Weed Suppression, White Mold Incidence, and Snap Bean Yield in Fall-planted Cover Crop Residue Systems

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Introduction

Limited herbicide options and the tentative state of registration for Ronilan fungicide in snap bean production require development of additional management strategies for suppression of weeds and white mold (*Sclerotinia sclerotiorum*) in snap bean production. One possibility employs cereal residues derived from cover crops. Cereal cover crop residues left on the soil effectively suppress many small-seeded, annual weeds through allelopathy and mulch barriers. In addition, several compounds have been isolated from cereals that have antifungal properties. These compounds, coupled with other influences of the cereal residue, may reduce the effect of disease organisms in vegetable production systems. The objectives of this research were to evaluate weed suppression, white mold incidence, and snap bean yield in reduced tillage systems with two cereal residue management options.

Methodology

Micah, Hesk and Steptoe barley were planted on October 19, 1992 into a field that was fall plowed and disked. Barley was planted at 45 seeds/sq ft. (an average of 160 lbs/acre). Glyphosate was applied to all plots on May 6 just prior to cereal booting (1.5 lbs ai/acre). Half of each main plot was rolled and the other half rolled and flailed on June 14. Conventional tillage plots were winter fallow with no cover crop, chisel plowed on June 14, and rototilled June 17. Snap beans (OR 91G) were planted on June 23 in 15-inch rows with a John Deere no-till grain drill adapted to snap bean planting. Liquid fertilizer (70 gal/acre: 50 lbs N, 100 P, 50 K, 20 S) was shanked into the soil ahead of the disk opener. Beginning at first bloom, the experiment was lightly irrigated every evening until harvest to encourage white mold development. In addition, four rows of sweet corn were planted around the perimeter of the field to reduce air flow.

Poast and Basagran were applied July 16, 23 days after planting (DAP) at the first to second trifoliate stage. Wet and cool weather conditions threatened to diminish herbicide impact; light rain occurred within three hours of Basagran and one hour of Poast application but did not seem to affect activity. Ronilan 50DF (0.5 # ai/acre with 38 gal of water/acre at 50 PSI) was applied August 5 at first bloom to one half of the conventional tillage plot with both overhead and drop nozzles targeted toward both sides of the row.

Evaluations during the growing season included bean emergence from a 1 m^2 area 21 DAP, cereal residue drymatter on June 23 (at planting), and percent soil coverage by the cereal residue 9 DAP. Weed density by species was determined 21 DAP just before herbicide application.

Snap beans were harvested on August 25 and 26 by pulling plants from two rows of 20 foot in length from each plot. From these same plants, 20 plants were randomly selected and evaluated for presence of white mold growth or evidence of grey mold on any part of the plant. In addition, 200 pods were inspected for white or grey mold from randomly selected plants. After the mold evaluation, pods were stripped, weighed and graded. Weeds were pulled from the area cleared of snap beans in each plot, separated by species, and weighed.

Results and Discussion

Snap bean yield. Reduced tillage treatments with and without cereal residues generally yielded as well or better than the conventionally tilled plot (Table 1, Fig.1). Grade evaluations revealed no differences in grade across treatments, but that beans were harvested 1-2 days before optimum. The lowest yield was caused by excessive residue of *Steptoe* barley, which hindered efficient seed placement by the planter and resulted in fewer bean plants in one area of the field. Flailing of the cover crop residue improved yield slightly. Bean plant biomass followed a trend nearly identical to pod yield.

Weeds. Early season weed density was much less in reduced tillage than conventionally tilled treatments, and was slightly less in treatments with cereal residue than treatments without. Flailing did not have an important affect on weed density. Weed biomass at harvest was much less in the unflailed cover crop treatments than conventional tillage treatments. Flailing dramatically increased weed biomass. Weed biomass was greater in treatments with cereal residue than without, a reversal compared to early season weed density. But this was most likely a factor of the herbicide application. Cereal residues may have protected emerging seedlings from herbicide contact. The above average weed biomass in the *Micah* barley treatment is partly due to self seeding of the barley.

