Use of Mushroom Compost to suppress Fusarium Root Rot in Snap Beans

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Introduction

Both fresh and aged mushroom compost were delivered from Laurel Valley Soils, Chester County, to the Plant Pathology and Environmental Microbiology Farm at Rock Springs April 2015. A field that was previously cropped in corn was chosen for the study (Plant Pathology Farm, Field Block 27). Soil samples from the field were collected and analyzed to determine fertilizer requirements based on snap bean production. Compost samples were analyzed for nutritional analyses to determine appropriate application rates based on nitrogen demands of the snap beans. Based on lab analyses, 35 lbs of nitrogen per acre was recommended for the bean crop. To ensure adequate nitrogen was provided to all treatments, a 10 lb per acre nitrogen starter was applied at the time of planting. An application of 10 lbs of nitrogen at planting time left a 25 lbs/acre nitrogen requirement for each of the treatments (for control, fresh and aged compost). In May, a mulch applicator was calibrated for both the fresh and aged compost to provide the nutrient (nitrogen) needs of the crop, minus the starter. A 5% mineralization rate was used to calculate nitrogen availability from the aged compost and a 10% mineralization rate was used to calculate the nitrogen availability from the fresh compost. A fresh compost application rate of 10 tons/acre (wet weight) was used to provide 25 lbs of nitrogen to the bean crop assuming a 10% mineralization rate. An aged compost application rate of 28.5 tons/acre (wet weight) was used to provide 25 lbs of nitrogen to the bean crop assuming a 5% mineralization rate. The control received 100% of the nitrogen requirements from synthetic fertilizer, 10 lbs at planting and the remaining 15 lbs as a side dressing. The fields were plowed in April, 2015 and disked May 15th to properly prepare the soil beds. Field plots were laid out on May 20th, 2015 and marked with flags to differentiate each of the treatment plots (Figure 1). Compost was applied to the field plots the week of May 25th. The compost was hand raked to uniformly spread the compost prior to lightly disking to incorporate the compost into the soil. Only the field plots on the right side of the diagram in Figure 1 (outlined with the blue line) were used for the spring application and subsequent disease ratings. The plots on the left side of the diagram were the planned application plots for the fall, 2015 application and 2016 planting/disease ratings.

The beans were planted with a 2 row planter on June 24, 2015. Six rows were planted in each plot (12 plots total). The left row of the planter box also carried a rye grain that was inoculated with *Pythium*, *Fusarium* and *Rhizonctonia* spp., all of which are soil-borne fungi that cause damping off and root rot in snap beans. Due to substantial rain events during the growing season, the fields were not irrigated and only natural rainfall provided the moisture needed for the plants.

