Effects of Organic Nutrient Amendments on Populations of Root-Colonizing Fluorescent Pseudomonads

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Organic amendments can alter the chemical, physical and biological properties of soils when applied in sufficient quantities. Composts are commonly used as soil amendments in organic farming to add nutrients and sustain productivity. By providing added fertility for plants and microbes, the ecology of the root environment may change. Multiple microbial populations may interact with each other and the host plant so as to encourage or suppress plant diseases. In this study we examined the effects of composted and raw dairy manure on root-colonizing *Pseudomonas* spp. with proven capacities to suppress plant pathogens. These included pseudomonads with the capacity to synthesize the antifungal metabolites 2,4-diacetylphloroglucinol (DAPG), pyoluteorin (PLT), and/or pyrrolnitrin (PRN). These populations were detected and enumerated using PCR-based assays for the detection of the corresponding genes for antibiotic biosynthesis, *phlD*, *pltBC*, and *prnB*. Overall, we observed that *phlD*+ pseudomonads were present more abundantly in the rhizosphere of both crops than either of the other two assayed populations, indicating the relative importance of DAPG-producers among the root-colonizing pseudomonads.

Significant differences in rhizosphere inhabiting microbial populations were observed in plots receiving the organic amendments. The abundance of cultured pseudomonads was similar on the two crops, but tended to be higher on cabbage. Populations of *phlD*+/DAPG-producing pseudomonads were also similar on the two crops. Between 70 and 90% of tomato and cabbage plants were colonized by *phlD*+ bacteria, and approximately 50% of the plants harbored populations large enough to suppress root

Table 1: Effects of organic amendments on selected soil and microbial variables.

	% Organic Matter			*Pseudomonas* spp.		
	Total	Particulate	MicBN	Total	*phlD*+	
TOMATO						
Control	1.97 b	0.40 b	38 b	5.7	4.0	
Compost	2.08 ab	0.52 a	40 b	5.5	3.9	
Manure	2.24 a	0.57 a	52 a	6.4	4.3	*
CABBAGE						
Control	2.03 b	0.38 b	48 b	6.0	3.8	
Compost	2.27 a	0.55 a	54 ab	6.2	4.0	
Manure	2.19 ab	0.50 a	60 a	6.3	4.5	*

pathogens. Manure amendments increased rhizosphere populations of both total pseudomonads and antibiotic producing pseudomonads, on both crops but the effect was

greatest on tomatoes. Root colonization by DAPG producers was increased from 75 to 100% early in the growing season. However, by mid-July, compost amendments had no significant effects on the abundance of DAPG producers in the rhizosphere. In contrast, changes in soil bacterial communities were more subtle, and not statistically significant at the post-harvest time point using the same methods. However, the 18S profiles generated from soil DNA did show significant increases in several signals. These results may indicate that microbial eukaryotes (e.g. fungi and oomycetes) play a predominant role in later stages of organic matter decomposition or that fluctuations in these populations occur over longer time-scales.

Organic amendments affected the experimental system in multiple ways. The C:N ratio of the amendments may explain to a great degree the response observed in the plant and microbial data. Soil microbes depend on carbon and nitrogen for growth, but they are thought to be less competitive for nitrogen than plants. The compost amendment could be expected to release more N earlier in the growing season because of its lower C:N ratio. This might explain the increases in crop yield and pigweed populations in the compost-amended treatments. In contrast, the manure amendment had a C:N ratio close to the level associated with immobilized plant-available N but, conversely, would be nearly optimal for microbial growth. Indeed, increases in microbial abundance were indicated both in the rhizosphere mid-season, and, to a lesser extent, post-harvest. Because the community profiles were qualitatively very similar, differences in composition of the amendments had little effect on which microbial populations responded to the amendments. This may indicate a high degree of nutritional competency and generalist feeding among such communities.

Publications Resulting From This Work

McSpadden Gardener, B., Miller, S., Kleinhenz, M., Doohan, D., Grewal, P., Stinner, D. 2002. Dried and composted dairy manure in vegetable cropping systems: Effects on soil and plant health. pgs. 581-591 *In* Proceedings of the 2002 International Compost Symposium: Composting and Compost Utilization. The JG Press, Inc: Emmaus, PA. (www.Biocycle.net)