White mold. Percent white mold infected pods was greater in the unflailed residue treatments than in treatments without cover crop residue or the conventional tillage treatments (Table 1, Fig.2). However, the infection rate for pods was very low throughout the experiment.

Another indicator of white mold presence is the percentage of infected plants, including plant stems. These data reveal a slightly different trend. While unflailed residue treatments had greater infection rates, all of the flailed plots had very low infection rates. Of particular contrast is the difference between the incidence of white mold in flailed residue treatments versus the conventional tillage treatment without Ronilan. Ronilan effectively controlled white mold infection.

In summary, these results indicate that tillage, cover crop residue, and residue management may impact both disease incidence and weed emergence and growth. However, caution must be exercised in interpreting this data. Though white mold was prevalent in this trail, the infection rate of snap bean pods was very low and infected plants were found in patches. Using infected plants as an indicator may improve the assessment but may not directly correlate with pod infection. The advantage of cereal cover crop residues was most apparent in early season weed suppression but was not an advantage in the long term, if only considered from a weed control perspective. Fall tillage with no cover crop, combined with applications of Poast and Basagran, minimized weed growth best. Snap bean yield of the most promising reduced tillage and cover crop treatments was comparable to or greater than the conventionally tilled treatment and average yields in the Willamette Valley.

Table 1. Effect of cereal cover crop residues and management on a snap bean production system.

Cereal cover crop	Residue management	Disease incidence: % Pods infected by white mold	Disease incidence: % Pods infected by grey mold	Disease incidence: % Plants infected with white mold	Disease incidence: % Plants infected with grey mold	Bean yield: Pod yield (t/ac)	Bean yield: Bean plant biomass (t/ac)	Weed suppression: Weed biomass (#/plot)	Weed suppression: Pigweed biomass (% of weed biomass)	Weed suppression: Broadleaf density (before post herbicide; no./0.5 m sq)	Mulch: % soil coverage (9 DAP)
Micah barley	Flailed	0.3	0.1	0.0	2.5	7.4	11.4	1.9	69	4	76
	Unflailed	1.3	0.1	6.2	2.5	6.0	9.8	1.4	85	2	72
Steptoe barley	Flailed	0.0	0.0	0.0	0.0	4.7	9.3	1.1	100	2	87
	Unflailed	0.4	0.1	5.0	1.3	3.6	7.9	0.3	44	2	79
Hesk barley	Flailed	0.0	0.2	0.0	3.8	6.3	11.6	3.4	100	2	61
	Unflailed	0.1	0.5	3.8	3.8	5.2	9.3	0.4	50	6	60
No cover crop	Flailed	0.1	0.9	1.3	11.3	6.8	11.4	0.4	69	8	27
	Unflailed	0.0	0.1	7.5	2.5	6.8	10.7	0.1	50	3	23
Conventional tillage	No Ronilan	0.0	0.1	18.8	2.5	4.3	9.7	3.6	100	30	9
	Ronilan	0.0	0.0	0.0	3.8	5.8	10.5	2.1	100	22	10
LSD		NS[1]	NS	10.8	NS	2.7[2]	3.1	2.5	45	17	23
Probability of significant differences among main and crossed effects. Main effects are Residue and Residue Management (flailed/unflailed). Analysis excludes conventional tillage plots, both with and without Ronilan.											
Residue		0.14	0.46	0.62	0.57	0.42	0.63	0.34	0.81	0.08	0.02
Flailed vs Unflailed		0.18	0.43	0.17	0.30	0.16	0.14	0.12	0.12	0.67	0.003
Residue vs (Flail/unflailed)		0.50	0.62	0.92	0.68	0.81	0.80	0.49	0.41	0.02	0.99
Contrasts											
Cereal vs none		0.30	0.23	0.26	0.23	0.37	0.48	0.18	0.37	0.02	0.005
Micah vs other cereal		0.04	0.71	0.59	0.93	0.28	0.55	0.68	0.83	0.95	0.81

[1] P=0.05 for disease evaluations.

[2] P=0.10 for bean yield, weed suppression, and mulch.

