JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Effect of sowing date, cultivar, and sowing method on yield of some quantitative and qualitative traits of cotton in subtropical climatic Zone of Orzouieh region Kerman

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Abstract— This study aimed to evaluate the effect of sowing date, cultivar and method of sowing on the yield of some quantitative and qualitative traits of cotton in subtropical climates of Orzouieh Kerman- Iran (with cotton-maize-sesame-wheat-barley cropping system). Field experiments were carried out in 2017 and 2018. Experiments were conducted as split-split plots based on a randomized complete block design with three replications. Treatments were included: A) Sowing date in three levels:1- May 22 (plant transfer: 1 month ago), 2- June 10 (transplanting: 1 month ago) and 3- July 1 (plant transfer: 1 month ago) as the main plots, B) Cultivar: 1-Khordad 2-Varamin 3-hybrid (as subplot), C) Method of cultivation in three levels: 1- single plant cultivation, 2- double plant cultivation and 3- seed cultivation as the subplot. The results showed that quantitative parameters such as yield (kg ha-1), cotton yield (kg ha-1), fibre yield (kg ha-1), and water use efficiency (kg m-3) as well as qualitative parameters such as fibre length (mm), fibre strength (g/tex) and fibre thickness (Micronaire) it had significant differences with transplanting of Khordad cultivar on May 22 compared to direct seed planting on May 22. The sowing date of June 10 and July 1 in all three cultivars and sowing methods had the lowest yield at the same planting date. These results showed that in the cotton-maize-sesame-wheat-barley cropping system in the subtropical zone of Orzouieh region -Kerman-Iran, transplanting of Khordad cultivar compared to seed direct sowing in the May 22 date is a suitable strategy to improve the qualitative and quantitative yield of cotton.

Keywords: Cotton, plant transfer, Sowing date, cultivar

I. INTRODUCTION

Cotton is one of the main crops of Iran's subtropical region's crop system. Kerman Orzouieh region is one of these subtropical regions. The crop sowing system (cotton, maize, sesame, wheat, barley) in this region is highly dependent on planting date, cultivar, method of cultivation and water requirement of wheat fields. In this region, wheat is sown in autumn and wheat fields are in the earing and flowering stages in May. Therefore, the water requirement of wheat fields (in May of the following year) affects the cotton planting date. The best cotton planting date in this region is May 1st. But this stage coincides with the date of cotton planting and the water requirement of wheat fields impedes cultivating cotton timely. This problem has caused cotton to be sown with a delay of one month. Suitable sowing date is one of the most important factors in the cultivation management of cotton cultivars ([7]Kaur et al, 2019). Timely planted crops experience the optimal condition of sunlight for biomass production. ([7]Kaur et al, 2019) quoting ([1]Arshad et al, 2017)). Subsequently, late planting dates develop unsuitable and critical temperature conditions at vegetative and reproductive growth stages ([7]Kaur et al,2019). It seems that delaying the planting date reduces the number of days to complete the different phonological stages of the plant ([2]Ban et al, 2015). Studies in the Orzouieh region show that the average yield of cotton fields is not suitable, also the quality of the produced fibres is not desirable (Ministry of Jihad Agriculture Statistics, 2016). This is mainly due to the delay in planting date, the cultivar cultivated and the method of planting (mainly seed direct planting). A decrease in cotton yield due to (because of) delay in sowing date in different cultivars has been reported ([9]Mahmood-du-H et al, 2003).

This decrease is mainly due to environmental conditions at the late planting date (such as air humidity, rainfall, cumulative soil temperature at planting and germination, temperature at flowering and maturity, sunny days and air temperature during the growing season, and Air temperature at pollination time). The effect of different sowing dates on yield and yield components of cotton showed that delayed sowing (compared to normal sowing date) had low grain cotton yield and low water use efficiency.

