Pennsylvania On Farm Soybean Network

Field Trial Report

The Effects of Manure Application on Soybean Ground 2013

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Introduction

Soybeans are becoming an integral part of crop rotations throughout Pennsylvania, whether it is in a two-crop rotation or a double-cropping system after small grains. According to the 20007 Agriculture Census, Franklin County is ranked 2nd in the state of Pennsylvania for livestock, which means Franklin County farmers utilize a great deal of manure. Many farmers rely on their soybean ground to provide the amount of land needed for their manure applications. Application of manure to soybeans based on crop uptake of N is allowed under PA nutrient management regulations.

While there has been some research done on this topic in the Midwest, little research has been done in Pennsylvania to determine if manure land applications positively or negatively affect soybean yields. Some farmers claim that too much manure makes soybeans lodge. Several of the Midwest studies indicate higher yields due to manure applications, while some studies cite increased incidence of disease (particularly white mold) due to manure applications. It is also said that if manure (or any other nitrogen source) is applied to soybeans that they will not nodulate and therefore will not yield as well.

This goal of this study was to see if manure applications to soybean ground had any effect of the incidence of disease, weed pressure, soil nitrate levels, nodulation and yields. This study looked at three separate field locations, each applying a different type of manure. Location #1 utilized liquid dairy manure, location #2 utilized liquid swine manure and location #3 spread poultry (turkey) manure. Each location consisted of replicated strip trials, 3 treated (manure applied) and 3 untreated. All three types of manure were applied with the broadcast method.

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Table 1. Field and Treatment Information for the Trial.

Plot Information					Pre-Manure Application									
Location #	Average Plot Size (acres)	Predominant Soil Types	Type of manure applied	Manure application rate	Manure Analysis (Total Nitrogen)	Nitrate-N in Treated (Manure-Applied) Plots Pre-Application (ppm)	Nitrate-N in Untreated (Non-Manure) Plots Pre-Application (ppm)	Soil pH in Treated Plots	Soil pH in Untreated Plots	Phosphorus in Treated Plots	Phosphorus in Untreated Plots	Potassium in Treated Plots	Potassium in Untreated Plots	Plant Population (plants/acre)
1	0.16	HeA, Ck	Liquid Dairy	7140 gal/acre	32.28 lbs/1000 gal	4.93	4.47	7.00	6.90	54.30	49.70	108.70	127.70	124,465
2	0.9	AgB, BuB	Liquid Swine	3,000 gal/acre	35.17 lbs/1000 gal	5.17	6.33	6.80	6.80	87.00	74.00	166.70	163.70	136,081
3	0.61	HbC, HaB, Fu, CsA	Poultry (turkey)	2 tons/ acre	48.25 lbs/ton	10.87	11.8	7.00	7.00	69.70	75.00	130.70	127.00	176,668
Plot Design: Replicated strip trials in each field for a total of 18 plots (9 treated and 9 untreated).														

OBSERVATIONS

Weeds

All the plots were scouted on a regular basis (approximately every 7 to 10 days) throughout the growing season to determine if there was a higher incidence of weeds and diseases in the plots that had received manure applications versus the plots that did not receive manure. This was the second year this research was conducted. In 2012, shortly after planting, the weeds in the poultry manure plots were larger and more numerous than the weeds in the untreated plots. However, in 2013, there were no noticeable differences in the growth and prevalence of weeds at any of the locations.

Diseases

The incidence of plant diseases did not seem to be affected by manure applications. The plant diseases that were identified occurred in all 18 of the plots (9 treated and 9 untreated). As in many soybean fields, the first occurrence of disease was Septoria brown spot in all three locations in all of the plots. Some of the other diseases identified throughout the plots were downy mildew, frogeye leaf spot and Phytopthora stem rot. When the diseases did appear, they appeared at the same time throughout the plots. Manure applications did not seem to cause a difference in the timing and severity of the diseases. Phytopthora stem rot was more prevalent (but not a significant cause of damage in the research plots) in two of the plots (1 manure and 1 non-manure) at the dairy manure location, most likely due to a lower lying soil that remained wet for a longer period of time during the spring.

One of the concerns with applying manure to soybeans is the increased incidence of white mold (Sclerotinia stem rot). No evidence of white mold was found during scouting of the plots. However, it is important to note that the three fields in this study did not have a history of white mold.

Table 2. Results and Statistics for N Related Data and Yield at Each Trial Location.

