To: Nick George, Midwest Food Processors Association and DATCP
From: Jim Nienhuis, Dept. of Horticulture, UW-Madison
Date: Sept. 28, 2010

Final Report

Reducing risk associated with large-scale organic snap bean production in Wisconsin
WDATCP Contract # 23013 (07/01/2008-06/30/2010)

Production and processing of organic snap beans in the state of Wisconsin offers a significant opportunity for value-added economic impact to over 700 certified growers and a very significant processing opportunity for the industry. Demand currently exists for at least 10,000 certified acres of organic snap bean production; nevertheless, less than 2,000 acres are currently grown and processed. Growers and processors in the Pacific Northwest and Southern United States fill the slack in the organic snap bean production in Wisconsin, at much higher cost. The reason for that production supply cannot fill current Wisconsin processing demand is because of the greater risk associated with organic snap bean production; yields are, at best, only approximately 65% of conventional snap beans (Jim Brockpahler, Ag Manager, Lakeside Foods, New Richmond).

The objective of this grant is to provide growers and processors a package of best management strategies that address constraints and reduce the risk associated with organic snap bean production in Wisconsin. The most important constraints to increased organic snap bean production in Wisconsin include:

a. Root rot disease
b. Nitrogen management
c. Seed corn maggot

I. Project activities for this reporting period.

A) Seed Corn Maggot

A significant challenge to the organic grower is that organic certification does not allow the seed to be treated with the conventional cocktail of fungicides and insecticides; this greatly exacerbates the risk to germinating seeds and seedlings due to root rot disease and seed corn maggot (*Delia platura*). An organic insecticide Entrust (Dow Chemical Corp), a Spinosad derivative compound was tested as a potential seed treatment to reduce damage to germinating seeds and seedlings due to the seed corn maggot. Two cultivars, 'UW3' (root rot resistant) and 'Hystyle' (root rot susceptible) were tested in fields at the Hancock ARS, Hancock, WI with high and low levels of root rot inoculum. The experiment was repeated over two years (summers of 2009 and 2010).

Table 1. Effect of cultivar and Entrust seed treatment on yield, percent and percent stand in fields with high and low levels of root rot inoculum evaluated over two years (2009 and 2010) at Hancock ARS.

Field with high levels of root rot inoculum					
Cultivar	**Entrust seed treatment**	**Yield T/A**	**Mean separation[1]**	**Pct. Stand**	**Mean separation[1]**
Hystyle	**yes**	**0.30**	**B**	**48.20**	**C**
Hystyle	**no**	**0.18**	**B**	**36.27**	**D**
UW3	**yes**	**1.58**	**A**	**86.48**	**A**
UW3	**no**	**1.18**	**A**	**62.17**	**B**
Field with low levels of root rot inoculum					
Cultivar	**Entrust seed treatment**	**Yield T/A**	**Mean separation[1]**	**Pct. Stand**	**Mean separation[1]**
Hystyle	**yes**	**2.21**	**B C**	**25.59**	**C**
Hystyle	**no**	**1.54**	**C**	**21.47**	**C**
UW3	**yes**	**3.14**	**A**	**60.17**	**A**
UW3	**no**	**2.76**	**A B**	**39.73**	**B**

[1] Means with the same letter are not significantly different.

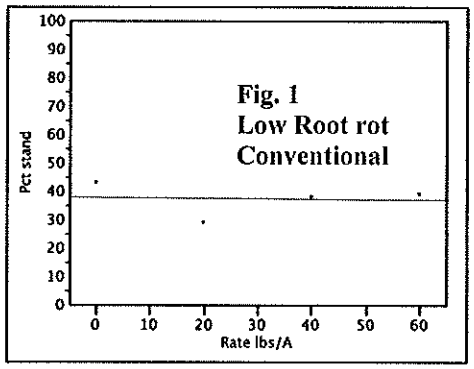
'UW3', the root rot resistant cultivar developed by UW-Madison had higher yield and percent emergence and stand compared to the traditional root rot susceptible cultivar, 'Hystyle' regardless of whether evaluated in a field with high or low levels of root rot inoculum (Table 1). Seed treatment of UW3' and 'Hystyle' with Entrust resulted in an increased percentage yield and emergence in both 'Hystyle' and 'UW3' regardless of the level of root rot inoculum. The smaller average percent increase in 'Hystyle' compared to 'UW3' is likely due to the greater effect of root rot on 'Hystyle'.

