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Blueberry Production on Soils Amended with an Acidic Biotechnology Fermentation By-product

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Abstract
Industrial production of certain amino acids by fermentation requires acquisition of peptide solutions obtained from soybean meal by acidic hydrolysis. Because this hydrolysis is exothermic, a great amount of heat is released, and the residue is carbonized much like a process that produces charcoal. About one-half of the nitrogen (N) and a majority of the phosphorus (P) remain un-hydrolyzed in this residue. Although this byproduct could be neutralized with lime, I was interested in finding a use for it in its acidic state. Use of this material for establishment of acid-loving crops was a natural selection and blueberries were a logical fit as a crop to be grown. In order to evaluate this acid residue, a comparison of it with accepted soil acidification and modification procedures was deemed appropriate. Current conventional blueberry establishment in Iowa uses sphagnum peat moss (SPM) to alter soil physical conditions and elemental sulfur (ES) to acidify the soil. Besides acidic soybean meal residue (SMR), spent diatomaceous earth filter (DEF) was used to modify a clay soil to a lighter, silty texture.

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Introduction

Industrial production of certain amino acids by fermentation requires acquisition of peptide solutions obtained from soybean meal by acidic hydrolysis. Because this hydrolysis is exothermic, a great amount of heat is released, and the residue is carbonized much like a process that produces charcoal. About one-half of the nitrogen (N) and a majority of the phosphorus (P) remain un-hydrolyzed in this residue. Although this byproduct could be neutralized with lime, I was interested in finding a use for it in its acidic state. Use of this material for establishment of acid-loving crops was a natural selection and blueberries were a logical fit as a crop to be grown. In order to evaluate this acid residue, a comparison of it with accepted soil acidification and modification procedures was deemed appropriate. Current conventional blueberry establishment in Iowa uses sphagnum peat moss (SPM) to alter soil physical conditions and elemental sulfur (ES) to acidify the soil. Besides acidic soybean meal residue (SMR), spent diatomaceous earth filter (DEF) was used to modify a clay soil to a lighter, silty texture.

Materials and Methods

This study was initiated in the fall of 1996 at the research farm on the north-facing slope near the demonstration garden. Plots in the experiment were 14 ft wide and 16 ft long. The area was plowed and disked prior to treatment. Conventionally treated plots received three inches of SPM and ES at a rate of one ton per acre. Byproduct plots received a three-inch depth of DEF and 30 tons per acre of SMR. Both treatments were incorporated in the soil to a depth of nine inches. In the spring of 1998, an additional 30 tons per acre of SMR was applied and incorporated; all the plots were tilled again. Three blueberry cultivars were selected -- Elliott, Patriot and Sierra. The last variety was a new release expected to be as adapted to Iowa's growing conditions as the first two were. Two rows of blueberry plants were established in each plot with three plants of each cultivar being planted across from each other in the adjacent rows. Growing conditions in 1997 were hampered by greater than normal rainfall, and the down-slope plots seeped water. A micro-spray irrigation system was installed during the first summer. Flowers were removed from blueberry plants to prevent fruit bearing in the establishment year. Wood chips are applied annually to all the plots to assist weed control and promote shallow root development that is essential to insure productive blueberries. Harvesting (by hand) began in 1998 and has continued each year since. An ammonium sulfate fertilizer is applied at 25 lb of N per acre three times during the growing season to conventionally established plots; no fertilizer is applied to the by-product plots.

Results and Discussion

Soil samples were collected from all the plots in the fall of 1999 to compare treatment effects. Soil test pH was over one unit lower and 59 ppm P higher in by-product treated plots. The amounts of ES and SMR applied were selected to equally acidify the soil, but SMR was better. Because SMR has a large P content, it was expected to raise the soil test level (no P was applied to the conventional plots.) Ion analysis of distilled water extracts showed that both nitrate-N and sulfate-S levels were more than twice greater in by-product than conventionally treated plots. Survival and yield data are presented in Table 1. Although randomly assigned, the by-product plots were generally located down-slope, and blueberries in that position suffered severe water damage. In later, drier years, there has been no loss of plants. These survival results confirmed that the blueberry culture manuals were correct when stating that this plant requires moist but not waterlogged soil. Fruit yields per plant and an extrapolation of those yields to an acre indicate that Elliott and Patriot cultivars are yielding the greatest amounts of fruit, and that the greatest yields, either per plant or per acre, are achieved in by-product treated plots. These data suggest that commercially feasible blueberry production may be achieved in Iowa with the use of by-products. This experiment is planned to be continued for the next several years. At this point, no disease or insect infestations have occurred, and thus the use of all pesticides has been avoided.

Acknowledgments

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Table 1. Blueberry performance in soil modified conventionally and with by-products.

	Surviving plants per plot			Fruit yield, grams per plot		
Cultivar	1998	1999	2000	1998	1999	2000
			By-products			
Elliott	3.8	3.8	3.8	2,176	7,486	5,515
Patriot	2.7	2.7	2.0	1,116	5,084	3,160
Sierra	1.2	1.2	1.2	24	1,346	616
			Conventional			
Elliott	6.0	6.0	5.7	2,608	7,121	6,032
Patriot	5.7	5.7	5.7	2,177	6,695	5,703
Sierra	5.7	5.7	5.7	429	2,857	1,630
	Yield, lb per plant			Projected yield, lb per acre at 1,500 plants per acre		
Cultivar	1998	1999	2000	1998	1999	2000
			By-products			
Elliott	1.3	4.3	3.2	1,892	6,509	4,754
Patriot	0.9	4.2	3.5	1,382	6,299	5,221
Sierra	0.0	2.5	1.2	67	3,813	1,744
			Conventional			
Elliott	1.0	2.6	2.3	1,436	3,921	3,517
Patriot	0.8	2.6	2.2	1,269	3,904	3,325
Sierra	0.2	1.1	0.6	249	1,656	951