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Determination of the best management for soybean cropping following barley

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Abstract

In order to identify the best management method for soybean [*Glycine max* (L.) Merr.] following barley (*Hordeum vulgare* L.), a field study was carried out at the Sari Agriculture College Station during two years. The experiment was conducted as a split–split plot design based on complete blocks with two methods of residue management (burning or non-burning of barley residue) as the main plot factor, three tillage methods (plow + disk, double disk and no-tillage) as sub-plot factor, and three within row plant spacings (4, 8 and 12 cm, with 50 cm row width) as sub-subplot factor. The experiment was performed in four replications and soybean cultivar Hill was used. The combined analysis of the data showed that the effect of tillage methods and spacing within rows on yield was significant at the 1% level of probability. No significant interaction among experimental factors was observed. Comparison of means (Duncan's multiple range test) indicated that yield means of plow + disk and double disk were significantly different (2371 and 2412 kg/ha, respectively) compared with no tillage (2115 kg/ha), but the difference between them was not significant. Yield means of 4 and 8 cm within row spacings (2452 and 2405 kg/ha, respectively) were significantly different compared to 12 cm spacing within the row (2041 kg/ha), but a significant difference between them was not observed. Results of this study showed that residue non-burning, plow + disk or double disk and 4 or 8 cm within-row-spacings are the best planting methods for soybean following barley.

Keywords: Soybean; Double cropping; Barley residue management; Tillage; Within row spacing

1. Introduction

Double cropping increases the efficiency of water, energy and agricultural investment and reduces soil erosion (Sanford et al., 1986). Soybean [*Glycine max* (L.) Merr.] double cropping following cereal leads to improvement of soil nitrogen use (Varvel and Peterson, 1992). Proper management of cereal residue results in soybean improved growth. Cereal residue consists of straw and stubble. The straw usually is removed by farmers after baling. Crop residues can be beneficial as a suitable substrate for soil microorganisms, as raindrop barrier and as effective soil amendment. Residue burning increases soil erosion and reduces its moisture (Addiscott and Dexter, 1994;

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Wilhelm et al., 1986). Most farmers in the north of Iran burn cereal residue after harvesting without paying attention to its destructive outcome.

Tillage is another important factor for soybean production by providing a suitable seedbed. Methods of soybean seedbed preparation fall into two categories: conventional and conservational. The reports on the effects of different tillage systems on soybean yield are inconsistent. Some studies showed that soybean yield increases in no-till systems (Dick and Van Doren, 1985; Grabau and Pfeiffer, 1990), but other studies showed that there is no significant difference between soybean yield under conventional and conservational tillage systems (Elmore, 1987; Vasilas et al., 1988). Regardless of these results, soybean yields in no-till systems are often lower than yields under conventional tillage systems (Philbrook et al., 1991). This can be related to unfavorable seedbed, reduced plant stands, impeded soil drainage, incomplete weed control, low soil temperature early in the season, and residue accumulation on soil surface (Edward et al., 1988; Elmore et al., 1992). Vyn et al. (1998) reported that maximum soybean yield was obtained under conventional tillage and the no-till system delayed crop growth and decreased grain yield. They also concluded that soybean grain yield was negatively correlated with surface residue cover, but positively correlated with soil aggregates <5 mm in diameter. Caviness et al. (1986) attributed delayed soybean growth and yield reduction following wheat under no-tillage to cooler and wetter seedbed early in the season and possibly to allelopathic effects of wheat residue.

One approach for maximizing soybean yield is to optimize plant population. This can be achieved by modifying spacing between or within rows. When a soybean crop is seeded late or double cropped, yields are frequently lower than their longer season counterparts (Kane et al., 1997). Soybean cropping after the harvest of a winter barley (*Hordeum vulgare* L.) crop in the north of Iran is cropping later than a full-season crop. Soybean cultivars used in double-cropping systems are generally of the same maturity group as full-season cultivars grown for that region. Soybean yields often increase, up to a point, with increasing plant population (Ablett et al., 1984; Oplinger and Philbrook, 1992). However, soybean yield responses to plant population are generally small and often inconsistent (Lehman and Lambert, 1960). In general, increasing plant populations has increased plant height and resulted in greater yield losses from lodging (Weber and Fehr, 1966). Devlin et al. (1995) reported that as plant population increased, plant mortality increased, and final plant population decreased.

A successful barley-soybean double crop depends on good management. Establishing the adequate residue management, a proper tillage system and an adequate soybean stand are critical. Knowing the best conditions for double cropping will provide for a successful second crop. In the north of Iran, no investigation on residue management, tillage methods and plant population for soybean after barley harvest has ever been done.

The objective of this experiment was to determine the best residue management, the most effective tillage method and the optimum plant population for soybean cropping following barley.

2. Material and methods

2.1. Site and experimental design

Field tests were conducted during two years (2002 and 2003) at the Research Station of the Sari Agriculture college, Iran (36°42′N, 53°13′E), on a silty clay soil with 44% clay, 45% silt, 11% sand and 1.2% organic matter.

Each year, the experiment followed a split split-plot arrangement of treatments in randomized complete block design. The main experimental unit was residue management (burning or non-burning of barley residue), with subunits of different tillage methods consisting of plow + disk, double disk and no-till systems. The tillage method units were further divided into sub-subunits of plant populations, adjusted to three within row spacings (4, 8 and 12 cm). Each main plot was 15 m wide and 22.5 m long. Plot sizes of the sub-plot and sub-subplot experimental units were 2.5 m × 15 m and 2.5 m × 5 m, respectively. Four replications and soybean cultivar Hill (maturity group V) were used in this study. Treatment structure was 2 residue managements × 3 tillage methods × 3 plant population densities × 4 replications = 72 plots for each year.