Evaluation of Cover Crops for Improving Root Health and Yield of Vegetables

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In recent years, vegetable growers have increasingly used cover crops to improve soil quality, prevent erosion, and increase organic matter as well as to suppress nematodes, fungal root pathogens and other pests. The addition of fresh organic matter to the soil in the form of green manures has been shown to generally improve soil quality and health. In fact, many of the soil's biological, physical and chemical properties are a function of soil organic matter quantity and quality. Thus, increasing organic matter in soil has many benefits including increased plant nutrients availability, providing a better physical condition for plant growth, increasing the buffering capacity of soil, stimulating root development and increasing biological diversity. Increasing the diversity and activities of the total microbial community generally result in the suppression of root pathogens and other pests as well as their damage to plants, thus improving root and soil health in general. In contrast, poor replenishment of organic matter in the soil after harvest will result in the deterioration of soil quality and productivity. As soil organic matter decreases, it becomes more difficult to maintain high crop productivity without additional inputs due to problems with erosion, compaction, reduced fertility, inadequate water availability and increased pressure from diseases and other pests.

The preferred characteristics of a cover crop for suppressing damage by root pathogens are that it is a non-host or poor host to the target pathogen(s) and that it will also suppress the existing soil population of the pathogen(s) when incorporated as a green manure. Recent results from New York and elsewhere have well documented the differences in the efficiencies of various cover crops in suppressing the populations of root pathogens and their damage to several vegetables. The latter studies will be reviewed during the presentation, but more detailed information will be presented on a new collaborative, multi-state (NY, PA, CT) cover crop project, which is briefly summarized below.

Nine cover crop treatments are been evaluated in each of four vegetable production systems that have been maintained since 1995 by Dr. Curt Petzoldt of our NYS-IPM program. The four systems are conventional, organic, present-IPM, and Future-IPM. The latter system includes a year in the rotation that is devoted to improving soil quality. Soil of this system exhibits the highest soil health status score and the healthiest roots as determined by the bean soil bioassay. The main goal of the project is to demonstrate the differential impact of cover crops over several cycles on soil health status and root health ratings under different disease pressure. The selected cover crops (buckwheat, red clover, oat, radish, rapeseed, rye/vetch, sudangrass, wheat and fallow check) were first planted in the four systems/fields in fall 2008. Three strips (replicates) that were 15' x 200' were planted/cover crop/field (Fig. 1 & 2). Base-line soil and root health assessments were recorded in April – May 2009, the plots were planted to sweet corn that was

harvested for silage and all the plots were re-planted with the target cover crops in the same test plots. All the plots were sampled for soil health and root health assessments in May 2010, over-wintering cover crops were then mowed and incorporated, and two weeks later all the plots were planted to snap bean cv. 'Caprice' as the indexing crop (marketable yield and root health assessment). The plots were harvested on 4 Aug using a single row "Pixall (BH100) Bean Harvester" (Fig. 3). Bean yield was highest in the field with the highest soil heath parameters and the lowest root rot severity ratings (Future IPM System Field, Table 1). The cover crop treatments also greatly affected root health and yield of beans, but varied among the 4 fields (Tables 1, 2). However, yield of beans was lowest and root rot severity ratings were highest with buckwheat as the cover crop. Root rot severity ratings were also high in plots planted to cover crops of red clover, forage radish, and rapeseed in all fields and specially as assessed in soil bioassay in the greenhouse (Table 3). Preliminary results and observation made to-date have showed differential effects of cover crops in suppressing weeds Fig. 4 A & B), reducing surface hardness, and other factors.

