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A Study on the Effect of Different Rotation Systems on Some Quality Features of Maraş-92 Cotton Cultivar

Davut Karaaslan and Hasan Kiliç
Dicle University, Faculty of Agriculture , Deparment of Field Crops, 21280 Diyarbakır, Turkey
Southeast Anatolian Agricultural Research Institute, 21110 Diyarbakır, Turkey

Abstract: The effect of different rotation systems on the fiber quality of cotton under the irrigated conditions of Diyarbakır, was studied. Cotton is cultivated for the first year and main winter product+second product are cultivated in the second year, that is, three products are cultivated in two years, 12 rotation systems consisting of cotton-cotton, cotton-wheat+maize, cotton-wheat+rice, cotton-wheat+sunflower, cotton-wheat+soyabean, cotton-barley+maize, cotton-barley+silage maize, cotton-lentil+maize, cotton-lentil+silage sorghum x vetch hybrid, cotton-chickpea+maize, cotton-chickpea+soyabean and cotton-common vetch x barley mixture+maize were analyzed. It was identified that the length of fiber (fibrograph 2.5%), rate of oil in cotton seed and first hand % are significantly affected by the rotation systems whereas cotton-gin output, 100 seed weight, fiber strength and thickness of fiber are not statistically affected.

Key words: Maraş-92, rotation system, *Gosspium hirsutum* L.

Introduction

Cotton was an important place in the world trade because of its utilization in different fields. The world cotton consumption has increased more than 50% in the last 25 years and has reached to approximately 19 million tons (Tosun, 1998). The importance of cotton is gradually increasing since it constitutes an important raw material for textile industry, oil industry etc. Cotton is important for Turkey as well it provides an employment opportunity to a large group, constitutes 34% of the export revenues and 20-25% of annual vegetable oil production.

Cotton, which is of such importance, is being cultivated permanently. However, in the recent years it is being cultivated under rotation system with wheat due to both economic difficulties and problems caused by monocultural agriculture.

Southeastern Anatolia Region was in total 2.8 million hectares of land which can be harvested. Only 438 thousand hectares can be irrigated. But, various products can be cultivated on such land due to the ecological conditions. It was a high production potential (Anonymous, 1997). 1.7 million hectares will be irrigated after activating GAP (Southeastern Anatolia Project). Cotton is cultivated on more than half of the land (258 thousand ha) which is currently being irrigated (Anonymous, 1997). Although the plantation area for wheat and barley vary in years, such area is about 1 million ha and 655 thousand ha respectively. There is not a definite or systematic rotation system in the region. The general tendency of the producer is to cultivate the product which provides the highest income as per unit area. Like for all the other agricultural products, it is necessary to involve different products in the rotation system to replace monoculture cotton plantation. Because monocultural product has a negative impact on soil fertility and leads to the enhance of diseases and insects (Genç *et al*., 1978). The producers encounter significant problems due to diseases, insects and similar reasons in case cotton is cultivated monocultural. Even though the cotton cultivation is new in the region, it is possible to observe the said negative conditions in the coming years. The best example for this is the white fly epidemics and the consequences of this in Çukurova region as a result of cotton plantation for long years (Genç *et al*., 1978).

It was reported that ordinary common vetch, broad-bean, lupin and early ordinary common vetch applications do not have a negative effect on cotton's fiber, cotton-gin output, 100 seed weight and other features of the cotton seed (Tosun, 1998).

It was reported that monocultural cotton cultivate uptake from soil the same plant nutritution, so that this nutritution content decrease in the soil and plants can't uptake the main nutritions (Ilisulu, 1973).

The highest cotton yield was taken from cotton+chikpea rotation system and the lowest was taken from cotton+wheat rotation system (Rad, 1989).

It was reported that cotton+maize and cotton+soyabean rotation systems were given the highest cotton yield (Ebelhar and Well, 1989).

Cotton+rice rotation system was given the highest cotton yield (Kurtz *et al*., 1990).

This study was performed to identify fiber quality of the products obtained from different rotation systems in which the main product is cotton has been negatively affected.