Plots	Pre-manure Application Soil Test (Total N %)	7 to 11 Days After Application Soil Test (Total N %)	End of Growing Season Soil Test (Total N %)	Pre-manure Application Soil Test (Nitrate-N ppm)	7 to 11 Days After Application Soil Test (Nitrate-N ppm)	End of Growing Season Soil Test (Nitrate-N ppm)	V-2 Nodulation (# of nodules)	R2-R3 Nodulation (# of nodules)	Tissue Samples (V-2, % dry weight basis)	Tissue Samples (R2-R3, % dry weight basis)	Yield (bushels/acre)
All Plots											
No Manure	0.1356	0.1178	0.1389	7.53	6.80	9.55	31.45	63.16	3.93	6.11	63.08
Manure	0.1345	0.1200	0.1355	6.99	11.02	8.92	28.35	71.31	4.28	6.14	62.79
P value	0.911	0.813	0.731	0.740	**0.033**	0.596	0.493	0.571	**0.032**	0.724	0.898
Dairy											
No Manure	0.1300	0.1100	0.1367	4.47	2.57	10.63	22.67	69.67	3.99	6.12	57.96
Manure	0.1300	0.1200	0.1300	4.93	8.77	8.93	19.73	65.13	4.19	6.04	58.59
P value	1.000	0.548	0.692	0.662	**0.003**	0.621	0.594	0.791	**0.057**	0.511	0.890
Swine											
No Manure	0.1200	0.1067	0.1200	6.33	5.80	10.33	41.20	79.07	3.90	6.04	66.19
Manure	0.1167	0.1033	0.1233	5.17	12.37	9.80	35.20	107.67	4.10	6.05	66.46
P value	0.768	0.778	0.643	0.096	**0.080**	0.756	0.414	0.291	**0.081**	0.777	0.903
Poultry											
No Manure	0.1567	0.1367	0.1600	11.80	12.03	7.70	30.47	40.73	3.90	6.18	65.09
Manure	0.1567	0.1367	0.1533	10.87	11.93	8.03	30.13	41.13	4.54	6.34	63.31
P value	1.000	1.000	0.609	0.665	0.959	0.624	0.934	0.953	**0.002**	0.528	0.347

P value of 0.1 or less = significant at 90%

RESULTS

The following parameters were investigated in each plot: pre-manure application soil tests for total nitrogen and nitrate nitrogen, soil tests for total nitrogen and nitrate nitrogen 7 to 11 days after manure application, nodulation (at V2 and R2-R3), tissue samples for nitrogen (V2 and R2-R3), yield and end of the growing season soil tests for total nitrogen and nitrate nitrogen (Table 2). When all locations and manure types were analyzed together, there was a statistically significant increase in the soil nitrate nitrogen 7 to 11 days after manure application and also an increase in V-2 tissue nitrogen levels (Table 2). Even though there was a significant difference in the nitrate-nitrogen levels between the manure and non-manure plots 7 to 11 days after manure application, by the end of the growing season there was no longer a significant difference in soil nitrate nitrogen between the manure and non-manure plots. There was no significant difference in in yields due to the manure treatments.

When the plots were analyzed separately by manure type, the results were similar with several exceptions. All three locations showed a statistically significant increase in V-2 tissue nitrogen when manure was applied. The soil tests for nitrate nitrogen taken 7 to 11 days after manure application were significantly higher when manure was applied at the swine and dairy manure locations, but not at the poultry manure location. There was also a significant difference in the pre-application soil nitrate-N levels between the manure and non-manure plots before the treatments were applied. The plots that were planned to receive manure had lower soil nitrate-N levels. There is no explanation for this, but it could have had a slight impact on the magnitude of the increase in soil nitrate-N following swine manure application. There was no significant difference in the yields between the manure and non-manure plots at any of the locations.

CONCLUSIONS

The results indicate that applying manure at lower rates to soybeans will result in neither a positive or negative impact on the crop. Yields in these trials were good at over 60 bushels/acre, and there was no impact of manure application on yield. There was no apparent increase in weeds or diseases. There was an increase in soil nitrate nitrogen and consequently in early season plant nitrogen where manure was applied as might be expected, but this did not carry through to have any impact later in the season. There has been concern that manure (nitrogen) applications on soybeans will negatively impact their nodulation. However, this was not observed in this trial. At the end of the season, there was no difference in residual soil nitrate-nitrogen due to the manure applications, and the soil nitrate-nitrogen levels were at typical background levels for soil nitrate-nitrogen in PA.

Based on these three studies in one year, there would appear to be no management advantage to applying manure to soybeans. The fact that the soybeans in this trial were not impacted positively or negatively from the manure N indicates that manure could be applied if necessary to supply phosphorus and potassium to soybeans. The phosphorus

and potassium levels were not below optimum at these sites, so the effect of the P and K in the manure was not evaluated. Finally, the lower residual nitrate-nitrogen levels at the end of the growing season indicate little increased potential for nitrogen loss to the environment through leaching if manure is applied to soybeans.