EFFECTS OF SPRING-INTERSEED WINTER RYE ON WEED CONTROL AND ORGANIC SOYBEAN YIELD

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Demand for organic crop production in the U.S. has increased, resulting in over 4.2 million certified organic crop production hectares in 2005 (USDA, 2010). In 2005, more than 55% of the organic field crop production hectares in Missouri were soybean, while Missouri ranked 23rd in the U.S. for the number of certified organic producers in 2007 (USDA, 2010). Missouri farmers have noted increased profit margins with organic versus conventional crop production systems in mid-west states (Archer et al., 2007; Cavigelli et al., 2009), and are more likely to consider using land previously set aside in the conservation reserve program for organic crop production (Delate et al., 2002). Claypan soils in Missouri enrolled in the conservation reserve program generally are highly erodible. Using pre-plant primary tillage followed by two or three rotary hoeings and at least two in-crop cultivations has been an acceptable method of controlling weeds in organic soybeans (Delate et al., 2002; Place et al., 2009; Thelen et al., 2004). Long-term research indicated that tillage-intensive, organic systems had greater soil benefits than conventional no-till on drought-prone, erodible soils (Teasdale et al., 2007). However, the intensity of labor and tillage required for organic crop production has limited the widespread adoption of organic soybean production, especially on highly erodible soils.

Winter rye requires a vernalization period before jointing and flowering, and it commonly dies under summer stress (Robinson and Dunham, 1954; Ateh and Doll, 1996). Interseeding winter rye in spring may promote a synergistic relationship with soybean, while restricting rye to vegetative growth. In this condition, rye may serve as a living mulch that suppresses weeds and minimizes soil erosion, while exerting minimal competition with soybean. Using winter rye in narrow-row soybean may allow farmers to increase production efficiency by reducing the time allotted to cultivation. In separate experiments, spring-interseeded winter rye at 125 kg ha^{-1} in wide (76-cm) and narrow (19-cm) rows reduced soybean yield by 17 to 27% in two of three years in the narrow-row experiment and in all three years in the wide-row experiment (Thelen et al., 2004). No known research has evaluated rates of rye or compared the cost-effectiveness of rye interseeded in wide- and narrow-row soybean. The objective of this research was to evaluate spring-seeded winter rye seeding rates on control of weeds, crop response, and gross margins of organic soybean in different row spacings.

Field research in 2002 and 2003 evaluated spring-interseeded winter rye (*Secale cereale* L.) at 60, 120, or 180 lbs/acre at two soybean [*Glycine max* (L.) Merr.] row spacings (7.5- and 30-inch) on weed control, yield, and gross margins. Based on regression analysis, wide-row (30-inch) soybean grain yield and gross margins were greatest when winter rye was interseeded at 102 and 95 lbs/acre, respectively (data not presented). Yields and gross margins for wide-row soybean were 8 to 55% greater than narrow-row (7.5-inch) soybean seeded at 200,000 or 300,000 seeds/acre which was probably due to flexibility for implementing cultivation. As interseeded rye rates increased from 60 to 180 lbs/acre, yields and gross margins for narrow-rows decreased. Soybean row spacing had minimal impacts on specific weed species and total weed biomass or density. The use of wide-row soybean and spring-interseeded rye at 60 lbs/acre was more cost-effective compared to narrow rows.

None of the narrow-row treatments in this research resulted in grain yields equivalent to wide-row soybean, which was probably due to flexibility for implementing cultivation in wide rows. The utilization of winter rye in narrow-row, organic soybean production did not provide adequate grain yields or gross margins to justify conversion from wide- to narrow-row production. Risk associated with narrow-row soybean and spring-interseeded rye as a weed management system preclude the adoption of narrow-row soybean in an organic soybean production system since narrow-row soybean rules out using mechanical weed control. Additional research is needed to discover whether it is possible to increase soybean yield and consistency of this weed management system. A logical next step would be to look at integrating increased soybean seeding rates with interseeded rye at rates less than 100 lbs/acre in wide-row soybean, and delayed spreading of interseeded rye in wide or narrow rows.

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