Materials and Methods

The material in this study is Maraş-92 cotton cultivar (*Gossypium hirsutum* L.) registered by Kahramanmaraş Cotton Production Station in 1992.

Table 1: The rotation systems used in the experiment

1. year	2. year (main crop+second crop)
1. cotton	cotton (monoculture)
2. cotton	wheat+maize (grain)
3. cotton	wheat +sunflower
4. cotton	wheat +rice
5. cotton	wheat +soyabean
6. cotton	barley+ maize (grain)
7. cotton	barley +maize(silage)
8. cotton	lentil+ maize (grain)
9. cotton	lentil+sorghum (silage)
10. cotton	chickpea+ maize (grain)
11. cotton	chickpea+soyabean
12. cotton	Vetch x barley+ maize (grain)

The study was carried out in the experimental field of Southeastern Anatolia Agricultural Research Institute in the cultivation period of 1993/94, 1994/95 and 1995/96. The research soils are zonal soils which are generally red-brown and included in the big soil group having a clayish nature, flat or about-to-be flat, having very small erosion and deep or

medium deep (Anonymous, 1990). Long years climatical findings showed that there were 454 mm total reinfall and 15.8 ^{0}C average temperature in every year in the region (Anonymous, 1998).

The study which was performed on the first class irrigatable base land of Southeastern Anatolia Agricultural Research Institute during the production seasons of 1994, 1995 and 1996, 1992/93 being the preliminary study, has been installed according to the pattern of randomized blocks design, three products have been obtained in two years.

The dimensions of experimental plots were 5x10 m^2 at plantation and was evaluated as 2.8x8 m^2 at harvesting. Cotton was planted on the first week of May which is considered to be the normal plantation time of the region and it was harvested on the first week of November. In every three years, the land was left fallow for winter after it was ploughed following the second product harvest and the preparations for seed beds were undertaken in early spring. After cotton harvest, following the grinding of plant stems and plough of the soil, the main products for winter was planted.

The cultivation techniques in the region was applied in general for planting, irrigating, maintaining, harvesting and threshing of products involved in the study. Cotton was irrigated for 7-9 times although such number varies from year to year. Totally, 8 Kg da^{-1} of pure P_2O_5 and 16 Kg da^{-1} pure N fertilizers were applicated. The entire P_2O_5 and half of N were applicated at plantation, the remaining N was applicated to soil before the first irrigation.

Following the ginning of boll samples, such samples were sent to the fiber laboratory of Çukurova Agricultural Research Institute and their technological characteristics were identified. The oil rate in cotton seed was identified in the laboratory of Southeastern Anatolia Agricultural Research Institute according to the Raney Oilseed Crasher method (Troeng, 1955).

The statistical analysis was undertaken by MSTAT-C package program. Features such as fiber index, fibrograph 2.5%, fiber strength, thickness of fiber, fibrograph UR %, fibrograph 50%, first hand % and oil rate in cotton seed was evaluated.

Results and Discussion

Cotton-gin output (%): For cotton-gin output, the difference between rotation systems, years and rotation systems x years was not observed to be statistically significant (Table 2). In the year 1994, the highest cotton-gin output was obtained from cotton-common vetch barley mixture+maize rotation system @ 39.90%. In the year 1995, the highest cotton-gin output was obtained from cotton-lentil+maize rotation system @ 42.88% and in the year 1996 from cotton-barley+maize rotation system @ 42.05%. The highest cotton-gin output according to the average of three years was 40.96% and obtained from cotton-wheat+maize ration system. The lowest cotton-gin output was obtained from cotton-barley+maize in the year 1994 @ 37.68%. In 1995, the lowest output was obtained from cotton-chickpea+soyabean rotation system @ 40.04% and in 1996, from cotton-wheat+sunflower rotation system @ 39.26%. The lowest cotton-gin output according to the average of three years was identified as 39.65% from cotton-chickpea+soyabean rotation system. This situation indicates that there is not any adverbs effect of rotation systems on cotton-gin output.

100 seed weight (g): As a result of statistical analysis undertaken for 100 seed weight, there was not a statistical significance between rotation systems, years and rotation systems x years (Table 1).

