 30, and August 12, 17, 18, and 19, 2004. Weed counts in pea plots were taken on June 22, and July 19 and 30, 2004. Stand counts were taken in pea plots on June 22 and July 19. Peas were harvested on July 30, and August 12, 16, and 19, 2004.

Results and Discussion

In 2004, excellent organic green bean yields were obtained in both treatments. There was a trend towards higher plant stands in green beans that were planted with a rye cover crop (Table 1) with significant differences on June 22. Green bean yields were also significantly greater following the rye cover crop compared to plots with no cover crop (Table 1). This result contrasted with first-year results where no significant differences were observed in stands and yields with or without a rye cover crop. Producers must adequately kill the cover crop prior to vegetable planting, however, or crop stands and

subsequent yields could be decreased (Delate et al., 2002). Competition from any remaining residue from the rye cover crop was not apparent in either year of the experiment.

Broadleaf weeds (pigweed, lamb's quarter and others) increased throughout the growing season (Table 2). There was no significant difference in broadleaf populations, until the end of the season (July 30) when broadleaves were significantly lower in green bean plots with a rye cover, compared with the control plots (Table 2). Grass weed populations remained low throughout the season with less than 1 weed per square meter in both treatments (Table 3).

When we examined differences among green bean cultivars in 2004, there were no significant differences in yields between 'Contender' and 'Jade' (Table 4). These results were similar to yields in 2003. Plant populations were also similar in both cultivars (Table 3). As in 2003, there were also no differences in either broadleaf or grass weed populations between cultivars (Tables 5-6).

When the effect of green bean cultivars and rye cover crop was analyzed together, yields did not differ (Table 7), and stand counts were significantly greater only on June 22 in the 'Jade' plots with a rye cover crop (Table 7). On July 6 and July 19, the 'Contender' control plots were equivalent in stand counts to the 'Jade' plots with a rye cover crop (Table 7). At the final weed count (July 30), broadleaf weeds were significantly less in both the 'Contender' and 'jade' plots with a rye cover crop (Table 8). There was no significant interaction between cultivar and rye cover on grass weed populations throughout the season (Table 9).

Pea yields were severely impacted by rabbit browsing in the third week of the experiment in 2004. In the plots where crops could be harvested, yields were significantly greater in plots with a cover crop (Table 10). Stand counts were also greater in rye-cover plots (Table 10). These results contrasted with 2003, where no differences in yields and stands were observed between treatments. Broadleaf weeds were significantly greater in control plots compared with rye-cover plots which was similar to 2003 (Table 11). Grass weeds were not affected by the cover crop, similar to 2003, but populations were low overall (less than 2 grass weeds per square meter) (Table 12). When specific cultivars were examined, plant populations were similar to 2003, where there were no differences in stands, similar to 2003 results (Table 13). Similar to 2003, yields were equivalent in 'Green Arrow' and 'Little Marvel' plots (Table 13). Cultivars were equally competitive with weeds, as demonstrated by similar grass and broadleaf populations in both cultivars (Tables 14-15). The lack of cultivar differences was also observed in 2003 experiments.

When the effect of pea cultivars and rye cover crop was analyzed together, yields were greatest in the 'Little Marvel' crops grown with a rye cover (Table 16). Stands were greatest in both 'Little Marvel' and 'Green Arrow' plots with a rye cover (Table 16). Weeds were not significantly different until July 30, when broadleaf weeds were lower in 'Little Marvel' and 'Green Arrow' plots with a rye cover (Tables 17-18).

Results from these experiments were very encouraging for organic green bean and pea producers. With the exception of rabbits browsing on pea plants in 2004, green bean and pea yields were excellent in 2003-2004, with no apparent nutritional, insect or disease problems. While there were no significant differences in yields and weed populations between treatments in 2003, the overall benefit of planting a rye cover crop prior to green bean and pea planting was evident in 2004. Because weed management is recognized as one of the most pressing needs of organic farmers, a rye cover crop can assist in managing weed populations, particularly in years where weeds are plentiful due to high rainfall. Broadleaf weeds were effectively managed in both years in both pea and green bean plots with the rye cover crop. Grass populations were not considered a problem in either year, and were not affected by the rye cover crop. Although weed populations were not affected by the rye cover cop in 2003, any effort towards reducing weed seed densities will lead to an increase in yields in the long term.

