

AGRONOMICAL AND TECHNOLOGICAL PERFORMANCES OF SOME EARLY COTTON CULTIVARS PLANTED AS SECOND CROP IN DIYARBAKIR CONDITION, TURKEY

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Received July 20, 2017. Revised: Oct. 4, 2017. Accepted: Oct. 20, 2017. Published online: Dec. 27, 2017

ABSTRACT. The opportunity to increase agricultural areas is limited, so that increasing demands can be achieved by producing more products from existent agricultural areas. Second cropping is a sustainable practice in which more than one crop is grown consecutive on the same ground. This study was carried out to determine agricultural and technological properties of growing cotton (*Gossypium hirsutum* L.) as second crop on stubble of ridge planted wheat in Diyarbakır. The experiment was conducted in the experimental area of Dicle University Agricultural Faculty as randomize complete block design with three replications. Eight cotton varieties (Berke, Lachata, BA 119, STV 468, STV 373, Özbek 100, Fantom and DP 396) were used as material. Wheat, planting on ridge, was harvested approximately 10 cm above the soil surface June 12, 2012. Straws of harvested wheat were removed from the experimental area. Same day cotton varieties were planted two rows on each ridge. The results indicated that STV 468, Fantom and Berke in terms of

seed cotton yield; Fantom, Berke in terms of fiber length; DP 396 and Berke in terms of fiber strength had given the highest values. However, our study suggested that whether very earlier cotton varieties (Özbek 100, Berke and Fantom) are grown, cotton will be grown as second crop after ridge planted wheat in the stubble seedling under Diyarbakır ecological condition.

Keywords: cotton; stubble; yield; early maturity; sustainable practice.

INTRODUCTION

Cotton is one of the most important raw materials for textile industry in the world. Although cotton is grown in Turkey generally as main crop, it is also grown after harvesting winter wheat. Increasing agricultural productivity may be possible increasing production areas or by obtaining more production per unit

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area. The opportunity to increase agricultural areas is limited so that increasing demands can be achieved by producing more products from existent agricultural areas. Recently, double cropping practices increase in terms of economic and environmental benefits (Searchinger *et al.*, 2013). Second crop production is a sustainable practice in which two crops are grown and harvested successively on the same ground for per year. Second crop production helps to naturally control pests, weeds and diseases, while encouraging healthy soil. However, second-cropped cotton production, adequate residue cover of after the wheat harvest is useful, such as increased organic matter, reduce fertilizer requirements greater rainfall infiltration, moisture conservation and lower soil erosion potential will be lost (Hexem & Boxley, 1986; Bauer & Busscher, 1996, Heggenstaller *et al.*, 2008). Every effort must be made to get the wheat harvested and the cotton seeded as early as possible. Changes in commodity prices and weather conditions also likely contribute to variation in double-cropped acreage from year to year (Borchers *et al.*, 2014). Several studies have shown that global crop production needs to double by 2050 to meet the projected demands from rising population, diet shifts, and increasing biofuels consumption. Boosting crop yields to meet these rising demands, rather than clearing more land for agriculture, has been highlighted as a preferred

solution to meet this goal (Ray *et al.*, 2013).

The first and most important consideration is to achieve an even emergence of cotton seedlings. The goal of planting should be good seed-soil contact with minimal seedbed disruption to preserve soil moisture. This combination can be challenging because of the wheat straw residue. Furthermore, wheat harvest occurs during the end of the recommended cotton planting window, and it is essential to plant as soon as possible. Several options are available for planting cotton in this environment, including no-till and burning the wheat straw. Although burning removes the residue, it should be remembered that the benefits of this residue, such as increased organic matter, greater rainfall infiltration, moisture conservation and lower soil erosion potential will be lost. Thus, growers are encouraged to plant cotton directly into the stubble without burning (Stewart *et al.*, 2007).

Some studies are stated the earlier maturity cotton varieties, as a second crop can be good performed after the wheat production (Mert *et al.*, 2003, Buntin, 2002, Ekinci *et al.*, 2008). But, second crop productivity was reduced and fiber technological properties adversely affected according to single crop (Killi & Bölek, 2006). Therefore, every effort must be made to get the wheat harvested and the second crop seeded as early as possible (Beuerlein, 2001; Ekinci *et al.*, 2008). Halevy and Bazalet (1989) were reported with increasing

PERFORMANCES OF SOME EARLY COTTON CULTIVARS PLANTED AS SECOND CROP

temperature might be shorten period of flowering and maturity in cotton. Ramey (1995) determined the temperature regime that occurs as bolls are developing affects the physical properties of the fibers in second crop cotton cultivation. However, Porter *et al.* (1996) determined fiber strength increased, although fiber length not affected by delayed planting. Bilbro & Ray (1973) found that as planting was delayed fiber length and fiber fineness declined, while fiber strength increased.