The highest 100 seed weight in the year 1994 was obtained from cotton-wheat+rice rotation system @ 9.86 g. In 1995, it was obtained from cotton-wheat+rice rotation system @ 10.36 g and in the year 1996, from cotton-lentil+maize rotation system @ 9.76 g. The highest weight according to the average of three years was 9.95 which was obtained from cotton-wheat+rice rotation system. The lowest 100 seed weight in 1994, 7.37 from cotton-wheat+sunflower rotation system, in 1995, 9.08 g from cotton-chickpea+soyabean rotation system, in 1996, 9.02 g from cotton-wheat+maize rotation system. According to the average of three years, it was 9.13 g from cotton-wheat+sunflower rotation system. This situation indicates that there is not any adverbs effect of rotation systems on 100 seed weight .

Fiber index: In case of fiber index, the difference between years and rotation system x years was not statistically significant (Table 3).

The highest fiber index in 1994 was obtained from the rotation system of cotton-wheat+rice rotation system with a rate of 6.19%. In 1995, from cotton-lentil+maize rotation system @ 7.27% and in 1996, from cotton-barley+maize rotation system @ 6.86% and according to the average of three years, from cotton-wheat+sunflower rotation system, cotton-wheat+rice, cotton-lentil+maize rotation systems a 6.66%. The lowest fiber index in 1994 was obtained from cotton-wheat+sunflower rotation system @ 5.68%, in 1995 from cotton-chickpea+soyabean rotation system @ 6.11% and in 1996 from cotton-wheat+sunflower rotation system @ 5.92%. The lowest fiber index according to the average of three years were obtained from cotton-chickpea+soyabean rotation system @ 6.16%. This situation indicates that there is not any adverbs effect of rotation systems on fiber index.

Fiber length (2.5%): As a result of the statistical analysis undertaken for fiber length, there were differences between rotation systems whereas the difference between years and rotation system x years was not statistically significant (Table 3).

The highest fiber length in 1994 was obtained from cotton-wheat+soyabean rotation system @ 30.85, from cotton-lentil+silage sorghum rotation system in 1995 @ 30.56 and from cotton-wheat+rice rotation system in 1996 @ 26.68. The highest average fiber length of three years were obtained from cotton-wheat+rice and cotton-wheat+soyabean rotation systems @ 30.16 and 30.15 respectively. The lowest fiber length in 1994 was obtained from cotton-chickpea+maize rotation system @ 29.52, from cotton-wheat+maize rotation system in 1995 @ 28.77 and from cotton-wheat+sunflower rotation system in 1996 @ 28.31. This situation indicates that there is not any adverbs effect of rotation systems on fiber length.

Fiber strength: For fiber strength, the difference between years and rotation system x years was not statistically significant (Table 4).

The highest fiber strength in 1994 was obtained from cotton-wheat+rice rotation system @ 90.73 inch, from cotton-barley+maize rotation system in 1995 @ 101.6 inch and from cotton-wheat+rice rotation system in 1996 @ 101.3 inch. According to the average of three years, the highest fiber strength was obtained from cotton-wheat+rice rotation system @ 95.84 inch. The lowest fiber strength in 1994 was obtained from cotton-cotton rotation system @ 85.23, from cotton-lentil+maize rotation system in 1995 @ 94.16 inch and from cotton-common vetch x barley mixture+maize rotation system in 1996 @ 90.00 inch. The lowest fiber strength according to the average of three years were

Table 2: The average of cotton-gin output and 100 seed weight of 1994, 1995 and 1996 years

