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EFFECT OF SOME CROPPING SYSTEMS ON YIELD AND YIELD COMPONENTS OF COTTON AND ONION.

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ABSTRACT

Two field experiments were conducted at Mallawi, Agric. Res. St. (Middle Egypt) during the two seasons 2004 / 2005 and 2005/ 2006 to investigate the effect of some cropping systems on yield and yield components of cotton and onion. The experimental design was complete randomized blocks with three replications. The treatments included four cropping systems i.e. solid cotton cv Giza 83 grown after clover (2-cuts) (T_1), solid onion cv Giza 6 Mohassan (T_2), onion + cotton (intercropped) after fallow (T_3) and Fahl berseem (one cut) followed by onion + cotton (intercropped) (T_4). The results indicated that, seed cotton yield / fad of those grown solid and intercropping with onion after berseem (T_1 and T_4) were higher than those grown after fallow (T_3). Yield and yield components of intercropped cotton and onion grown after fallow (T_3) and after Fahl berseem (T_4) were decreased compared with solid. The decrease of seed cotton yield was 8.31 and 4.91% in the first season, 6.57 and 1.26 % in the second season and 7.44 and 3.03 %in the combined yield of the two seasons respectively. While the decrease of bulb yield of intercropped onion was 40.29 and 36.23 % in the first season, 39.61 and 37.79 % in the second season and 39.95 and 37.01 % in the combined yield of the two seasons.

Land equivalent ratio LER, CR, AYL and gross profit were higher when Fahl berseem was sown before cotton intercropped with onion than grown after fallow (T_3). Aggressivity showed that cotton was the dominated component and onion was the dominant.

INTRODUCTION

Cotton and onion as other crops are influenced by several factors including: cropping systems fertilization, irrigation, tillage, soil type etc.. It is well known that legume crops improve the soil primarily through symbiotic N_2 fixation, and add an additional beneficial effect of legumes on the following crop yield Baldock *et al.* (1981) noted that leguminous cover crops can produce substantial quantities of biologically fixed N, making supplemental fertilizer N. Wagger (1989) noted also, that estimates of legumes positive contributions are perhaps 20 to 30%, actually being recorded by the subsequent corn crop. Myers and Wagger (1991) during two seasons recorded those cover crops treatments produced increases in mean corn grain yield of 6.0 and 6.1 Mg ha^{-1} compared to fallow treatments which yield 3.4 and 4.0 Mg ha^{-1}. Badr *et al.* (1993) and El-Habbak *et al.* (1993) indicated that preceding crops significantly affected cotton plant height, number of fruiting branches, number of bolls/ plant and seed cotton per plant and per faddan. Brown *et al.* (1985) showed that cotton yield after rye and vetch cover crops were equal to yields obtained with the fall plow-fallow system.

Relaying cotton on some long duration winter crops may tackle the problem of delaying cotton from the timely date of seeding and save costs and time of land preparation and enable farmers to grow long duration winter crops such as onion, faba bean and wheat. El-Habbak *et al.* (1993) found that plant height, number of bolls / plant, number of fruiting

branches / plant, number of bolls/ plant and seed cotton yield per plant and per faddan were decreased when cotton was relayed with onion. Relaying cotton with onion plants resulted in reduction of onion yield and yield components as compared with onion in pure stand. They added that LER ranged from 1.44 to 1.70 and the highest gross profit resulted from relaying cotton with onion while El-Gahel and El-Aal (1998) showed that plant height, number of fruiting branches plant, earliness, seed cotton yield / fad. average boll weight and number of unopened bolls/ plant were not significantly affected by intercropping patterns or transplant spacing of onion. Abou-Keraisha (1998) and Selim *et al.* (1998) concluded that relay cotton with faba bean had no adverse effect on yield and yield components of both faba bean and cotton. Ramesh (1998) found that intercropping cotton with onion gave the highest seed cotton yield as well as the highest intercrop yield. Kulandaivel *et al.* (2001) showed that cotton when intercropped with black gram as an intercrop resulted in higher economic return and land equivalent ratio than with onion. Ghosh (2004) found that when LER and Agg, were greater AYL and IA were greater. Zohry (2005) showed that pure stand of cotton was superior to all other relayed patterns (onion intercropped with cotton, faba bean intercropped with cotton and wheat intercropped with cotton) followed by that relayed on faba bean, while the lowest values were observed when cotton was relayed with wheat. The highest values of land equivalent ratio (LER), gross benefit and net return were obtained when cotton was relayed with onion.