This decrease in yield is related to changes in environmental parameters such as mean temperature at flowering to maturity, average air temperature and sunny days during the growing season ([6]Huang, 2016). Decrease in leaf area index, lint yield, and grain cotton yield with delayed sowing date in RCH 650 BGII F228, F1861, and NCS855 BGII cultivars due to reduced canopy green area and lack of maximum solar energy and unsuitable environmental conditions have been reported ([7]Kaur et al, 2019). This condition decreases lint yield and grain cotton yield by affecting the number of bolls per plant and its weight, vegetative branch length and reproductive branch length ([7]Kaur et al, 2019). According to ([14]Sikandar et al, 2017), delay in planting date reduced grain cotton yield, number of bolls per plant, fibre length and lint yield in three cultivars of Haridost, Koonj, Sindh-1. Studies have shown that planting date also affects qualitative traits. ([4]Deho et al, 2014) reported that fibre length and grain cotton yield of Sadori, Chandi-95, and Malmal cultivars at the 15th May planting date were better than the 1st May. ([10]Mauget et al, 2019) studied quantitative and qualitative characteristics of some cultivars on different planting dates. According to this report, its lint yield was higher in May than in June. On the May planting date, bolls are not exposed to low temperatures. For this reason, fiber length, fiber micronaire and strength are improved. Similar results were reported by ([5]Hakoomat et al, 2009). In addition to sowing date, sowing methods in different cultivars change quantitative traits such as cotton water use efficiency. For example, ([8]Liaquat et al, 2017) reported a significant difference in water use efficiency with six planting methods on two cotton cultivars BH-160 and CIM-506 in three regions (Bahawalpur, Bahawalnagar and Ahmadpur). In the Orzouieh region due to the impossibility of planting cotton in May (on the mainland) because of the occupation of land by wheat and the water requirement of the fields can be prepared for transplanting cotton. Transplanting is important in the Orzouieh region; because of the impossibility of direct seed cultivation in May. The transplants are grown a month later (after wheat harvest) on the main field. In this method, practically the crop growth will be delayed for a month on the same date of planting (Compared with direct seed planting). Also, less water is consumed. On this basis, more qualitative and quantitative yields may likely be obtained than conventional direct seed sowing and planting date. In a similar study, ([13]Saghir et al, 2018) reported that the quantitative and qualitative yield of cotton was better in the transplanting of different cultivars and early sowing dates compared to direct seed sowing and late sowing date. The most important reasons for this improvement were: 1- Better vegetative growth in suitable climatic conditions than in harsh weather in late sowing date and direct seed sowing, 2- Improving growth at optimum Plant densities for growth in transplanting culture.3- Better growth in early growth 4- Better resistance to harsh conditions during continued reproductive growth ([13]Saghir et al, 2018). Similar results by ([11]Mushtaq et al, 2010); ([17]Wei et al, 2017); and ([16]Wang et al, 2016), have also been reported. According to the aforesaid cases, this study was conducted in 2016 and 2017 to evaluate the effect of cultivar, planting date, and method sowing on some qualitative and quantitative characteristics of cotton in the subtropical climate of the Orzouieh region -Kerman-Iran. This study aimed to offer a suitable strategy to improve the quality and quantity of cotton fields.

Materials and Methods

II. Study area and Experiment design

Two field experiments were carried out during 2016 and 2017 in the Orzouieh region with a longitude of 59° 32´ East, latitude of 28° 19´ North, altitude difference of 1067 m, mean annual rainfall of 110 mm, maximum and minimum annual temperature of 49, -4 respectively. Experiments were conducted as split-split plots based on a randomized complete block design with three replications. Treatments were included: A) Sowing date in three levels:1- May 22 (transplanting: 1 month ago), 2- June 10 (transplanting: 1 month ago) and 3- July 1 (transplanting: 1 month ago) as the main plot, B) Cultivar: 1- Khordad 2-Varamin 3-hybrid (as sub-plot), C) Method of cultivation in three levels: 1- single transplant cultivation, 2- double transplant cultivation and 3- seed cultivation as the subplot. The soil of the test site was examined by composite sampling (5 samples from 0-30 cm depth). Soil analysis showed that the soil was not saline and alkaline. This condition was observed uniformly in all plots. The texture of the soil was loamy. The soil physicochemical properties of experimental fields are shown in Table (1).

TABLE I: Soil physicochemical characteristics of experimental fields of 2016 and 2017

Year	Depth(cm)	Clay	Silt (%)	Sand	Fe	Zn($mgkg^{-1}$)	K($mgkg^{-1}$)	P	OC	PH	EC($ds\ m^{-1}$)
1396	0-30	18	46	36	6.4	0.76	240	10	0.4	7.4	1.85
1397	0-30	12	60	28	7.25	0.53	270	8	0.32	7.6	2.9

III. Fertilization and Applying treatments

The required elements of the field were determined based on the results of Table (1). Urea fertilizer 400 kg ha-1 was used to supply soil nitrogen. Phosphorus (150kg ha-1) and potassium (100kg ha-1) fertilizers were added to the soil before planting. The fertilizer sources were triple superphosphate and potassium sulfate. Seed direct sowing was carried out on May 22, June 10, and July 1 from Khordad, Varamin and Hybrid cultivars. Seed consumption was 40 kg ha-1. The plants /bushes' distance on the rows and the distance between the rows were 20 cm and 75 cm, respectively. The number of planting rows and the length of each row were selected four and six meters, respectively.

Single planting treatments were planted at 66666 plants ha-1. The transplants were produced a month ago. In this treatment, the plants/bushes' distance on the rows and the distance between the rows were selected at 20 cm and 75 cm, respectively. Two transplant treatments were planted similar to single transplant treatment. But the plants /bushes' distance on the rows was 40 cm. The size of each plot was 24 m2 (6 * 4) and the distance between plots was 75 cm.