Rotation systems	Cotton-gin output (%)				100 seed weight (g)			
	1994	1995	1996	Average	1994	1995	1996	Average
cotton-cotton	39.39	41.19	41.13	40.56	9.24	9.78	9.53	9.51
cotton-wheat+sunflower	38.55	41.18	39.26	39.66	7.37	9.23	9.14	9.13
cotton-wheat+rice	38.53	40.55	40.91	40.00	9.86	10.36	9.63	9.95
cotton-wheat+grain maize	39.56	41.61	41.73	40.96	9.24	9.38	9.02	9.21
cotton-wheat+soyabean	39.13	41.80	41.09	40.67	9.15	9.47	9.18	9.27
cotton-barley+grain maize	37.68	40.90	42.05	40.22	9.68	9.30	9.45	9.48
cotton-barley+silage maize	38.02	40.76	40.41	39.73	9.56	9.37	9.19	9.37
cotton-chickpea+grain maize	39.32	40.42	41.21	40.31	8.89	9.64	9.69	9.40
cotton-chickpea+soybean	38.48	40.04	40.44	39.65	9.57	9.08	9.26	9.30
cotton-lentil+grain maize	39.54	42.88	40.19	40.87	9.41	9.66	9.76	9.66
cotton-lentil+silage sorghum	38.03	41.61	40.05	39.89	9.81	9.31	9.69	9.60
cotton-vetc x barley+grain maize	39.9	41.64	41.11	40.88	9.01	9.29	9.47	9.25
LSD (5%)		NS	NS	NS		NS	NS	NS
C V %	2.90	3.15	3.29		12.20	7.00	7.22	

NS=Non significant

Table 3: The average of fiber index and fiber length(2.5%) in 1994, 1995 and 1996 years

Rotation systems	Fiber index				Fiber length			
	1994	1995	1996	Average	1994	1995	1996	Average
cotton-cotton	6.00	63.88	6.65	6.51	30.08	29.13	28.75	29.32
cotton-wheat+sunflower	5.68	6.47	5.92	6.66	29.62	29.64	28.31	29.19
cotton-wheat+rice	6.19	7.08	6.70	6.66	30.50	30.29	29.68	30.16
cotton-wheat+grain maize	6.05	6.66	6.46	6.39	30.18	28.77	28.51	29.15
cotton-wheat+soyabean	5.86	6.82	6.40	6.42	30.85	30.00	29.60	30.15
cotton-barley+grain maize	5.87	6.48	6.86	6.39	31.05	29.49	28.97	29.83
cotton-barley+silage maize	5.87	6.45	6.39	6.35	30.77	29.65	28.59	29.64
cotton-chickpea+grain maize	5.69	6.55	6.82	6.35	29.52	28.87	29.16	29.18
cotton-chickpea+soybean	6.01	6.11	6.30	6.16	30.42	28.86	28.86	29.38
cotton-lentil+grain maize	6.14	7.27	6.58	6.69	29.77	29.90	28.65	29.44
cotton-lentil+silage sorghum	6.02	6.65	6.40	6.38	29.81	30.56	29.44	29.94
cotton-vetc x barley+grain maize	5.97	6.60	6.59	6.39	30.15	29.77	28.32	29.41
LSD (5%)		NS	NS	NS		NS	NS	NS
C V %	6.58	8.83	6.93		15.41	3.03	2.64	

NS=Non significant

Table 4: The average of fiber strength and fiber thickness in 1994, 1995 and 1996 years

Rotation systems	Fiber strength (inç/1000p)				Fiber thickness (micronarie)			
	1994	1995	1996	Average	1994	1995	1996	Average
cotton-cotton	85.23	95.63	94.90	91.92	3.61	3.86	3.90	3.70
cotton-wheat+sunflower	88.30	96.23	94.20	92.91	4.00	3.81	3.74	3.85
cotton-wheat+rice	90.73	95.50	101.3	95.84	3.98	3.84	4.21	4.01
cotton-wheat+grain maize	87.33	95.53	97.40	93.59	3.98	3.64	3.69	3.77
cotton-wheat+soyabean	87.80	96.56	95.83	93.16	3.96	3.25	4.10	3.74
cotton-barley+grain maize	86.20	101.6	91.60	93.16	3.96	3.35	4.01	3.84
cotton-barley+silage maize	87.80	96.66	98.73	95.73	3.88	3.25	4.10	3.74
cotton-chickpea+grain maize	85.43	96.40	98.80	93.54	3.51	3.68	4.03	3.74
cotton-chickpea+soybean	90.50	94.43	97.50	93.03	4.03	3.69	3.74	3.86
cotton-lentil+grain maize	86.83	94.16	94.40	91.80	4.11	3.90	3.71	3.90
cotton-lentil+silage sorghum	86.66	96.86	97.83	94.46	3.76	3.84	3.91	3.84
cotton-vetc x barley+grain maize	89.10	95.33	90.00	91.48	3.75	3.81	4.01	3.85
LSD (5%)		NS	NS	NS		NS	NS	NS
C V %	4.15	4.18	4.62		9.86	12.79	5.78	

NS=Non significant

obtained from cotton-common vetch barley+maize rotation system @ 91.48. This situation indicates that there is not any advers effect of rotation systems on fiber strength.