Table 2. Pesticide application record sheet

	Basagran, 1 lbs ai/acre	Poast, 0.28 lbs ai/acre	Ronilan 50DF, 0.5 lbs ai/acre
Application Date	7/15/93	7/15/93	8/5/93
Application Timing	POST, 1-2 trifoliate	POST, 1- 2 trifoliate	Early bloom
Start/End Time	8:30-9:30 AM	10:45-11:15 AM	10-10:30 AM
Air Temp	62	69	79
Soil Temp (2 ")	68	68	-
Rel Humidity	60 %	60 %	50%
Wind Direction	SW	SW	N
Wind Velocity	0-5	0-5	0-2
Cloud Cover	90 %	80 %	none
Soil Moisture	dry	dry	very wet
Plant Moisture	dry	dry	dry
Sprayer/PSI	45 PSI	30 PSI	50 PSI
Mix Size	2 liter	2 liter	2 liter
Gallons H_2O/Acre	28.66	15	57.5
Nozzle Type	8002	8002	8002 drop nozzles
Nozzle Spacing and Height	26/22	26/22	15", on both sides of the row and one above

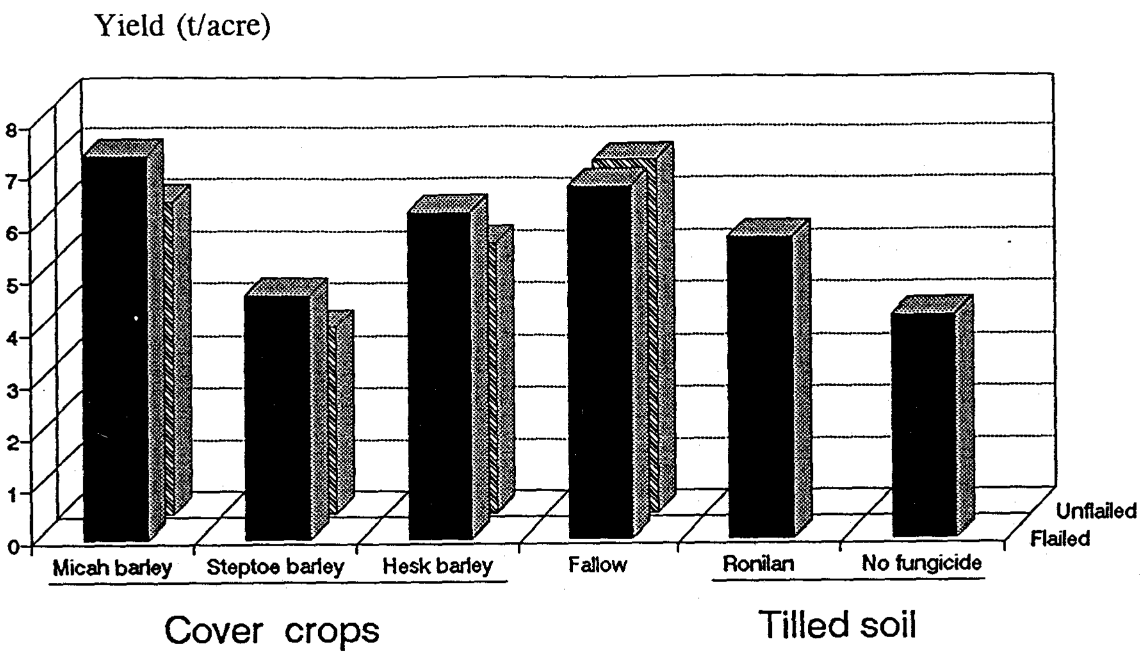

Figure 1. Snap bean yield in cover crop residue systems.