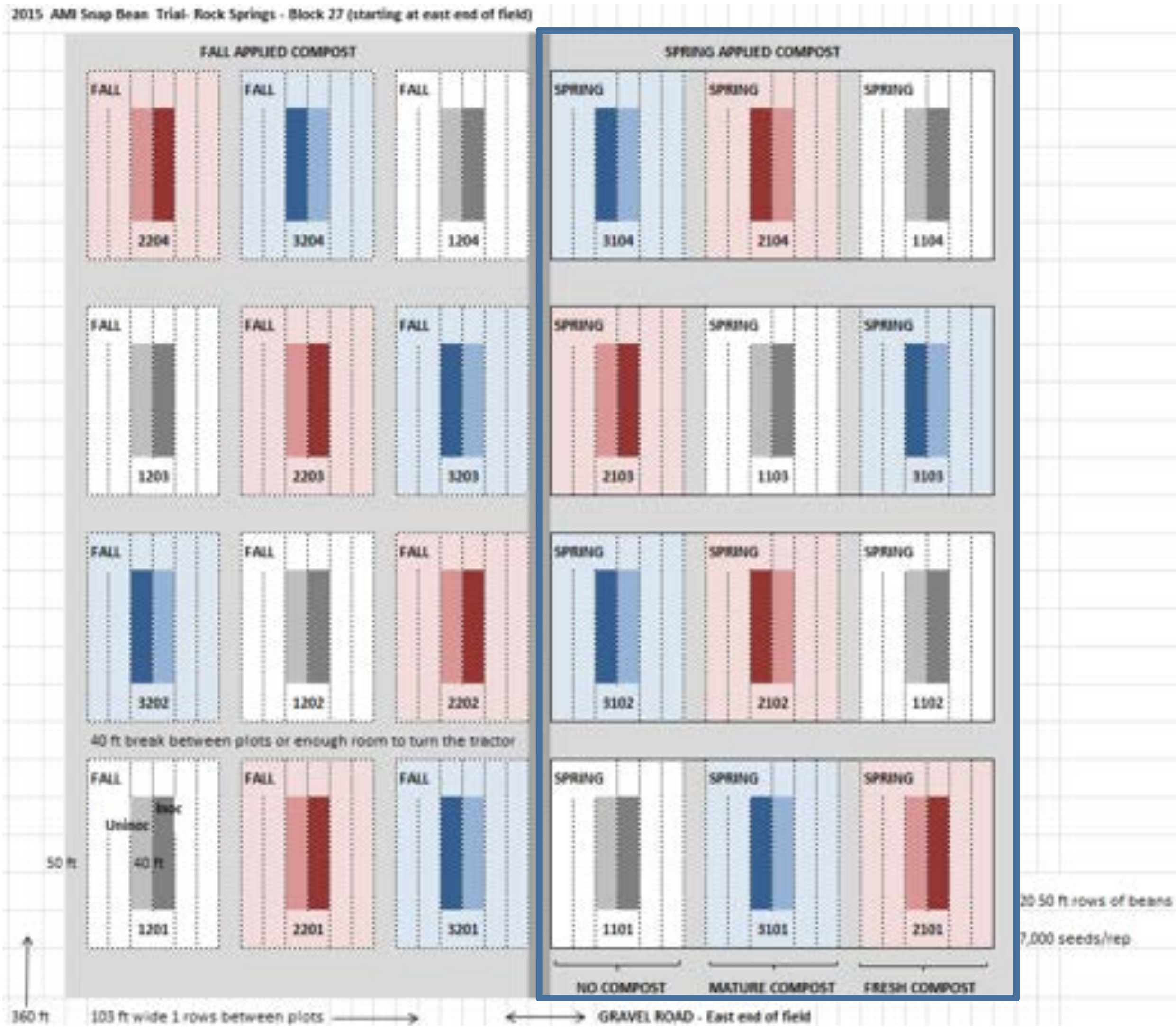

Figure 1. 2015 AMI Snap Bean Trial – Rock Springs. Field Block 27. Compost applied to 12.5 x 50 ft areas (625 square feet). Plot numbering: 1st number: 1=no compost, 2 = fresh compost, 3= mature compost. 2nd number: 1=spring application, 2 = fall application. 3rd/4th number: replicate number. Four replicates per treatment. The 12 field plots on the right, contained within the blue boarder, were the plots that received treatments and were planted in beans spring 2015.

Results

On July 3rd, 10th and 17th, plant emergence data was taken by marking a 20 foot section of the 2 inner most rows and counting all plants within that area. Only the two innermost rows of each plot were used to do plant counts and root health ratings to allow for a buffer zone between treatments, therefore, reducing the likelihood that treatments (compost application) will have any impact on the adjacent plots. During the first emergence assessment, we observed that bean germination was very inconsistent across the plots, unrelated to field treatments (Figure 2). We also observed that the right planter rows appeared worse than the left rows. It was subsequently determined that there was a mechanical problem with the planter that interfered with correct planting (seed placement). Because of the timing of compost application and plantings of adjacent fields there was no option to relocate to another field and replant for the 2015 season. A decision was made to continue emergence data collection on 2 subsequent dates and to do a root health rating on plants in the left-most rows only. Because of the obvious planter issues, yield assessments were not able to be completed this year.

Figure 2. Field plots designated by different colored flags placed throughout the field. Note the inconsistent planting in the top of the picture.