MATERIAL AND METHODS

Two field trials were carried out at Mallawi Agricultural Research Station (Middle Egypt) during 2004 / 2005 and 2005 / 2006 seasons to investigate the effect of some cropping systems on yield and yield components of cotton and onion. The experimental design was complete randomized blocks with three replications. The treatments included four cropping systems as follows.

1. Solid cotton cv Giza 83 (T_1) grown after berseem (2-cuts) (Meskawy as multi–cut variety)
2. Solid onion cv Giza 6 Mohassan (T_2)
3. Onion + cotton (intercropping) after fallow (T_3)
4. Fahl berseem (mono–cut variety) followed by onion + cotton (intercropped) (T_4)

The plot area was 7.2 ×6.0 m and made up of 6 and 12 ridges, 6 m. long. Planting and harvesting dates of berseem, onion and cotton are presented in Table (1). Onion (pure stand) was transplanted on both sides and on the top of narrow ridges (0.60 m) in width and at a distance of 10 cm. apart (210.000 plants / fad.). Whereas intercropped onion with cotton was transplanted in four rows on the top of wide ridges (1.2m.). Cotton in pure stand grown after berseem was planted on the southern side of narrow ridges (0.6m.) and thinned at two plants / hill. (70,000 plants / fad.). While cotton grown with onion was planted on both sides of wide ridge (1.2m) and thinned at two plants / hill (100% cotton + 67% onion). It is worth noting that both onion and cotton were intercropped using the same within ridge spacing as in respective sole systems i.e. 10 and 20 cm, respectively. Normal cultural practices for growing berseem, onion and cotton were applied as recommended.

Measurements

Ten plants from each crop were chosen randomly to determine yield parameters. While the yield / fad. was determined from the whole plot. Estimated traits were as follows.

Cotton: plant height (cm), number of fruiting branches/ plant, number of total bolls/ plant, percent number of open bolls/ plant, lint weight of ten bolls, seed weight of ten bolls, seed cotton yield / plant and seed cotton yield / fad.

Onion: bulb length (cm), bulb diameter (cm.), weight of fresh bulb (gm.), and bulb yield in ton/ fad (ton).

Competitive relationships:

1. **Land equivalent ratio (LER):**

LER is determined as the sum of the fractions of the yield of intercrops relative to their sole crop yields (Willey and Osiru, 1972).

Land equivalent ratio LER was determined according to the following formula:

$$LER = \frac{yab}{yaa} + \frac{yba}{ybb}$$

Where: Yaa is pure stand yield of species a, Ybb is pure stand yield of species b, Yab is mixture yield of a (when combined with b) and Yba is mixture yield of b (when combined with a).

2. **Aggressivity (Agg)**

This was proposed by Mc-Gilichrist (1960) and was determined according to the following formula.

$$Aab = \frac{yab}{yaa \times zab} - \frac{yba}{ybb \times zba}$$

An aggressivity value of zero indicates that the component crops are equally competitive. For any other situation both crops will have the same numerical value, but, the sign of the dominant crop will be positive and the dominated will be negative. The greater the numerical value of (Agg), the bigger the difference in competitive abilities and the bigger th difference between actual and expected yield .

3. **Competitive ratio (CR)** was calculated by the following formula as given by Willey and Rao (1980).

$$CR = CRa + CRb\ CRa = \left\{\left(\frac{LERa}{LERb}\right) \times \left(\frac{Zba}{Zab}\right)\right\},$$

Where: LERa and LERb represent relative yield of a and b intercrops, respectively. Since the CR values of the two crops will in fact be reciprocals of each other.

CRa, CRb are the competitive ratio for intercrop where Zab representing the sown proportion of intercrop a (cotton) in combination with b (onion) and Zba the sown proportion of intercrop b (onion) in combination with a (cotton).

4. **Actual yield loss (AYL)** according to Banik (1996) was calculated as:

$$AYL = AYLa + AYLb = \left[\left\{\frac{(Yab/Zab)}{(Yaa/Zaa)}\right\} - 1\right] + \left[\left\{\frac{(Yba/Zba)}{(Ybb/Zbb}\right\} - 1\right].$$

Where AYLa and AYLb are the partial yield loss of intercrop cotton and onion respectively. Yab representing the yield of intercrop a (cotton) in combination with b (onion), Yba the yield of intercrop b (onion) in combination with a (cotton).