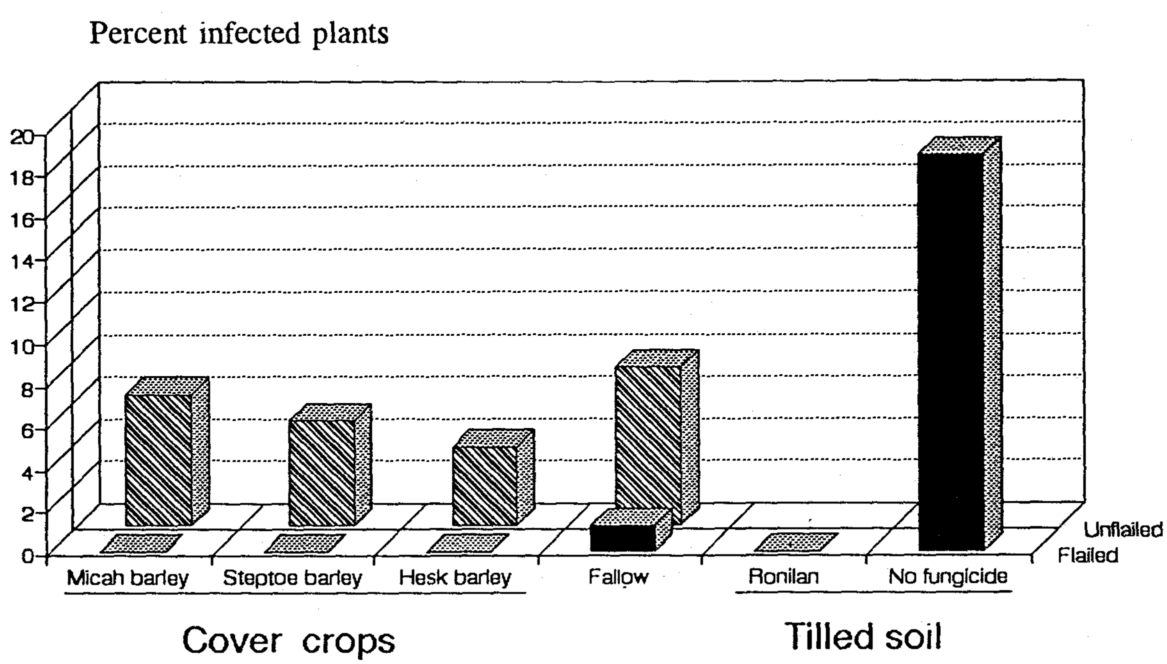

Figure 2. White mold incidence in snap beans with cover crop residues

Weed Suppression, White Mold Incidence, and Snap Bean Yield in Spring-planted Cereal Residue Systems

Ed Peachey and Ray William

Introduction

Cereal residues impact crop growth and suppress weeds through allelopathic, competitive, or physical affects. Last year, cereal residues reduced weed biomass by 90 percent when coupled with stale seedbed systems for cucumber production. The objectives of this research were to evaluate four systems that maximize the competitive/allelopathic/physical aspects of spring-planted cereals for weed control in snap bean production, and to assess the impact of these systems on snap bean yield and white mold development.

Methodology

Micah barley was broadcast in four different systems along with fertilizer (420 lbs/acre: 12-29-10) in 10 by 20 foot plots prior to planting snap beans (see Table 1 for treatment description). The soil was rottotilled to 2" to incorporate the seed and fertilizer into the soil. Each treatment included a companion plot without cereals (see Table 1 for a description of treatments). Either glyphosate (1 lbs ai/acre) or Poast and Basagran were applied to kill the cereal, depending on the growth stage of the beans. Snap beans (OR 91G) were planted on June 23 with a John Deere no-till grain drill modified for snap bean planting in 15 inch rows. Liquid fertilizer was shanked into the soil at planting at 50, 100, 50, and 20 lbs of N,P,K, and S respectively.

Snap beans were harvested on August 28 by pulling plants from 10 foot of 2 rows in each plot and hand picking the pods. Pods were weighed and graded. White mold incidence was evaluated by pulling twenty plants from around the perimeter of each harvested area and identifying plants infected with white and grey mold. Weeds were pulled from each plot and weighed, including surviving barley plants.