Sampling and analysis

The irrigation system was under pressure in all treatments. The amount of water consumed was measured by volume contour. Water consumption was recorded in each irrigation period/ cycle. Water use efficiency (lint yield) was calculated using the formula given by

WUE =crop yield (economic yield)/ water used (I+ R) to produce the yield (Viets, 1962) I = Irrigation

R = Rainfall

Transplant trays made of disposable plastic (72 units) were used for transplant production. In each transplant tray unit, two seeds were sown for double transplanting and one seed was sown for single transplanting. Transplanting trays were filled with a mixture of 2 units of sand, 2 units of field soil, 1 unit of manure and 1 unit of vermin compost. The produced transplants (20 to 25 cm high) of the cultivars were planted at the aim planting dates in the main field. Rows 2 and 3 of the planting lines were selected for note-taking. Also, 10 plants (randomly) were selected from each row. Harvests were carried out after deletion one meter from the beginning and end of the rows. Lint yield, cotton grain and fiber yield were calculated and recorded in different treatments. Samples of fibers (weighing 350 g) were prepared from each treatment. Quality parameters (fiber length, firmness and fineness) were measured and recorded in the Cotton Fibers Technology Laboratory - General Directorate of Cotton and Oil Seeds of Iran.

Data analysis

SAS and MSTAT C software were used for statistical calculations. Also, Duncan's multiple range tests at 1% and 5% probability levels were used to calculate the mean square of traits.

Shown: Indicates cotton seedlings

Results

The results showed that the effects of treatments on measured traits were significant at 1% and 5% levels (Table 2).

TABLE II: Analysis of Variance of Quantitative and Qualitative Traits of Cotton in 2016 and 2017

Sources of variation	Yield	D.F	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
Replication	2016	2	517.5^{ns}	13.262^{ns}	17223^{ns}	0.012^{ns}	0.001^{ns}	0.0008^{ns}	0.000002^{ns}
	2017		1367.5^{ns}	77.962^{ns}	17581.7^{ns}	0.063^{ns}	0.008^{ns}	0.003^{ns}	0.000038^{ns}
Sowing date	2016	2	361456**	380631**	221748**	141.5**	27.87**	8.97**	0.064557**
	2017		3645371**	551904**	1453605**	138.35**	29.173**	8.98**	0.064178**
An Error	2016	4	398.582	86.56	14690.63	0.024	0.0034	0.0097	0.000003
	2017		2565.103	55.055	10749.690	0.04703	0.00456	0.010343	0.000055
Cultivar	2016	2	3129749**	372329**	965200**	19.32**	0.42**	0.107**	0.060901**
	2017		3420289**	520566**	1166382**	20.271**	0.5504**	0.0802**	0.064712**
Sowing date Cultivar*	2016	4	290799**	36758**	102135.9*	2.64**	0.034*	0.012**	0.004709**
	2017		267164**	44263**	108752.7*	2.357**	0.023^{ns}	0.02039*	0.003991**
B Error	2016	12	297.32	252.91	18381.95	0.014	0.0092	0.011	0.000007
	2017		1377.715	173.984	27767.018	0.04598	0.01061	0.01105	0.000022
sowing method	2016	2	4114412**	412509**	777193**	12.42**	2.062**	6.116**	0.304973**
	2017		3591757**	542645**	1269024**	9.6048**	2.3556**	5.7489**	0.291147**
sowing method* Sowing date	2016	4	292704**	46687**	367676**	0.338**	0.54**	0.66**	0.005668**
	2017		382360**	43795**	254715**	0.3985*	0.5941**	0.6603**	0.006251**
Sowing method * Cultivar	2016	4	92563.7**	5878**	226561**	0.133*	0.024^{ns}	0.036**	0.004119**
	2017		61902.5**	27907**	23060**	0.2179*	0.01^{ns}	0.0436**	0.003295**
sowing method* Sowing date* Cultivar	2016	8	80840.9**	10579**	216941**	0.409**	0.0439*	0.011*	0.001610**
	2017		72670.7**	26087**	65959.77*	0.2888*	0.0421*	0.0147*	0.001268**
Error	2016	36	24523.06	393.707	15954.719	0.0183	0.01197	0.00366	0.000014
	2017		1754.56	355.875	22010.09	0.05944	0.01753	0.00445	0.000028
C.V	2016	-	1	3	7.8	0.53	0.4	1.4	1.1
	2017		1.59	2.15	8.66	0.94	0.46	1.56	1.5

Lint yield (kg ha-1)

Interaction effect of sowing date* cultivar* sowing method treatment showed that the highest lint yield was obtained from May 22* Khordad cultivar* double transplanting with an average of 3788.05 kg ha-1 (Table 3). This treatment increased lint yield by 1042.35 kg ha-1 compared to May 22 * Khordad cultivar* Seed cultivation treatment (control- 2745.7 kg ha-1). At the same planting date (May 22) and two transplanting sowing, Varamin and hybrid cultivars (3535.45 kg ha-1 and 2877.95 kg ha-1, respectively) were after the Khordad cultivar (Table 3). This trend was also observed in single transplant treatment under the same conditions (Table 3). The lint yield was decreased on June 10 and July 1sowing dates in all three cultivars and three sowing methods compared to May 22 sowing date (Table 3). This reduction was higher in direct sowing treatment compared to double and single sowing in all three cultivars and three sowing dates (Table 3).