This study was carried out to determine to some agricultural and fibre technological properties as second crop growing some early-maturity cotton varieties on stubble of ridge planted wheat.

MATERIALS AND METHODS

The study was conducted in experimental area of Dicle University in 2012. Early maturity cotton varieties Berke, Lachata, BA 119, STV 468, STV 373, Özbek 100, Fantom and DP 396 were used as material. Wheat, planting on ridge was harvested approximately 10 cm above the soil surface June 12, 2012. Straws of harvested wheat were removed from the experimental area. Same day, cotton varieties were planted two rows on each ridge.

The experiment was conducted as a randomized complete block design with three replications. Parcels consisted of rows in 12 m length. Inter row-spacing of 70 cm and intra row-spacing 15 cm. Plots

consisted of four rows and two out of four rows in the middle were sampled during harvesting. Fertilizer was applied as 70 kg ha⁻¹ pure Nitrogen, 70 kg ha⁻¹ pure Phosphorus with the first irrigation, 70 kg ha⁻¹ pure Nitrogen second irrigation. Soil pH was between 7.73-7.86. Due to its clay content (49-67%), soil enlarges and swells in the winter, and shrinks in the summer with deep cracks. Therefore, after planting to improve soil moisture and to ensure germination were irrigated with tap pipes the space of ridge. Hoeing was accomplished three times by tractor, two times by hand. During the research, irrigations were done six times, and the bolls were harvested with hand. Soil samples were taken from different points of the field at 0-30 cm depth before planting and analyzed in the Soil Analysis Laboratory of GAP Soil and Water Resources and Agricultural Research Institute, Şanlıurfa, Turkey.

Climatic values of cultivation period and long term on Diyarbakır are given in Table 1. Mean of air humidity (%) was lower than long term all months, except October. July and August mean of temperature in Diyarbakır, especially higher than the other months. Year of conducted trial is similar values with long term in terms of mean of temperature. The highest total precipitation was in October.

Soil samples were taken from different points of the field at 0-30 cm depth before planting and analyzed in the Soil Analysis Laboratory of GAP Soil and Water Resources and Agricultural Research Institute. Results of soil analysis including physical and chemical properties of soil belonging to experimental area are given in Table 2.

Table 1 - Climatic values of cultivation period and long term on Diyarbakır

Meteorological observation	June		July		August		September		October	
	Long term	2012	Long term	2012	Long term	2012	Long term	2012	Long term	2012
Mean of air humidity(%)	35.0	27.8	26.0	20.9	26.0	20.8	31.0	23.1	47.0	55.2
Mean of temperature (°C)	26.0	27.7	31.0	31.3	30.3	31.1	24.8	26.1	17.1	18.4
Total precipitation (mm)	7.6	7.0	0.7	1.6	0.5	0.0	2.6	1.8	31.3	17.4

Diyarbakır Regional Directorate of Meteorology Records, 2012

Table 2 - Some physical and chemical properties of the soil of experimental area

Structure	Organic mat. (%)	Soil dept.(cm)	Water satur.(%)	Salt (%)	pH	Clay (mg/l)	Sand (%)	Lime (%)
Clay	1.67	0-30	79.0	0.045	7.49	66.48	14,8	10.2

Silt (mg/l)	Nitrogen (kg/ha)	K ₂ O (kg/ha)	P ₂ O ₅ (kg/ha)	Na (%)	Cu (mg/l)	Mn (mg/l)	Fe (mg/l)	Zn (mg/l)
18.72	102.0	972.3	4.2	8.76	1.31	13.71	7.50	0.34