5. **Intercropping advantage (IA)** was calculated using the formula of Banik *et al.* (2000):

IA cotton = **AYL** cotton × **Price** cotton

IA onion = **AYL** onion × **Price** onion

6. **Gross profit:**

It was calculated in Egyptian pounds per faddan at market price of the averages of 2003 / 2004 and 2004/2005 seasons at Mallawi region. Seed cotton price was 550 L.E / kantar, onion was 400 L.E/ton and berseem was 45 L.E / ton.

Data of the two seasons were statistically analyzed and the combined analysis of variance over two seasons, was calculated according to Snedecor and Cochran (1988) using MSTAT computer V_4 (1986). L.S.D. test at 0.05 level of significance was used to compare the differences between treatments.

Table (1): Planting and harvesting dates of Meskawy berseem, Fahl berseem, onion and cotton in the first and the second seasons.

Crops	First season		Second season	
	Planting date	Harvesting date	Planting date	Harvesting date
Clover (two cuts)	18/10	20/12 & 18/2*	15/10	11/12 & 15/2*
Clover (one cut)	21/9	15/11*	20/9	12/11*
Onion	22/11**	8/5	18/11**	3/5
Cotton	23/3	25/10	21/3	19/10

* cut ** transplanted

RESULTS AND DISCUSSIONS

I -Cotton

Data presented in Table (2) show that all studied characters except plant height in the two seasons and combined analysis and lint weight of 10 bolls in the first season and number of bolls / plant in the second season were significantly affected by cropping systems. However, it is clear that most cotton traits reached their maximum values when cotton was grown as solid (T_1). Intercropping with onion after Fahl berseem ranked the second (T_4) whereas, the lowest values were observed when cotton was intercropped with onion (T_3). The results showed also that the values of most growth traits and yield components of cotton grown solid (T_1) were greater than those grown in (T_3 and T_4) in both seasons and the combined data of the two seasons. The increases in solid cotton was, estimated to 2.94 and 2.82 % for plant height, 3.75 and 2.72 % for number of fruiting branches / plant, 7.78 and 4.67 % for number of bolls / plant, 10.94 and 1.47% for open bolls / plant, 6.66 and 4.17 % for seed cotton yield / plant and 8.03 and 3.12 % for seed cotton yield / fad. While the increases in intercropped cotton grown after Fahl berseem (T_4) were 10.93% for number of fruiting branches / plant 5.11 % for number of bolls / plant, 9.33 % for percentage open bolls / plant, 8.21% for lint weight of 10 bolls, 8.71 % for seeds weight of 10 bolls, 8.53% for seed cotton weight of 10 bolls 2.4% for seed cotton yield / plant and 4.76% for seed cotton yield / fad over these grown after fallow (T_3) in the combined data of the two seasons. It is also evident that cotton traits (solid or intercropped) grown after berseem (one or two cuts) were greater than those grown after fallow (T_3). Similar results are observed by Myers and Wagger (1991) and Abou-Keraisha (1998).

It could be concluded that intercroppping systems resulted in reduced yield and yield components of cotton. Nevertheless cotton grown after Fahl berseem had relatively higher values in the intercrops. These results are in agreement with those obtained by El-Habbak *et al.* (1993), Abou-Keraisha (1998) and Zohry (2005).

II – Onion

Data in Table (3) indicated that all studied characters of onion except in case of bulb length in the second season were significantly affected by cropping systems. The results showed that relay cropping systems (T_3 and T_4) resulted in reduced yield and yield components of onion as compared to those grown in pure stand (T_2). The reductions in intercropped onion grown after fallow (T_3) were 6.63, 6.33 and 6.27 % for bulb length 18.76, 13.34 and 16.05 % for bulb diameter, 18.52, 18.85 and 18.71 % for weight of fresh bulb and 40.28, 39.60 and 39.94 % for yield of bulbs / fad in the first, the second and the combined data of the two seasons, respectively. While the reduction in intercropped onion grown after Fahl berseem were 2.06, 8.00 and 5.47 % for bulb diameter, 36.22% for yield of bulbs / fad. as compared to solid onion (T_2). Bulb length and weight of fresh bulb of intercropped onion grown after Fahl berseem were greater than those grown as solid. These results are in agreement with those revealed by El-Habbak *et al.* (1993) and Zohry (2005). Intercropped onion with cotton and grown after Fahl berseem (T_4) it recorded higher values than when onion was intercropped with cotton and grown after fallow (T_3). The increase was 20.01, 2.78 and 10.36% for bulb length, 20.55, 6.16 and 12.61% for bulb diameter, 32.14, 26.85 and 29.41 % for weight of bulb and 6.81, 3.01 and 4.52 % for bulb yield / fad in the first, the second and the combined data of the two seasons respectively. It could be concluded that Fahl berseem (leguminous clover crop) grown before intercropped onion can produce substantial quantities of biologically fixed N which had a beneficial effect on the following crop (onion). Similar results were recorded by Wagger (1989), Myers and Wagger (1991) and Abou-Keraisha (1998).

