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Response of cotton (*Gossypium hirsutum* L.) to different tillage systems and intra-row spacing

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Abstract

The earliness is of great importance to cotton production in Mediterranean-type environments due to detrimental effects of autumn rainfall on lint quality. However, farmers commonly avoid early sowing due to risks of cold soil temperature and waterlogging after sowing in spring. Ridge-tillage system is one approach to increase soil temperature and mitigate adverse effects of waterlogging. The ridge-tillage system is also advantageous in reducing inputs in tillage operations. However, a limited experimental data are available about the effects of ridge-tillage system on earliness of harvesting, lint yield and quality of cotton in the Mediterranean-type environments. Thus, the objective of this study was to determine how ridge-tillage (RT)-planting system and intra-row spacing affect cotton lint yield, earliness and fiber quality compared with conventional tillage (CT)-planting system. Field experiments were conducted on a clay soil (Vertisol) in Hatay province (36°39′N–36°40′E, 83 m a.s.l.) in the Eastern Mediterranean Region of Turkey during 2000 and 2001. The experiment was laid out as a split-plot with three replications with tillage systems as main plots and intra-row spacings (13, 17, 21 and 25 cm) as subplots. The effects of tillage systems on lint yield and earliness were inconsistent among years. The RT-planting system resulted in 13.5% higher lint yield and 14.5% more earliness in 2001 when abundant rainfall occurred after sowing, while significant effects of tillage systems were not observed in 2000. The intra-row spacings significantly affected lint yield and earliness in both years. The earliness increased with closer spacing, while the highest lint yield was obtained from 17 cm intra-row spacing in both years. However, the fiber quality parameters were not significantly affected by tillage systems, intra-row spacings and tillage system × spacing interaction in both years. Finally, the results suggest that RT-planting system with 17 cm intra-row spacing can be used in cotton production instead of CT-planting system in the Eastern Mediterranean Region of Turkey. Ridging in 17 cm intra-row spacing also seems to be suitable to mechanical harvesting.

Keywords: Cotton (*Gossypium hirsutum* L.); Ridge tillage; Conventional tillage; Intra-row spacing; Lint yield; Earliness; Fiber quality

1. Introduction

Although cotton (*Gossypium hirsutum* L.) is a perennial crop with indeterminate growth habit, it is grown as an annual crop commercially. Therefore, it is

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very responsive to changes in environmental conditions. Changes in temperature, humidity and soil moisture may result in allocation of energy to sinks other than lint production. The yield potential of cotton grown in the Mediterranean-type environments is generally high due to long, warm and sunny growing season. However, inadequate emergence due to cool soil temperature or waterlogging after sowing and poor fiber quality owing to early autumn rainfall were the main constraints of cotton production in that type of environments. The adequate stand establishment is essential to high yield with acceptable fiber quality. Ridge-tillage system is one approach to improve stand establishment by increasing soil temperature and reduce adverse water logging effects after sowing. Ridge-tillage planting system could also help increase yield and earliness by improving soil water and temperature regimes in root zone during the first growing period (Benjamin et al., 1990; Lal, 1990; Unger and Musick, 1990). The earliness has further importance to cotton production in Mediterranean-type environments due to detrimental effects of autumn rainfall on lint quality. Early maturity in cotton could also reduce production costs by decreasing pesticide applications, irrigation, etc. (Jost and Cothren, 2001).

The ridge-tillage system also offers a further advantage of reducing inputs for tillage operations. The two essential equipments for the RT-planting system are a ridge lister and scrubber. On the other hand, the CT-planting system, which is a widespread tillage system for cotton in the Eastern Mediterranean Region of Turkey, commonly involves eight or more trips through the field, such as shedding stalk, disking (twice), ploughing, further disking (twice or more), harrowing (twice) and firming.

Yield responses of cotton to ridge tillage reported in the literature have been inconsistent. In some studies, reduced or equivalent cotton yields have been produced with RT compared with conventional planting systems (Brown et al., 1985; Stevens et al., 1992; Bauer and Busscher, 1996; Wheeler et al., 1997). However, others have reported enhanced yields of cotton by RT compared with CT-planting system (Carter and Colwick, 1971; Constable et al., 1992; Wiese et al., 1994; Clark et al., 1996; Hunt et al., 1997; Blaise and Ravindran, 2003). Research indicates that any yield benefits of RT may not be observed until several years after adopting the system (Triplett et al., 1996). Yield increases are attributed to improved soil moisture under RT-planting system (Harmon et al., 1989; Baumhardt et al., 1993; Daniel et al., 1999).

The population density, determined by a combination of row and intra-row spacing, also significantly affects both yield and quality of cotton under different production systems. The effects of row spacing on cotton lint yield were extensively studied earlier by several researchers (Hawkins and Peacock, 1971, 1973; Bridge et al., 1973; Baker, 1976; Buxton et al., 1979; Smith et al., 1979; Unay and Inan, 1996). Recent investigation on row spacing of cotton have shown that the highest yields produced from 76 cm row spacing regardless of tillage systems in a semi-arid Mediterranean environment in Turkey (Ozpınar and Isık, 2004). In ridge planting system, ridges are difficult to build and maintain in row widths of less than 76 cm (Griffith et al., 1990). Therefore, 76 cm row spacing in ridges seems to be suitable for mechanical harvesting. However, response of cotton to intra-row spacing under different tillage systems was less studied under the Mediterranean conditions. The optimization of intra-row ridge spacing also affects earliness, yield and fiber quality.

The objective of this study was to investigate the effects of different tillage systems and intra-row spacing on lint yield, earliness of harvesting and some fiber quality properties of cotton in a Mediterranean-type environment in Turkey.

2. Material and methods

2.1. Site, soil and climate

The experiments were carried out during 2000 and 2001 growing seasons at experimental fields of Ozbugday Seed Company, in Hatay, which is located in the Eastern Mediterranean region of Turkey (36°39′N, 36°40′E, 85 m above sea level). The soil of the experimental site, developed from alluvial deposits of river terraces, is typical for the Eastern Mediterranean region in Turkey and is classified as Chromoxeret by USDA (1998) Soil Taxonomy and as Vertisol by FAO/UNESCO (1974) having relatively high clay content with the predominant clay minerals