Emergence data, Table 1, is only for the left most rows since the left planter box appeared to plant more consistently than the right planter and the left rows were the ones that were inoculated with the soil-borne fungi. Plot 3104 had such a reduced stand due to planting issues that emergence data from this plot was not able to be taken. Because of problems with the planter and variabilities observed between plots, we do not feel comfortable with statistically comparing the emergence data, though it appeared that there was no difference between the treatments.

July 3rd emergence average - Left Row

Treatment	Rep 1	Rep 2	Rep 3	Rep 4	Avg.
No compost	243	173	257	239	228
Mature	214	ND	260	169	214
Fresh	81	227	207	286	200

July 10th emergence average - Left Row

Treatment	Rep 1	Rep 2	Rep 3	Rep 4	Avg.
No compost	309	225	305	278	279
Mature	254	ND	318	201	258
Fresh	102	275	267	344	247

July 17th emergence average - Left Row

Treatment	Rep 1	Rep 2	Rep 3	Rep 4	Avg.
No compost	309	261	294	280	286
Mature	227	ND	356	198	260
Fresh	103	264	285	327	245

Table 1. Plant emergence data from three sampling dates. ND indicates data not reliable due to planting issues.

On August 28th, 2015, 15 plants were collected from each plot to conduct a root health rating of the bean plants. Three samples of 5 adjacent plants were collected within each plot. Samples were taken from the left, centermost rows that were inoculated with the soil-borne fungi. Sample locations were determined based on areas that appeared to have consistent planting to avoid areas that had planter problems where possible. All of the samples from each plot were placed together in a bag and taken back for ratings. Each 15 plant sample was placed on the ground and rinsed with a light stream of water to remove soil clinging to the roots. Roots were rated from 1-9 based on a rating system previously used by the authors with one representing a perfect, healthy root and a 9 representing a very weak, symptomatic root. Ratings were primarily based upon the color of the roots and the degree of disease symptom development. Healthy roots appear white while roots that are symptomatic appear darker and show reddish/purple discoloration. Symptomatic roots also show varying degrees of lesions on the roots. The roots of the beans that received no compost appeared to have a higher degree of discoloration and displayed more symptoms (Figure 3).

Fresh Compost

Mature Compost

Control – No Compost

Figure 3. Bean roots used for health ratings. Each picture represents plants taken from one plot from each treatment.

The health of the bean roots that were planted in soils amended with fresh compost appeared similar to the beans planted in the soils receiving mature compost, though both scored better than the roots of the beans planted in the control soils (Table 2).

Treatment	Cumulative Avg.
No compost	**3.3**
Fresh Compost	**2.5**
Mature Compost	**2.5**

Table 2. Snap bean root health ratings based on color and disease symptoms (lower ratings represent healthier roots). Rates are based on the average of 15 plants per plot (4 plots per treatment) except for one plot receiving mature compost that was only based on 3 plants due to lack of sampling size.

Conclusion

Due to planter problems, statistical comparisons of emergence, disease ratings and yield effects could not be completed. It appeared that there were no differences in plant emergence between the treatments. However, differences in root health as it relates to disease symptoms were observed between the treatments. The bean roots in the compost amended soils, regardless of compost maturity, appeared healthier than the roots from the plants in the plots that received no compost. The observed differences in root health supports the hypothesis that soils amended with mushroom compost have suppressive qualities against *Fusarium, Rhizoctonia* and *Pythium* species that cause root rots, thereby adversely affecting bean yield.

Next Year Objectives

This fall we plan on moving to a new field and laying out plots as outlined in Figure 1.
Four plots will receive fresh compost and 4 plots will receive mature compost, after which the plots will be lightly tilled to incorporate the compost. We will then apply fresh compost and mature compost to additional plots in the spring of 2016. Spring field preparation, inoculation and planting will be done to all plots in a similar process that was completed spring, 2015 (after correcting the planter problem). Emergence, root health ratings and bean yield will be completed during the 2016 growing season. Next summer, the mushroom compost field plots will be included in the tours at Penn State's Ag Progress Days so vegetable growers have an opportunity to observe any benefits of using mushroom compost on their fields.