TABLE lll: Means Squares of Treatment on Lint Yield (kg ha^{-1}) in Orzoouieh- Kerman- Iran Subtropical Climate

Data planting	Va	Method planting 2016			Va	Method planting 2017			Means 2016& 2017		
		One plant	Tow plant	Seed planting		One plant	Tow plant	Seed planting	One plant	Tow plant	Seed planting
may22	KH	3729b	3812.1a	2704.5c	KH	3662b	3764a	2786.9c	3695.5	3788.05	2745.7
	V	3466b	3541.9a	2569.5c	V	3465b	3529a	2584.5c	3465.5	3535.45	2577
	H	2322b	2867.9a	1638.8c	H	2341b	2888a	2150.5c	2331.5	2877.95	1894.65
June10	KH	2842b	3152.9a	2545.1c	KH	2927b	3088a	2879c	2884.5	3120.45	2712.05
	V	2540b	2659.3a	2392.4c	V	2424b	2645a	2354c	2482	2652.15	2373.2
	H	2163b	2357.7a	1604.7c	H	2280b	2364a	1980.5c	2221.5	2360.85	1792.6
july1	KH	2705b	2882.1a	1873c	KH	2768b	2943a	1801c	2736.5	2912.55	1837
	V	2445b	2580.7a	1700.3c	V	2584b	2615a	1686.7c	2562	2597.85	1693.5
	H	1944b	2355.3a	1604.3c	H	2234b	2345a	1651.8c	2089	2350.15	1628.05

Fiber Weight (kg ha-1)

The highest fiber yield was obtained from the 22 May* Khordad cultivar* double transplanting (1378.85 kg ha-1) treatment. While fiber yield in the control treatment (May 22* Khordad cultivar* direct seed sowing) was 960.9 kg ha-1. Varamin and hybrid cultivars (1187.05 kg ha-1 and 974.22 kg ha-1, respectively) were in the second rank (Table 4). This trend was observed in the single transplant treatment compared to the control treatment under the same conditions (Table 4). Control treatment (960.9 kg ha-1) compared to May 22* Khordad cultivar* cultivation (1378.85 kg ha-1) reduced fiber yield by 417.95 kg ha-1 (Table 4). Planting date of July 1 significantly decreased fiber yield in all three cultivars and three methods (Table 4). June 10* three cultivars* three methods treatment had better fiber yield compared to July 1* three cultivars* three methods treatment (Table 4).

TABLE IV: Means Squares of Treatment on Fiber Yield (kg ha^{-1}) in Orzoouieh- Kerman- Iran Subtropical Climate

Data planting	Va	Method planting 2016			Va	Method planting 2017			Means 2016& 2017		
		One plant	Tow plant	Seed plant		One plant	Tow plant	Seed planting	One plant	Tow plant	Seed planting
May22	KH	1242b	1270.7a	961.8c	KH	1320b	1487a	960c	1281	1378.85	960.9
	V	1155b	1175.1a	856.5c	V	1154b	1199a	856.4c	1154.5	1187.05	856.45
	H	757.1b	988.94a	709.8c	H	765b	959.5a	725c	761.05	974.22	717.4
June10	KH	968b	1039.9a	868.1b	KH	983b	1051a	840.1c	975.5	1045.45	854.1
	V	828b	875.3a	797c	V	848b	871.8a	680.4c	838	873.55	738.7
	H	752b	796.2a	647c	H	760.3a	769a	649b	756.15	782.6	648
July1	KH	901.9b	949.8a	624.5c	KH	919b	976a	613c	910.45	962.9	618.75
	V	828.6b	860.2a	566.7c	V	819.7b	867.6a	553.3c	824.15	863.9	560
	H	774.2b	785a	546.3c	H	717.3b	766.3a	541.8c	745.75	775.65	544.05

Seed Cotton Weight (kg ha-1)

Analysis of variance (Table 2) shows that the effect of treatments on cotton seed weight was significant at 1% and 5%. The highest cotton seed weight was obtained from May 22 * Khordad cultivar * double transplanting treatment (2483.5 kg ha-1) (table 5). Control treatment (1897.1 kg ha-1) reduced this trait by 586.4 kg ha-1 (Table 5). Varamin (2014.5 kg ha-1) cultivar compared to the hybrid cultivar (1911 kg ha-1) had higher cotton seed weight at May 22 planting date and two transplants (Table 5). The lowest cotton seed weight (1093.55 kg ha-1) was obtained from a hybrid cultivar on July 1 by direct seed sowing method (Table 5).