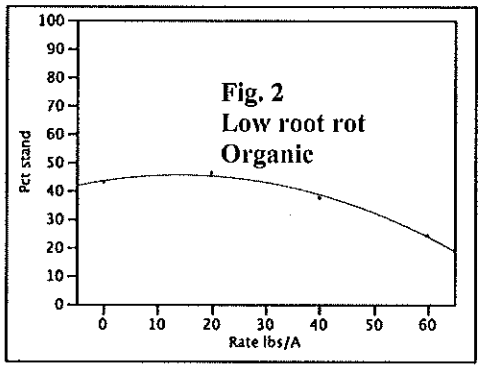
We conclude that Entrust provides a significant increase in emergence of snap bean seeds compared to non-treated seed.

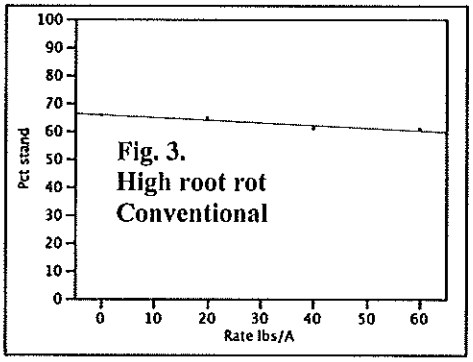
Table 2. Effect of Entrust seed treatment

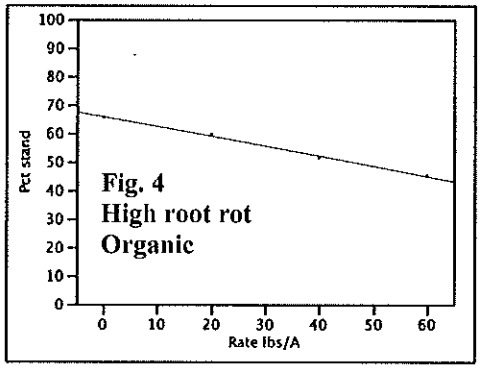
		Average percent increase in seed treated with Entrust	
Root Rot inoculum	Cultivar	Yield	Stand (emergence)
High	**Hystyle**	**66.0**	**32.9**
	UW3	**34.0**	**39.1**
Low	**Hystyle**	**43.5**	**19.2**
	UW3	**13.8**	**51.4**

B) Nitrogen fertilizer on emergence (Figures 1-4). Response to conventional nitrogen fertilizer (ammonium sulfate) compared to organic chicken compost at four levels in fields at the Hancock ARS with high and low levels of root rot inoculum. Treatments were evaluated over two years, summer 2009 and 2010. Percent plant stand (emergence) in response to conventional nitrogen fertilizer (ammonium sulfate) compared to organic chicken compost at four levels (0, 20, 40 and 60 lbs/acre).