III – Competitive relationship

1. Land equivalent ratio (LER)

Data presented in Table (4) showed the effect of intercropping cotton with onion on land equivalent ratio (LER). Land equivalent ratio values were greater than one by inter-

cropping cotton with onion. This evidenced that the actual productivity was higher than the expected productivity. Relative yield of cotton (RYc) and onion (RYo) were greater when grown after Fahl berseem (T_4) than those grown after fallow (T_3). The reduction in (Ryo) was greater 0.37 – 0.40 % than in (RYc) 0.03-0.07% as compared with its sole crop yield in the combined data of the two seasons. The results also showed that LER of cotton intercropped with onion after Fahl berseem (T_4) was higher (1.60) than that grown after fallow (T_3) (1.53) in the combined data of the two seasons. Similar results recorded by El-Habbak *et al.* (1993), Kulandaivel *et al.* (2001) and Zohry (2005).

2. **Aggressivity**

Data in Table (4) show that aggresivity values of cotton were negative, whereas values of onion were positive; it means that cotton was dominated while onion was dominant crop. Regarding the average means of combined data in both seasons the highest values for aggressivity was obtained from Fahl berseem followed by onion with cotton intercropping (T_4). These results are in agreement with those obtained by Abou-Keraisha (1998) and Zohry (2005).

3. **Competitive ratio (CR)**

Data on the competitive ratio (CR) revealed that intercropped cotton had higher competitive ratio in (T_3) system in the first and the combined data of two seasons and in both system (T_3 and T_4) in the second season. Indicating that cotton crop is more competitive than onion crop in these intercropping systems.

Table (2): Effect of cropping systems on yield and yield components of cotton (the first, the second seasons and the combined data of the two seasons).

Characters / Treatments	Plant height (cm.)	No. of fruiting branches / plant	No. of bolls / plant	Open bolls / plant %	Average weight of 10 bolls / gm			Seed cotton yield / plant (gm.)	Seed cotton yield / fad (kintar)
					Lint	Seeds	Seed cotton		
	First season								
Solid cotton (T_1)	127.10	6.63	22.00	77.05	5.70	10.45	16.15	50.74	7.94
Onion + cotton (T_3)	126.70	6.35	19.95	68.60	5.55	9.95	15.50	46.80	7.28
F.berseem / onion / cotton (T_4)	122.10	6.48	20.57	76.15	5.90	10.80	16.70	48.05	7.55
LSD 0.05	NS	0.09	1.35	4.32	NS	0.35	0.40	0.35	0.16
C.V.		1.04	4.87	4.39		2.53	1.86	0.54	1.58
	Second season								
Solid cotton (T_1)	104.85	6.64	22.30	74.20	5.93	10.77	16.70	49.17	7.92
Onion + cotton (T_3)	98.60	6.45	21.15	67.73	5.40	10.00	15.40	46.87	7.40
F.berseem / onion / cotton (T_4)	103.35	6.45	21.75	72.92	5.95	10.90	16.85	47.85	7.82
LSD 0.05	NS	0.05	NS	4.70	0.33	0.53	0.33	0.20	0.13
C.V.		0.58		4.93	4.30	4.77	1.52	0.31	2.27
	Combined data of the two seasons								
Solid cotton (T_1)	115.97	6.64	22.15	75.63	5.82	10.61	16.43	49.95	7.93
Onion + cotton (T_3)	112.65	6.40	20.55	68.17	5.48	9.98	15.46	46.83	7.34
F.berseem / onion / cotton (T_4)	112.73	6.47	21.16	74.53	5.93	10.85	16.78	47.95	7.69
LSD 0.05	NS	0.05	1.08	3.19	0.27	0.22	0.25	0.19	0.09
C.V.		0.90	5.86	5.06	5.43	2.43	1.78	0.46	1.36

Table (3): Effect of cropping systems on yield and yield components of onion (the first, the second seasons and the combined data of the two seasons).