TABLE V: Means Squares of Treatment on Cotton Seed Weight (kg ha^{-1}) in Orzoouieh- Kerman- Iran Subtropical Climate

Data planting	Va	Method planting 2016			Va	Method planting 2017			Means 2016&2017		
		One plant	Tow plant	Seed planting		One plant	Tow plant	Seed planting	One plant	Tow plant	Seed planting
May22	KH	1966b	2558a	1947.4c	KH	2330b	2409a	1846.8c	2148	2483.5	1897.1
	V	1663b	1720a	1593.5c	V	2261b	2309a	1712c	1962	2014.5	1652.7
	H	1660b	1912a	1419.1c	H	1545b	1910a	1444.4c	1602.5	1911	1431.75
June10	KH	1844b	2079.8a	1243.8c	KH	1919b	1944a	1738.3c	1881.5	2011.9	1491.05
	V	1556b	1713.5a	1175.1c	V	1710b	1743a	1560.8c	1633	1728.25	1367.95
	H	1525b	1767.6a	1307.4c	H	1520b	1565a	1331.5c	1522.5	1666.3	1319.45
July1	KH	1803b	1933a	1243c	KH	1854b	1982a	1198c	1828.5	1957.5	1220.5
	V	1537a	1571.8a	1110.2c	V	1525b	1751a	1116.4c	1531	1661.4	1113.3
	H	1514b	1559.1a	1093.6c	H	1367b	1552a	1093.5c	1440.5	1555.55	1093.55

Fiber Length (mm)

The effect of treatments on fiber length becomes significant at 1% and 5% levels (Table 2).mean square of treatments showed that the highest fiber length (29.595 mm) was obtained from may 22 * Khordad cultivar* double transplanting treatment (Table6). This treatment increased fiber length by 3.51 mm compared to the control (26.08 mm). An increase in fiber length under the same conditions was observed in two other cultivars (mean Varamin: 28.28 mm and hybrid mean: 28.03 mm) (Table 6). The sowing date of July 1 (40 days delay in sowing) in all three cultivars and three planting methods decreased fiber length compared to control (may 22 planting date* khordad cultivar* direct seed planting) (Table6).

TABLE VI: Means Squares of Treatment on Fiber Length (mm) in Orzoouieh- Kerman- Iran Subtropical Climate

Data planting	Va	Method planting 2016			Va	Method planting 2017			Means 2016&2017		
		One plant	Two plant	Seed plant		One plant	Two plant	Seed planting	One plant	Two plant	Seed planting
May22	KH	28.46b	29.83a	28c	KH	28.8b	29.36a	28.16c	28.63	29.595	28.08
	V	28.1a	28.26a	27.3c	V	28.13b	28. 3a	27.36c	28.115	28.28	27.33
	H	27.63b	28a	26.13c	H	27.63b	28.06a	26.3c	27.63	28.03	26.215
June10	KH	27.36b	28.03a	26c	KH	27.3b	28.1a	26.16c	27.33	28.065	26.08
	V	25.83b	26.36a	25.1c	V	25.86b	26.4a	25.3c	25.845	26.38	25.2
	H	24.1b	25.33a	23.86c	H	24.13b	25.33a	24b	24.115	25.33	23.93
July1	KH	23.53b	24a	23.16c	KH	23.66b	24.23a	23.33c	23.595	24.115	23.245
	V	24b	24.5a	23.1c	V	24.13b	24.56a	23.3c	24.065	24.53	23.2
	H	22.7	23.03	22.5	H	22.63b	23.16a	22.36c	22.665	23.095	22.43

Fiber Strength (g / tex)

The effect of treatments on fiber strength (g/ tex) become significant at 1% and 5% levels (table2) The best fiber strength (strong 29-30g/ tex) was obtained from may22 and june10 in double transplanting and single transplanting treatments in all three cultivars (Table 7). june10* direct seed sowing* Khordad cultivar treatment was ranked the same. Mediocre fiber strength (26-28g/ tex) was obtained from July1 planting date (40 days delay in planting) under three cultivars and three sowing methods (Table 7).

TABLE VII: Means Squares of Treatment on Fiber Strength(g/tex) in Orzoouieh- Kerman- Iran Subtropical Climate

Data planting	Va	Method planting 2016			Va	Method planting 2017			Means 2016& 2017		
		One plant	Tow plant	Seed plant		One plant	Tow plant	Seed planting	One plant	Tow plant	Seed planting
May22	KH	29.83b	29.93a	29.13c	KH	29.93a	29.93a	29.13b	29.88	29.93	29.13
	V	29.56b	29.73a	29.03c	V	29.36b	29.73a	28.96c	29.46	29.73	28.995
	H	29.26b	29.66a	28.96c	H	29.3b	29.63a	28.96c	29.28	29.645	28.96
June10	KH	29.56b	29.73a	28.86c	KH	29.6b	29.8a	28.93c	29.58	29.765	28.895
	V	29.4b	29.63a	28.83c	V	29.36b	29.63a	28.73c	29.38	29.63	28.78
	H	29.16b	29.63a	28.53b	H	29.53a	29.56a	28.53a	29.345	29.595	28.53
July1	KH	27.73a	27.8a	27.63b	KH	27.7a	27.73a	27.63ab	27.715	27.765	27.63
	V	27.56a	27.66a	27.5ab	V	27.53b	27. 63a	27.5b	27.545	27.645	27.5
	H	27.53a	27.53a	27.46b	H	27.4b	27.5a	27.3c	27.465	27.515	27.38