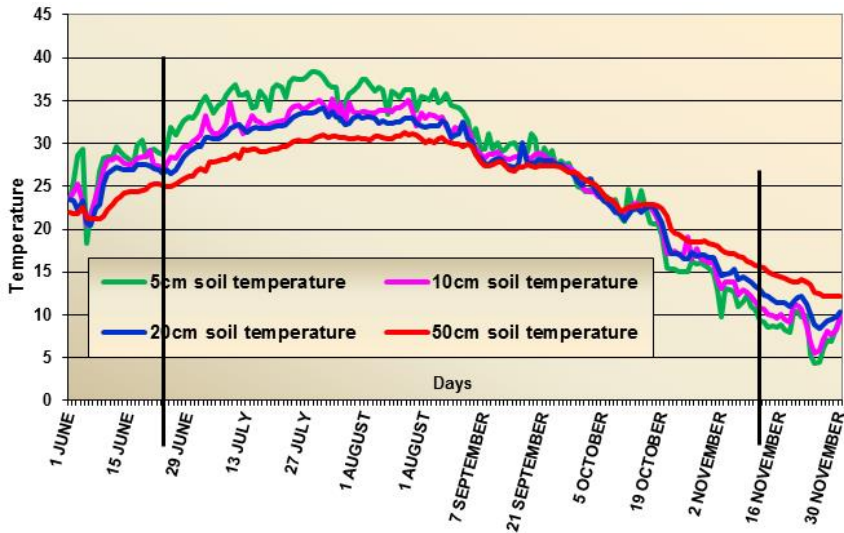


Figure 1 - 5 cm, 10 cm, 20 cm, 50 cm daily soil temperature in the cotton growth period (Diyarbakır Meteorology Directorate, 2012).

PERFORMANCES OF SOME EARLY COTTON CULTIVARS PLANTED AS SECOND CROP

Differences of temperatures of soil depth between, such as 5 cm, 10 cm, 20 cm and 50 cm, were found high. After the October temperature of soil depth is reduced and temperature of 50 cm soil depth is more hot than the other soil depth. The highest temperatures of soil depth were observed in mid-August. After the mid-August temperatures of soil depth have shown a decreasing trend (Fig. 1).

Phenological parameters of cotton cultivars, such as number of sympodial branches (number plant⁻¹), number of bolls (number plant⁻¹) date of first square (days), seed cotton yield (kg ha⁻¹) fiber length (mm), fiber fineness (micronair) and fiber strength (g tex⁻¹), were measured. Fiber properties were

determined with the HVI 900 (High Volume Instrument) device. Data were evaluated with JMP 7.0 (Copyright © 2007, SAS Institute Inc.), statistical software package, averages (%) grouped according to LSD significance test.

Data of daily relative humidity, sunny hours and rate of evaporation in the cotton growth period were given Table 1. July and August, months of summer, relative humidity is lower than the others months in the cotton growth period. Sunny hours change between 0-12 hrs/day. Sunny hours was zero 29th November. Evaporation of 24 hrs changed between from 1.1 to 18.0 % (Fig. 2).

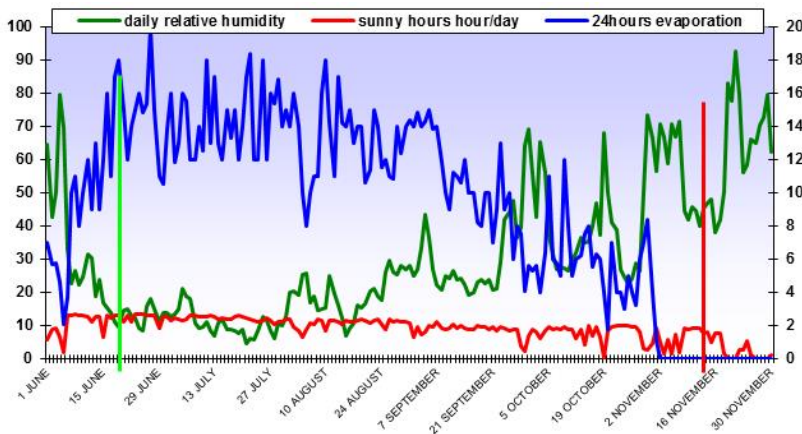


Figure 2 - Data of daily relative humidity, sunny hours and rate of evaporation in the cotton growth period (Diyarbakır Meteorology Directorate, 2012)

RESULTS AND DISCUSSION

The values and LSD (0.05) groups of investigated properties, such as number of sympodial branches, number of boll, date of first square (day), seed cotton yield (kg ha⁻¹)

are given in Table 3; fiber length (mm), fiber fineness (micronair), fiber strength (g tex⁻¹), fiber maturity (%), short fiber index (%) are shown in Table 4.

Table 3 - Means of agricultural properties of cotton varieties and LSD groups

Varieties	Sympodial branches (number of plant ⁻¹)		Number of bolls (number of plant ⁻¹)		Date of first square (days)		Seed cotton yield (kg ha ⁻¹)	
Berke	10.90	A	7.27	B	35.30	B	1950.37	A
Lachata	8.57	B	5.30	D	34.57	BC	1270.67	B
BA 119	11.10	A	6.00	CD	37.73	AB	1140.27	BC
STV 468	8.80	B	9.57	A	33.56	C	2040.20	A
STV 373	8.03	B	5.57	D	35.86	AB	680.83	C
Özbek 100	8.23	B	6.83	BC	33.00	C	1050.06	BC
Fantom	10.83	A	9.30	AC	29.37	D	1450.40	B
DP 396	7.70	B	5.67	CD	38.90	A	720.10	C
LSD	1.186**		1.226**		3.180**		46.093**	