Results and Discussion

Barley planted on the same day as snap beans and killed with Poast 19 days after planting (treatment 3a; see table 1) reduced weed biomass by 80% but only slightly affected snap bean yield compared to the same treatment without cereal (Tr 3b). Other strategies were less successful. The barley was very competitive with beans in treatment 2a at a critical stage of development and greatly reduced yields. Poast killed the cereal very slowly. In treatment 4a, Poast did not adequately kill the cereal, resulting in continued competition throughout the season. Vigorously growing barley greater than 12" tall may be difficult to kill at the labeled rate of Poast (0.28 lbs ai/acre). These results demonstrate the critical nature of timing for herbicide application.

The cause of reduced yield in treatment 1a is not clear. Though the residue biomass was greater than in other treatments, this level did not significantly interfere with the planter. Nitrogen immobilization may have contributed to the decrease although adequate nitrogen was applied in this experiment. Other possibilities include temperature depression, allelopathic compounds, or disease. Researchers at the Columbia Basin Agricultural Research Center have found that glyphosate must be applied at least 2 weeks prior to crop planting to minimize injury to the crop (Smiley et al, 1992). Plant roots begin sloughing off dead tissue soon after glyphosate is applied, which causes a large but temporary increase in disease organisms in the soil. The result is poor crop emergence and growth in the early stages of development.

Treatments with cereals had less weed biomass at the end of the season than treatments without cereals, with the exception of treatment 1. Weed biomass in treatment 1b is much less than in 2b, 3b and 4b.

The presence of cereal residues tended to reduce white mold incidence, although some of this response may be a result of less crop biomass and a more open canopy in treatments that significantly reduced crop growth. The exception is treatment 3a where crop yield is nearly as great as the control (3b) and white mold incidence was much less. Grey mold incidence followed a similar trend.

Two strategies standout from this experiment. The stale seed bed with a 5 week fallow period before herbicide application (Tr. 1b), but without cereal residue, produced a high yield with few weeds. However, white mold incidence was greater in this treatment than any other. The second strategy with promise is treatment 3a, with Micah barley planted at the same date as snap beans. Yield was comparable to the companion treatment without cereal residues, weed biomass was acceptable, and white mold incidence was very low. Future research should continue to evaluate these two systems. An additional system should be evaluated that includes 4-5 week old cereals killed with glyphosate just before snap bean emergence.

References

Smiley, R.W., A.G. Ogg Jr., and R.J.Cook. 1992. Influence of glyphosate on Rhizoctonia root rot, growth, and yield of barley. Plant-Disease 76:(9) 937-942.

Table 1. Snap bean performance in four systems employing spring-planted cereals.

		Cereal	Cultivation and cereal planting[1]	Herbicide application date	Herbicide	Yield (t/ac)	White mold (% infected plants)	Grey mold (% infected plants)	Broadleaf weeds (lbs/plot)	Barley weeds (lbs/plot)	Cereal drymatter (t/ac)[2]	Emergence (No./m^2; 21 DAP)
1	a	Micah barley	6	1 WBP[3]	Glyphosate	3.3	0	0	0.2	0.0	1.5	32
	a	None	6	1 WBP	Glyphosate	7.7	10	8	0.1	0.0	0.0	31
2	a	Micah barley	2	15 DAP[4] 23 DAP	Poast Basagran	0.9	0	0	0.0	0.0	1.4	NA
	a	None	2	15 DAP 23 DAP	Poast Basagran	7.9	0	10	2.1	0.0	0.0	26
3	a	Micah barley	0	19 DAP 23 DAP	Poast Basagran	7.4	0	0	0.2	0.0	0.5	23
	b	None	0	19 DAP 23 DAP	Poast Basagran	8.0	8	15	1.3	0.0	0.0	32
4	a	Micah barley	0	23 DAP 23 DAP	Poast Basagran	3.3	0	0	0.0	2.2	NA	31
	b	None	0	23 DAP 23 DAP	Poast Basagran	7.9	5	3	0.9	0.0	0.0	27
		LSD (p=0.05)				2.3	9.7	9.3	1.4	0.6	0.2	8

[1] Number of weeks before snap bean planting that last cultivation and cereal planting occurred.
[2] Cereal biomass at first herbicide application date.
[3] WBP: weeks before planting.
[4] DAP: days after planting.