Fiber fineness (Micronaire)

Results showed that fiber fineness was significantly (1% and 5%) affected by treatments. The best fiber fineness (3.1- 3.9 Micronaire) was obtained from may22 planting date* three cultivars * two sowing methods (double transplanting and single transplanting) treatment and June 10 planting date (20 days delayed planting) * three cultivars* double transplanting treatment (table8). June 10 sowing date* three cultivars* single transplanting and direct seed sowing treatments also July1 sowing date (40 days delayed sowing) * three cultivars* double sowing and single sowing (medium fiber fineness (4-4.9 Micronaire) treatment were the second rank. Coarse fibers (5-5.9 Micronaire) were obtained from July1 sowing date * three varieties * direct seed sowing treatment (Table 8).

TABLEVIII: Means Squares of Treatment on Fiber Fineness (Micronaire) in Orzoouieh- Kerman- IranSubtropical Climate

Data planting	Va	Method planting 2016			Va	Method planting 2017			Means 2016& 2017		
		One plant	Tow plant	Seed plant		One plant	Tow plant	Seed planting	One plant	Tow plant	Seed planting
May22	KH	3.25b	3b	4.38a	KH	3.26b	3.11c	4.38a	3.255	3.055	4.38
	V	3.48b	3.21c	4.58a	V	3.43b	3.22c	4.52a	3.455	3.215	4.55
	H	3.62b	3.21c	4.58a	H	3.58b	3.21c	4.54a	3.6	3.21	4.56
June10	KH	4.3b	3.73c	4.65a	KH	4.24b	3.69c	4.61a	4.27	3.71	4.63
	V	4.33b	3.83c	4.66a	V	4.32b	3.81c	4.64a	4.325	3.82	4.65
	H	4.38b	3.87c	4.72a	H	4.37b	3.82c	4.69a	4.375	3.845	4.705
July1	KH	4.84b	4.36c	5.3a	KH	4.87b	4.38c	5.26a	4.855	4.37	5.28
	V	4.86	4.53	5.3	V	4.85b	4.53c	5.21a	4.855	4.53	5.255
	H	4.87b	4.57c	5.26a	H	4.84b	4.56c	5.13a	4.855	4.565	5.195

Lint yield water use efficiency (kg m-3)

The effect of treatments on Lint yield water use efficiency (kg m-3) was significant at a 1% level (Table 2). Khordad cultivar*may22 planting date* double and single transplanting (0.535 kg m-3 and 0.525 kg m-3, respectively) treatment compared to control (Khordad cultivar*may22 planting date* direct seed planting- 0.275 kg m-3) had the best water use efficiency (Table9). Varamin cultivar (at the same planting date and transplanting methods) had no significant difference with Khordad treatment (Table9). But hybrid cultivars had lower water use efficiency compared to Khordad and Varamin cultivars. The lowest water use efficiency (0.13 kg m-3) was obtained from direct seed sowing* hybrid cultivar* July 1 sowing date treatment (40 days delay in sowing). This treatment reduced water use efficiency by 0.145 kg ha-1 compared to the control treatment (may 22 planting date* Khordad cultivar *direct seed planting -0.275 kg m-3) (Table 9).

TABLE IX: Means Squares of Treatment on Lint Yield Water Use Efficiency (kgm^{-3}) in Orzoouieh- Kerman- Iran Subtropical Climate

Data planting	Va	Method planting 2016			Va	Method planting 2017			Means 2016& 2017		
		One plant	Tow plant	Seed plant		One plant	Tow plant	Seed planting	One plant	Tow plant	Seed planting
May22	KH	0.53a	0.54a	0.27b	KH	0.52a	0.53a	0.28b	0.525	0.535	0.275
	V	0.49a	0.5a	0.26b	V	0.49a	0.5a	0.26b	0.49	0. 5	0.26
	H	0.32b	0.40a	0.21c	H	0.33b	0.41a	0.21c	0.325	0.405	0.21
June10	KH	0.4a	0.45a	0.25b	KH	0.41a	0.44a	0.29b	0.405	0.445	0.27
	V	0.35a	0.36a	0.24b	V	0.34a	0.37a	0.23b	0.345	0.365	0.235
	H	0.31a	0.33a	0.19b	H	0.31a	0.33a	0.2b	0.31	0.33	0.195
July1	KH	0.39a	0.41a	0.18b	KH	0.39a	0.42a	0.18b	0.39	0.415	0.18
	V	0.35a	0.38a	0.16b	V	0.36a	0.37a	0.17b	0.355	0.375	0.165
	H	0.31a	0.33a	0.16b	H	0.31a	0.31a	0.1b	0.32	0.31	0.13