References

- Delate, K., C. Cambardella, and D. Karlen. 2002. Transition strategies for post-CRP certified organic grain production. Published 28 August 2002. Crop Management. Online. Crop Management doi:10.1094/CM-2002-0828-01-RS.
- [USDA-AMS] U.S. Department of Agriculture -Agriculture Marketing Service. 2003. National Organic Program. Final Rule: 7 CFR Part 205 [Online]. Available at: <http://www.ams.usda.gov/nop> (accessed 10 April 2003; verified 12 December 2004). USDA-AMS, Washington, D.C.

Table 1. Organic green bean weed management trial: crop parameters, 2004.

Treatment	Yield (lb/plot)	Stand (plants m ⁻¹)		
		June 22, 2004	July 6, 2004	July 19, 2004
Rye Cover Crop	19.90a	11.96a	11.75	11.00
Control	13.81b	10.33b	11.19	9.67
LSD _{0.05}	4.04	1.31	NS	NS

Table 2. Organic green bean weed management trial: broadleaf weed parameters, 2004.

Treatment	Broadleaf weeds/m ²			
	June 22, 2004	July 6, 2004	July 19, 2004	July 30, 2004
Rye Cover Crop	0.25	0.63	3.13	2.63a
Control	0.29	1.19	2.50	13.88b
LSD _{0.05}	NS	NS	NS	4.41

Table 3. Organic green bean weed management trial: grass weed parameters, 2004.

Treatment	Grass weeds/m ²			
	June 22, 2004	July 6, 2004	July 19, 2004	July 30, 2004
Rye Cover Crop	0.00	0.44b	0.13	0.88

Control	0.00	0.00a	0.06	0.50
LSD _{0.05}	NS	0.32	NS	NS

Table 4. Organic green bean variety trial: crop parameters, 2004.

Treatment	Yield (lb/plot)	Stand (plants m ⁻¹)		
		June 22, 2004	July 6, 2004	July 19, 2004
Contender	17.44	10.79	11.31	10.27
Jade	16.27	11.50	11.63	10.44
LSD _{0.05}	NS	NS	NS	NS

Table 5. Organic green bean variety trial: broadleaf weed parameters, 2004.

Treatment	Broadleaf weeds/m ²			
	June 22, 2004	July 6, 2004	July 19, 2004	July 30, 2004
Contender	0.33	1.19	2.88	9.13
Jade	0.21	0.63	2.75	7.38
LSD _{0.05}	NS	NS	NS	NS

Table 6. Organic green bean variety trial: grass weed parameters, 2004.

Treatment	Grass weeds/m ²			
	June 22, 2004	July 6, 2004	July 19, 2004	July 30, 2004
Contender	0.00	0.19	0.06	1.00
Jade	0.00	0.25	0.13	0.38
LSD _{0.05}	NS	NS	NS	NS

Table 7. Organic green bean variety and weed management trials: crop parameters, 2004.

Treatment	Yield (lb/plot)	Stand (plants m ⁻¹)		
		June 22, 2004	July 6, 2004	July 19, 2004
Contender, Control	14.74	11.00b	12.38ab	10.71ab
Contender, Rye Cover Crop	20.14	10.58b	10.25b	9.88b
Jade, Control	12.88	9.67b	10.00b	8.75b
Jade, Rye Cover Crop	19.66	13.33a	13.25a	12.13a
LSD _{0.05}	NS	1.66	2.65	2.11

Table 8. Organic green bean variety and weed management trials: broadleaf weed parameters, 2004.

Treatment	Broadleaf weeds/m ²			
	June 22, 2004	July 6, 2004	July 19, 2004	July 30, 2004
Contender, Control	0.33	1.75	3.50	15.75b

Contender, Rye Cover Crop	0.33	0.63	2.25	2.50a
Jade, Control	0.25	0.63	1.50	12.00b
Jade, Rye Cover Crop	0.17	0.63	4.00	2.75a
LSD _{0.05}	NS	NS	NS	6.42

Table 9. Organic green bean variety and weed management trials: grass weed parameters, 2004.