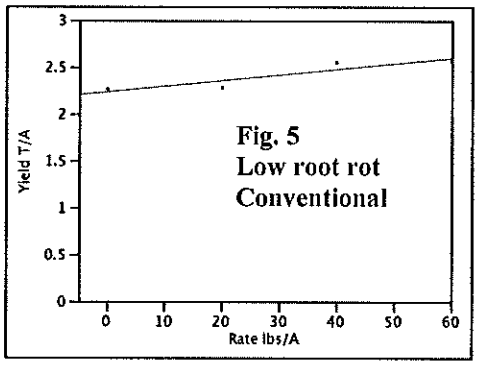


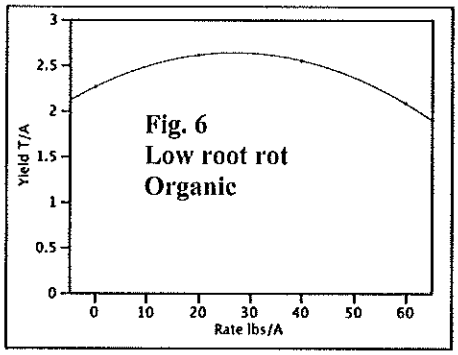


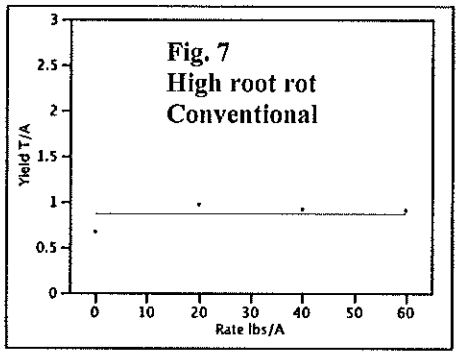


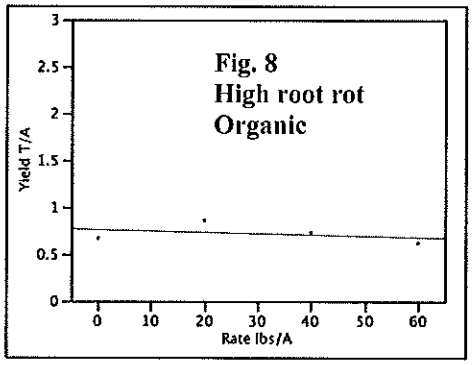
Percent plant stand (emergence) was not affected by the four levels (0, 20, 40 and 60 lbs/A) of conventional nitrogen fertilizer (ammonium sulfate) in both low and high levels of root rot inoculum. In contrast, the percent plant stand was reduced with increasing levels of nitrogen (0, 20, 40 and 60 lbs/A) provided by composed chicken guano. All the composted chicken guano was applied approximately two weeks prior to seeding, whereas the ammonium sulfate was applied 10% at seeding and 90% side-dressed approximately 3 weeks after seeding. The results indicate that higher levels of organic fertilizer may have a detrimental effect on seedling emergence either due to increased attraction of seed corn maggot or toxicity of the composed chicken compost.

C) **Nitrogen fertilizer on yield (Figures 5-8)** Response to conventional nitrogen fertilizer (ammonium sulfate) compared to organic chicken compost at four levels in fields at the Hancock ARS with high and low levels of root rot inoculum. Treatments were evaluated over three years, summer 2008, 2009 and 2010. Yield (tons/A) of snap beans in response to conventional nitrogen fertilizer (ammonium sulfate) compared to organic chicken compost at four levels (0, 20, 40 and 60 lbs/A).









Yield (T/A) was higher in the fields (Fig. 5 and 6) with low root rot inoculum (K25) compared to the fields (Fig. 7 and 8) with high root rot inoculum (E8). In fields with low levels of root rot inoculum (Fig. 5 and 6), there was a linear increase in yield with increasing availability of conventional nitrogen (Fig. 5). In contrast, there was a curvilinear response to increasing levels of organic fertilizer (Fig. 6). The curvilinear response may due to detrimental effects or toxicity of organic chicken compost. The optimum nitrogen level for organic chicken compost was 20 lbs of N per acre.

No response to increased conventional or organic nitrogen was observed in the fields with high levels of root rot inoculum (Fig. 7 and 8). The failure of the snap bean plants to respond to increasing levels of available nitrogen was likely due the health of the plants being compromised by the high levels of root rot pathogens in the soil.

D) Organic production using nitrogen credit from incorporation of alfalfa. The nitrogen requirement of organic snap beans may be provided by composed chicken manure or alternatively, the incorporation of green manure legumes (alfalfa). The objective of this 2010 study was to observe the effect of root rot resistant ('UW3') and root rot susceptible snap bean cultivars treated with and without Entrust seed treatment in a field in which available nitrogen is provided by a spring incorporation of alfalfa.

Table 3.
Yield and percent plant stand of two snap bean cultivars treated with and without Entrust in a certified organic production field in which nitrogen was provided by soil incorporation of alfalfa residue. Evaluated in early and late trial at Hancock ARS, Hancock, WI.

Cultivar	Entrust Seed treatment	Yield (T/A)	Mean separation[1]	Percent Plant stand	Mean separation[1]
UW3	Yes	3.76	A	88.76	A
	no	2.80	B	71.10	B
Hystyle	Yes	2.51	B C	62.18	B C
	no	1.73	C	46.09	C

[1] means with the same letter are not significantly different.

'UW3' had higher yield compared to 'Hystyle' at both levels of seed treatment (Table 3). The higher yields may be due to the higher level of root rot resistance associated with 'UW3' compared to the susceptible 'Hystyle'. For both 'UW3' and 'Hystyle' seed treated with Entrust had higher yields and plant stand (emergence).

II. Describe accomplishments and objectives met during this reporting period. What knowledge was gained or what advancements were made during reporting period?

The results of the 2008, 2009 and 2010 trials have confirmed that large-scale organic production is feasible in Wisconsin. Disease due to root rot (*Aphanomyces* and *Pythium*) can be effectively controlled using UW developed resistant cultivars, e.g. 'UW3'. Our experiments have demonstrated that nitrogen can be provided by composted chicken manure at the rate of 20 lbs of available N per acre or alternatively by incorporating residue of a leguminous crop (alfalfa). In addition, the results indicate that significantly improved plant emergence (percent plant stand) can be achieved by treating snap bean seed with Entrust organic insecticide.
Results of this research will be presented at the MWFPA meeting. The prior year's results for the Entrust experiment were published in the Annual Report of the Bean Improvement Cooperative, Volume 52, pages 142-144, BIC, 2009.