Performance of Dry Bean Genotypes Grown under Organic and Conventional Production Systems in Michigan

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ABSTRACT

The lack of data on the performance of dry bean (Phaseolus vulgaris L.) cultivars grown under organic management systems in Michigan prompted the evaluation of 32 diverse dry bean genotypes in side-by-side trials under organic and conventional production systems. Trial sites were located in grower fields in Gratiot County, in 2007 and 2008 and in Tuscola County in 2009 and at the Kellogg Biological Station in Kalamazoo County, in all 3 yr. The conventional plots were treated following standard acceptable management practices including application of granular fertilizer at planting and use of chemical seed treatments and foliar sprays to control pests. For the organic treatments certified organic land was used and only approved methods for organic production were followed. Rhizobium inoculant was applied to seeds in the organic treatment before planting. Yields were 20% higher in conventional systems than in the organic systems over all locations. Seed classes that yielded well in the organic system included pink-, small red-, and black-seeded genotypes and these classes also had the highest accumulation of seed N (36%). Some genotypes appear better suited to organic production than others; however, those genotypes performing poorly under the organic system also performed poorly under conventional system. Overall genotypes of Andean origin performed 25% lower than genotypes of Middle American origin in either organic or conventional systems. Older cultivars, such as the heirloom navy bean Michelite, commonly believed to be better suited to organic production, did not perform as well as modern commercial cultivars.

The increased interest in organic production of dry bean has emphasized the need to identify dry bean genotypes that will perform successfully in an organic system. Modern breeding programs use conventional production systems during the breeding process to develop commercial cultivars. Application of fertilizer and chemical pesticides are normally used to minimize pests, disease, and nutrient deficiencies to maximize yield, eliminate variability, and provide a more uniform environment for selection. With the low cost of N fertilizers, breeders and growers paid little attention to biological nitrogen fixation (BNF), thus in the absence of direct selection for N₂-fixing ability this valuable characteristic may be diminished in current bean cultivars. Progress made in developing cultivars with improved BNF has been largely restricted to tropical germplasm poorly suited to production at northern latitudes where daylength sensitivity is detrimental (Bliss et al., 1989).

The area planted to organic dry beans in Michigan and other production areas in the United States has seen a considerable increase in recent years. In the period from 1997 to 2005 the number of acres planted in Michigan expanded from 334 to 968 ha (ERS-NOP, Organic Briefing Room, www.ers.usda.gov/briefing/organic/ [accessed 1 June 2011]). A growing interest in organic production of dry beans is due to their contribution to soil fertility by fixing N. Organic agriculture has also contributed quite substantially to the global food supply (Badgley et al., 2007). Challenges encountered in conventional production also affect the production of dry beans in an organic system. While insects may be controlled by insecticides in both systems, only Organic Materials Review Institute (OMRI) approved, less-effective, natural pesticides may be applied in organic systems. Nutrient levels are also addressed differently between the two systems. Nutrients are applied typically as synthetic fertilizers in conventional production systems. Organic production systems rely on the application of manures and compost as well as crop rotation including cover crops to maintain nutrient levels in soils, and forage legumes are often included in many crop rotations as they contribute to soil fertility by fixing N. Organic agriculture has the potential to contribute quite substantially to the global food supply (Badgley et al., 2007).

Studies have been conducted to compare the performance of different dry bean genotypes in contrasting production systems. Singh et al. (2009) noted an interaction between production systems and genotypes when grown under irrigation in the semiarid production systems in the western U.S. Commercial dry bean genotypes and landraces were compared under seven different production systems involving organic and conventional practices, high input and low input, as well as on farm and on-station treatments. Genotypes such as pinto bean Othello and great northern bean Matterhorn (Kelly et al., 1999) produced consistent yields across production systems. Other genotypes, such as pinto bean Buster and pinto bean Bill Z were responsive to high inputs and may be better suited to systems where fertilizer and supplemental...