Fiber thickness: In case of fiber thickness, the difference between years and rotation system x years was not statistically significant (Table 4).

The highest fiber thickness in 1994 was obtained from cotton-lentil+maize rotation system @ 4.11, from cotton-lentil+maize rotation system in 1995 @ 3.90 and from cotton-wheat+rice rotation system in 1996 @ 4.21.

Table 5: The average of first hand (%) in 1995 and 1996 and the rate of oil content in the cotton seed in 1995

Rotation systems	First hand (%)			Oil content of cotton seed
	1995	1996	Average	1995
cotton-cotton	89.26	82.66	85.96	17.60bc
cotton-wheat+sunflower	73.83	73.00	73.41	16.46c
cotton-wheat+rice	74.90	64.33	69.61	18.00bc
cotton-wheat+grain maize	78.43	75.00	76.71	17.40bc
cotton-wheat+soyabean	77.93	75.66	76.80	18.66bc
cotton-barley+grain maize	75.96	68.66	72.31	16.46c
cotton-barley+silage maize	75.53	68.33	71.93	17.13c
cotton-chickpea+grain maize	84.60	74.00	79.30	19.60ab
cotton-chickpea+soybean	74.93	69.00	71.96	21.26a
cotton-lentil+grain maize	85.43	78.33	81.88	19.73ab
cotton-lentil+silage sorghum	83.33	77.33	80.33	18.73bc
cotton-vetc x barley+grain maize	83.26	72.00	77.63	2.441
LSD (5%)	NS	NS		7.92
C V %	10.88	9.19		2441

NS=Non significant

According to the average of three years, the highest fiber thickness was obtained from cotton-wheat+rice rotation system @ 4.01. The lowest fiber thickness in 1994 was obtained from cotton-chickpea+maize rotation system @ 3.51, from cotton-barley+silage maize rotation system in 1995 @ 3.25 and from cotton-barley+maize rotation system in 1996 @ 3.69. The lowest fiber thickness according to the average of three years was obtained from cotton-barley+maize rotation system and cotton-barley+silage maize and cotton-barley+silage maize rotation systems @ 3.74. This situation indicates that there is not any advers effect of rotation systems on fiber thickness.

First hand (%): There were differences between rotation systems for first hand (%) but there was no statistical difference between years and years x rotation systems (Table 5).

The highest first hand in 1995, 1996 and according to the average of two years were obtained from cotton-cotton rotation system @ 89.26, 82.66 and 85.96% respectively. The lowest first hand in 1995 was obtained from cotton-wheat+sunflower rotation system @ 73.83%, from cotton-wheat+rice rotation system in 1996 @ 64.33%. The lowest average first hand of two years were obtained from cotton-wheat+rice rotation system @ 69.61%. This situation indicates that there is not any advers effect of rotation systems on first hand percent.

Rate of oil in cottonseed (%): As a result of the oil analysis undertaken in 1995, the difference between the rotation systems were found to be statistically significant (Table 5). The highest oil rate was obtained from cotton-lentil+maize rotation system @ 21.26% and the lowest rates were obtained from cotton-wheat+sunflower, cotton-barley+silage maize and cotton-chickpea+soyabean rotation systems @ 16.46, 16.46 and 17,12 respectively. There is an important effect of rotation system on the oil content of cottonseed. Because there is an effect of nitrogen on oil content especially in some rotation systems that contain leguminous plants.

As a result; the different rotation systems hadn't negative effect on the yield and yield quality features of cotton. Also the rotation systems increased soils and soil fertility. Therefore cotton must be taken in the rotation systems used in the region.

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