Discuss

The results of this study showed that a two-years average of lint yield, fiber and cottonseed in may22 sowing date* Khordad cultivar* double transplanting (3788.05 kg ha-1, 1378.85 kg ha-1, 2483.5 kg ha-1 respectively) had the highest value compared to the control treatment (may 22 sowing date* Khordad cultivar* direct seed sowing). Lint yield, fiber and cotton seed yield (1042.35 kg ha-1, 417.95 kg ha-1 and 586.4 kg ha-1 respectively,) were increased in this treatment compared to the control (may22 planting date* khordad cultivar* direct seed sowing). Varamin and hybrid cultivars were seconded ranked (Tables 3, 4, 6). Also, control treatment (may 22* khordad cultivar* direct seed sowing– 9869.6 m3ha-1) consumed more water (2887.7 m3ha-1) compared to this treatment (may22* khordad cultivar* doubel transplanting). Mean of two-year average lint yield, cotton seed and fiber on sowing date of July1 (40 days delay in sowing) in all three cultivars and three sowing methods compared to control (may 22 planting date* khordad cultivar * direct seed sowing) and treatment date 22 may planting was significantly reduced. Investigations show that the best sowing date for cultivars such as Varamin is in the subtropical Arzouieh zone in the second half of May and late sowing dates for varieties such as khordad in the second half of June (Ravari et al. 2008). The difference between these two planting dates is mainly in the quantitative and qualitative yield of cultivars. In the best environmental conditions of May (including relative air humidity, cumulative soil temperature, the temperature during flowering and puberty, sunny days and temperature during vegetative and reproductive growth), the plants grow better. Also, growth indices (including leaf area index and biomass production) improve. (Mahmood- du- Hassan et al., 2003 ،Huang et al., 2016).

The number of suitable days to complete the different phonological stages of the plants is one of the most important parameters affecting the quantitative and qualitative yield of cotton. It seems that decreasing the number of days in late planting dates in the Orzouieh region and the impact of the phonological conditions of the plants on the harsh conditions of June and July are the reasons for the decrease in lint yield, cotton seed and fiber. The response of the cultivars is also affected by these conditions. This subject has been reported by other researchers in different cultivars and planting dates (Boquet et al. 2009; Hakoomat et al. 2009; Ban et al., 2015; Kaur et al. 2019).

In this area, the occupation of agricultural land in May by wheat (in the cotton-wheat-barley-maize cultivation system) prevents the cultivation of cotton in the second half of May. So that the cotton sowing date is transferred from the second half of May (suitable for sowing of cotton) to the post-harvest of wheat. This problem has caused the vegetative and reproductive growth of bushes (in continuation of the growing season) to be affected by unfavourable environmental conditions. In such conditions (late planting dates), the researchers suggest that transplanting be carried out to provide the vegetative need of the bushes and their escape from the harsh environmental conditions (Wang et al 2016). This method improves the vegetative growth of bushes.

Also sowing transplants in the main field reduces the harmful effects of delayed planting date. In this experiment, double transplanting and Khordad cultivar on May 22 date showed better quantitative and qualitative yield (lint weight, fiber weight, cotton seed weight, water use efficiency, fiber length, fiber strength, fiber fineness) compared to direct seed sowing. Increased bushes' resistance to harsh conditions, optimum bushes density per hectare, suitable distribution of solar radiation between bushes and canopy, and improved leaf area index were the reasons for this improvement yield in double transplanting and Khordad cultivar at May 22 date treatment compared to direct seed sowing and single transplant treatment in all three cultivars. This trend was also observed in single transplant cultivation compared to direct seed cultivation in all three cultivars. The results of the researchers Wei, et al., 2017 Mushtaq et al., 2010, Saghir et al., 2018, and Wang et al 2016 corresponded with these results. Water use efficiency is another important factor in cotton yield in the Orzouieh region. This experiment showed that water use efficiency was higher in transplanting (two transplants and single transplants) in all three cultivars and three sowing dates compared to the control. The use of a strip irrigation system with 90% irrigation efficiency instead of 65% leakage irrigation, transplanting, shortening of the plant growth period in the main land, and reduction of two-stage irrigation can be one of the reasons for transplanting superiority May 22 compared to direct seed cultivation. Due to climate change, severe rainfall reduction, and consecutive droughts in a wide area in Asia, and subsequently Iran, improved water use efficiency contributes significantly to water storage. Also, 80% reduction in seed consumption, creating uniform green surface, reducing pesticide and disease spraying in the first season, reducing fungal diseases, 80%harvest of the crop in the first harvest, and Finally, higher yields and better quality than direct seed cultivation in May 22 date are the benefits of transplanting cotton.