Treatment	Grass weeds/m ²			
	June 22, 2004	July 6, 2004	July 19, 2004	July 30, 2004
Contender, Control	0.00	0.00	0.00	1.00
Contender, Rye Cover Crop	0.00	0.38	0.13	1.00
Jade, Control	0.00	0.00	0.13	0.00
Jade, Rye Cover Crop	0.00	0.50	0.13	0.75
LSD _{0.05}	NS	NS	NS	NS

Table 10. Organic pea weed management trial: crop parameters, 2004.

Treatment	Yield (lb/plot)	Stand (plants m ⁻¹)	
		June 22, 2004	July 19, 2004
Rye Cover Crop	5.11a	10.33a	10.00a
Control	0.23b	6.58b	5.88b
LSD _{0.05}	1.47	1.30	1.38

Table 11. Organic pea weed management trial: broadleaf weed parameters, 2004.

Treatment	Broadleaf weeds/m ²		
	June 22, 2004	July 19, 2004	July 30, 2004
Rye Cover Crop	0.54	1.75	1.00a
Control	0.38	1.69	11.75b
LSD _{0.05}	NS	NS	3.84

Table 12. Organic pea weed management trial: grass weed parameters, 2004.

Treatment	Grass weeds/m ²		
	June 22, 2004	July 19, 2004	July 30, 2004
Rye Cover Crop	0.00	0.31	1.13
Control	0.00	0.31	0.88
LSD _{0.05}	NS	NS	NS

Table 13. Organic pea variety trial: crop parameters, 2004.

Treatment	Yield (lb/plot)	Stand (plants m ⁻¹)
-----------	-----------------	------------------------------------

		June 22, 2004	July 19, 2004
Green Arrow	1.85	8.13	7.63
Little Marvel	3.50	8.79	8.25
LSD _{0.05}	NS	NS	NS

Table 14. Organic pea variety trial: broadleaf weed parameters, 2004.

Treatment	Broadleaf weeds/ m ²		
	June 22, 2004	July 19, 2004	July 30, 2004
Green Arrow	0.54	2.00	7.00
Little Marvel	0.38	1.44	5.75
LSD _{0.05}	NS	NS	NS

Table 15. Organic pea variety trial: grass weed parameters, 2004.

Treatment	Grass weeds/ m ²		
	June 22, 2004	July 19, 2004	July 30, 2004
Green Arrow	0.00	0.25	0.75
Little Marvel	0.00	0.38	1.25
LSD _{0.05}	NS	NS	NS

Table 16. Organic pea variety and weed management trials: crop parameters, 2004.

Treatment	Yield (lb/plot)	Stand (plants m ⁻¹)	
		June 22, 2004	July 19, 2004
		Green Arrow, Control	0.07c
Green Arrow, Rye Cover Crop	3.62b	9.58a	9.25a
Little Marvel, Control	0.39c	6.50b	5.75b
Little Marvel, Rye Cover Crop	6.61a	11.08a	10.75a
LSD _{0.05}	1.27	1.83	1.94

Table 17. Organic pea variety and weed management trials: grass weed parameters, 2004.

Treatment	Broadleaf weeds/ m ²		
	June 22, 2004	July 19, 2004	July 30, 2004
Green Arrow, Control	0.42	2.13	12.75b
Green Arrow, Rye Cover Crop	0.67	1.88	1.25a
Little Marvel, Control	0.33	1.25	10.75b
Little Marvel, Rye Cover Crop	0.42	1.63	0.75a
LSD _{0.05}	NS	NS	5.82

Table 18. Organic pea variety and weed management trials: grass weed parameters, 2004.

Treatment	Grass weeds/ m ²
-----------	-----------------------------

	June 22, 2004	July 19, 2004	July 30, 2004
Green Arrow, Control	0.00	0.25	0.75
Green Arrow, Rye Cover Crop	0.00	0.25	0.75
Little Marvel, Control	0.00	0.38	1.00
Little Marvel, Rye Cover Crop	0.00	0.38	1.50
LSD _{0.05}	NS	NS	NS

Acknowledgements

We would like to thank Gerber Baby Food, Inc. and the Leopold Center for Sustainable Agriculture for their support of this project.