Fig 1

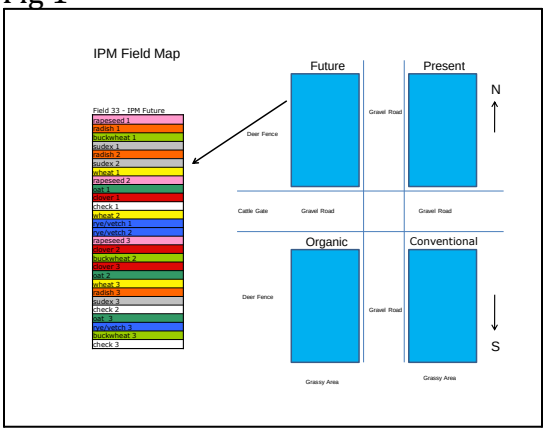

Fig 2

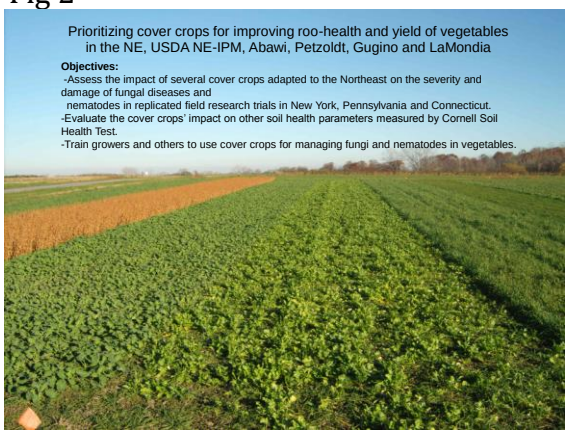

Fig 3

Fig 4

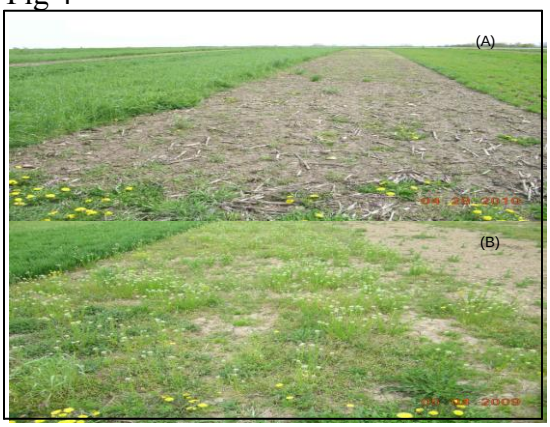

Table 1: Influence of Preceding Selected Cover Crops on Snap Bean Yield, 2010

	Pod Weight, lb/100'			
Cover crop	**IPM Present**	**IPM Future**	**Conventional**	**Organic [1]**
Rapeseed	37.3	41.0	26.3	
Radish	29.2	25.9	28.4	
Buckwheat	23.1	21.1	23.1	
Sudex	36.2	34.9	23.3	
Wheat	34.9	46.2	25.5	
Oat	35.9	38.2	31.6	
Clover	36.6	51.2	26.2	
Rey/Vetch	36.5	25.8	35.0	
Check	35.6	37.9	27.3	
lsd (p=0.05)	*14.3*	*20.4*	*14.9*	

[1] Plots were not harvested due to high weed pressure.

Table 2: Influence of Preceding Cover Crops on Root Rot Severity of Snap Beans, 2010.

	Field Root Rot Severity (1 to 9 scale)[1]			
Cover crop	**IPM Present**	**IPM Future**	**Organic**	**Conventional**
Rapeseed	4.8	4.87	5.4	5.6
Radish	4.9	5.28	5.8	5.3
Buckwheat	5.4	5.37	5.8	5.1
Sudex	3.8	4.18	4.6	5.3
Wheat	4.5	4.14	5.1	5.4
Oat	4.4	4.68	5.4	4.2
Clover	4.7	5.38	5.9	5.3
Rey/Vetch	4.9	4.7	6.4	5.4
Check	5.0	5.32	5.6	5.4
lsd (p=0.05)	*0.7*	*0.7*	*0.9*	*1.18*

[1] Determined on the scale of 1 to 9 with 1=Healthy and 9= severely infected and at an advance stage of decay.

Table 3: Influence of preceding Cover Crop on root rot severity when assessed after Cover Crop incorporation and before planting, 2010.

	Greenhouse Bioassay (1 to 9 scale)			
Cover crop	**IPM Present**	**IPM Future**	**Organic**	**Conventional**
Rapeseed	5.8	4.2	4.3	6.5
Radish	6.8	4.7	4.5	6.8
Buckwheat	5.4	5.0	5.3	6.2
Sudex	5.7	4.3	3.7	5.3
Wheat	5.3	5.2	4.3	5.5
Oat	5.8	4.8	3.7	3.5
Clover	7.6	6.3	5.8	6.5
Rey/Vetch	4.6	3.8	5.2	5.5
Check	6.5	6.7	4.5	6.5
lsd (p=0.05)	*1.3*	*1.5*	*2.9*	*1.5*