Table 4 - Means of technological properties of cotton varieties and LSD groups

Varieties	Fiber length (mm)		Fiber fineness (micr .)		Fiber strength (g tex ⁻¹)		Fiber maturity (%)		Short fiber index (%)	
Berke	30.31	AB	4.59	A	37.17	A	94.47	A	7.33	D
Lachata	29.69	BC	4.02	B	31.47	BC	86.23	CD	12.90	A
BA 119	29.15	C	4.66	A	33.03	B	89.87	B	10.27	B
STV 468	28.68	CD	4.52	A	32.03	BC	88.20	BC	7.40	D
STV 373	28.61	CD	4.50	AB	30.70	C	89.30	B	10.13	BC
Özbek 100	27.84	D	4.97	A	32.27	BC	90.27	B	9.60	BC
Fantom	31.13	A	3.48	C	32.93	B	84.66	D	7.23	D
DP 396	29.16	C	4.50	AB	36.17	A	90.37	B	8.40	CD
LSD	1.096**		0.481**		1.945**		2.898**		1.863**	

Two different statistical groups consist of the cultivars used in the study in terms of the number of sympodial branches. The number of sympodial branches changed from 7,70 to 11.10 Berke and Fantom cotton varieties were in the highest statistical group. The our findings were similar with those of Buntin (2002) and Ekinci *et al.* (2008). Among the cotton varieties planted wheat stubble back after the as second product the statistical differences were significant at the 5% level in terms of

number of bolls. The number of bolls changed from 5.30 (STV 373) to 9.57 (STV 468). The highest value obtained from STV 468 cotton variety. Berke and Özbek 100, followed by it. Statistical differences were significant at the 1% level in terms of date of first square (day). The date of first square (day) changed from 33.00 (Fantom) to 38.90 (DP 396). Fantom determined the most earliness variety in terms of date of first square. Özbek 100 and Lachata cotton varieties followed by

PERFORMANCES OF SOME EARLY COTTON CULTIVARS PLANTED AS SECOND CROP

it. Date of first square (day), earliness criterion was determined that an advantage in terms of shortening the vegetation period.

The seed cotton yield changed from 721.0 kg ha⁻¹ (DP 396) to 2040.20 kg ha⁻¹ (STV 468). Killi & Bölek (2006) and Ramey (1995) were determined similar results with our findings.

The longest fibre was obtained from Fantom cotton variety. Berke, DP 396 and Lachata followed by it. The shortest fibre was obtained from Özbek 100 cotton varieties. Our findings are similar to those of Ramey (1995), determined the temperature regime that occurs as bolls are developing affects the physical properties of the fibers in second crop cotton cultivation. Among the cotton varieties planted wheat stubble back after the as second product the statistical differences were significant at the 1% level in terms of fiber fineness (micronair). The fiber fineness changed from 3.48 micr. to 4.97 micr. The most coarse fiber was obtained from Özbek 100 (4.66 micr.) cotton variety. Our findings were similar to Bilbro & Ray (1973) found that as planting was delayed fiber length and fiber fineness declined. Three different statistical groups consist of the cultivars used in the study in terms of the fiber strength (g tex⁻¹). In the study, fiber strength (g tex⁻¹) changed from 30.70 to 37.17 (g tex⁻¹). STW 373 cotton variety has the lowest value in terms of the fiber strength. Four different statistical groups consist of the cultivars used in

the study in terms of fiber maturity. The fibre maturity changed from 84.66% to 94.47%. The most mature fiber was obtained from Berke among studied cotton varieties. The short fiber index changed from 7.33% to 12.90%. The highest short fibre index was obtained from Lachata cotton variety. The lowest short fibre index was obtained from Berke and Fantom cotton varieties. When considering short fiber index is an undesirable feature in textile sector, Berke and Fantom cotton varieties are able to prefer for the second crop cotton cultivation.

CONCLUSION

In this study was carried out to determine seed cotton yield and fiber technological properties as second crop growing some early-maturity cotton varieties on stubble of ridge planted wheat. In the experiment, the cotton varieties examined in terms of some yield and technological properties were found to have significant differences. In this study, more early maturity cotton varieties have better results in terms of yield and technological properties in second crop cotton system and were concluded to be possible successful double-cropping with planted early maturing cotton genotypes, such as Berke, STV 468 and Fantom in South-eastern Anatolia, Region of Turkey.

Our study suggest that the experiments should be done on ground with stubble and without

stubble as a second crop after wheat production and should evaluate both economically and the effect on soil structure in future study.

Acknowledgment. This research was supported by Dicle University Scientific Research Projects Cordination Office (DUBAP). We gratefully thanks to for their support.

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