IV. CONCLUSIONS

According to the Cotton-Corn-Sesame-Wheat-Barley cropping system in the Orzouieh Sub-Tropical zone of Kerman - Iran an appropriate Solution to prevent the deleterious effects of delayed Planting Date on Quantitative and Qualitative Yield of Cotton in different cultivars it's necessary. For this purpose, instead of direct seed sowing, cotton seedling is produced. Then, the seedlings of the Khordad cultivar (one month later) are planted in the main field after the wheat harvest. This solution has been proposed to prevent the deleterious effects of harsh environmental conditions on delayed planting dates in the Orzouieh Sub-Tropical zone of Kerman.

REFERENCES

[1] Arshad, M. N., Ahmad, A., Wajid, S. A., Jehanzeb, M., Cheema, M. and Schwartz, M. W. Adapting DSSAT Model for Simulation of Cotton Yield for Nitrogen Levels and Planting Dates. *Agronomy journal* 109: 2639–2648. (2017).

[2] Ban, Y. G., Nawalkar, D. P., Mote, B. M., Kumar, V. and Narwade, A. V. Crop phenology, thermal requirement, yield and fiber properties of cotton *(Gossypium hirsutum*) genotypes as influenced by different environments. *Indian Journal Plant Physiology* 20: 137– 144. (2015).

[3] Boquet, D. J. and Clawson, E. L. Cotton planting date: yield, seedling survival, and plant growth. *Agronomy Journal* 101: 1123-1129. (2009).

[4] Deho, Z. H., Tunio, S., Chachar, Q. and Oad, F. C. Impact of sowing dates and picking stages on yield and seed maturity of cotton (*Gossypium hirsutum* L.) varieties. *Sarhad Journal of Agriculture* 30: 404- 410. (2014).

[5] Hakoomat, A., Naveed Afzal, M. and Deho, M. Effect of sowing dates and plant spacing on growth and dry matter portioning in cotton (*Gossypium hirsutum* L.). *Pakistan Journal Botany* 41: 2145- 2155. (2009).

[6] Hung, J. Different sowing dates affected cotton yield and yield components. *International Journal of Plant Production* 10: 64- 83. (2016).

[7] Kaur, V., Sudhir K. M., Singh, K., Gill, K. K. and Pal, R. K. Performance of *Bt* and non *Bt* cotton cultivars under different sowing environment of south western Punjab. *Journal Cotton Research* 33: 93- 98. (2019).

[8] Liaquat, A., Wajiha A., Ghulam, H. and Muhammad I. Sh. Enhancement in cotton (Gossypium hirsutum L.) crop yield by water use efficiency under various planting techniques. *Environment, Earth and Ecology* 1: 6–16. (2017).

[9] Mahmmood, Du-H., Mahmmod, N., Mahmmod, Z. I., Mahmmod, T., Mahmmod, I. and Saghir, A. Effects of different sowing date on cotton (*Gossypium hirsutum* L.) cultivars. *Asian Journal of Plant Science*. 2: 461- 463. (2003).

[10] Mauget, S., Mauricio, U. and Jane, D. Planting date effects on cotton lint yield and fiber quality in the U.S. *Southern High Plains* 9: 2- 19. (2019).

[11] Mushtaq A., Liaqat A., Sattarand, M. and Muhammad Anjum, A. Response of seed Cotton yield to various plant populations and planting methods. *Journal Agriculture Research* 48: 163- 169. (2010).

[12] Ravari, S. Z., Hamzehnezhad, A., Najafinezhad, H., and Tohidinezhad, A. Effect of planting date on yield and yield components on four cotton cultivars in Baft- Orzouieh.*11th Iranian Congress of Agronomy and Plant Breeding*. (1999).

[13] Saghir, A., Iqbal, M., Taj, M., Mehmood, A., Shakeel, A. and Hasanuzzaman, M. Cotton productivity enhanced through transplanting and early sowing. *Acta Scientiarum Biological Sciences* 40: 2- 7. (2018).

[14] Sikandar, A., Muhammad, U. A., Mahmooda, B., Mohammad, I. A., Jamro, G. M., Aaqil, K., Faheem, A. Sh., Waheed, A. S. and Alam, Sh. Impact of various sowing dates on growth and yield parameters of different cotton varieties. *Journal of Applied Environmental and Biological Sciences* 7: 135- 143. (2017).

[15] Viets, F. G. Fertilizers and the efficient use of water. *Adv. Agronomy* 14: 223- 264. (1962).

[16] Wang, X., Yuru, H., Mingwei, D., Dongyong, X., Huaiyu, L., Xiaoli, T., and Zhaohu, L. Effect of planting date and plant density on cotton traits as relating to mechanical harvesting in the Yellow River valley region of China. *Field Crops Research* 198: 112– 121. (2016).

[17] Wei, H., Mei-li, Ch., Wen-qing, Z., Bing-lin, Ch., You-hua, W., Shan-shan, W., Ya-li, M. and Zhi-guo, Z. The effects of sowing date on cottonseed properties at different fruiting-branch positions. *Journal of Integrative Agriculture* 16: 1322– 1330. (2017).