Characters / Cropping systems	Bulb length (cm.)	Bulb diameter (cm.)	Weight of fresh bulb (gm.)	Yield of bulbs / fad (ton)
	First season			
Solid onion (T_2)	4.52	5.33	105.82	14.52
Onion+ cotton (T_3)	4.22	4.33	86.16	8.67
Fahl berseem / (onion+cotton)(T_4)	5.07	5.22	113.85	9.26
LSD 0.05	0.49	0.46	1.99	0.30
C.V.	8.00	7.05	1.47	2.08
	Second season			
Solid onion (T_2)	5.37	5.62	112.35	14.82
Onion+ cotton (T_3)	5.03	4.87	91.17	8.95
Fahl berseem / (onion+cotton)(T_4)	5.17	5.17	115.65	9.22
LSD 0.05	NS	0.35	2.13	0.25
C.V.		4.77	1.50	1.71
	Combined data of the two seasons			
Solid onion (T_2)	4.94	5.48	109.08	14.67
Onion+ cotton (T_3)	4.63	4.60	88.67	8.81
Fahl berseem / (onion+cotton)(T_4)	5.11	5.18	114.75	9.24
LSD 0.05	0.31	0.37	1.29	0.22
C.V.	7.31	8.42	1.43	2.33

4. Actual yield loss (AYL)

AYL had similarly trend to that of LER, aggressivity and CR. In particular, AYL of cotton and onion were positive in both intercropping systems. This indicated that the effect of cotton on onion was positive and also effect of onion on cotton was positive. The results also showed that AYL for cotton was higher than AYL of onion in the combined data of the two seasons. AYL values of cotton and onion when grown after Fahl berseem (T_4) was greater than after fallow (T_3). These indicate that increase in yield of cotton and onion when grown after Fahl berseem (T4) were 61.55 and 57.5% respectively (in the combined data of the two seasons). While the increase in yield of cotton and onion when grown after fallow (T_3) were 54.3 and 50.1% respectively (in the combined data of the two seasons). It is clear that the treatment which had higher LER had also higher AYL.

5. Intercropped advantage (IA):

IA is also considered as an indicator of the total economic feasibility of intercropping system. The data indicated that the more advantageous systems were in cotton grown after fallow (T_3) and grown after Fahl berseem (T_4) being +499.05 and 568.33 respectively in the combined data of the two seasons (Table 4). The facts that IA values were positive for treatments (T3 and T4) indicate that these intercropping systems had high economic advantage. These findings were also coincided with the results of the other competition indices (LER, CR and AYL). Ghosh (2004) found that when LER and AYL were high the economic feasibility IA had higher values.

6. Gross profit:

The gross profit in L.E for solid cotton, onion and cotton intercropped with onion are shown in (Table 4). Results cleared that the highest values (8396.50, 8506.50 and 8454.25 L.E) were observed by cotton intercropped with onion when grown after Fahl berseem (T_4) followed by cotton intercropped with onion grown after fallow (T_3) in both seasons and the combined data of the two seasons respectively. Solid cotton cultivated after berseem (T_1) the lowest values (5570.75, 5586.75 and 5578.75 L.E) in both seasons and the combined data of the two seasons respectively. These results are in agreement with those observed by El-Habbak *et al.* (1993), Abou-Keraisha (1998) and Zohry (2005).

Table (4): Effect of cropping systems on competitive relationships and gross profit in the first, second seasons and the combined data of the two seasons.

Characters / Treatment	Yield / fad.			Relative yield RY		LER	Agg		CR		AYL			IA			Gross profit L.E
	Cotton kintar	Onion ton	CLover ton	Cotton RYc	Onion RYo		Cotton	Onion	Cotton	Onion	Cotton	Onion	Total	Cotton	Onion	Total	
First season																	
Solid cotton (T_1)	7.94		26.75														5570.75
Solid onion (T_2)		14.52															5808.00
Fallow onion + cotton (T_3)	7.28	8.67		0.917	0.597	1.514	-0.280	+0.280	1.029	0.977	+0.529	+0.492	+1.021	+290.95	+196.8	+487.60	7476.00
F.berseem (onion + cotton) (T_4)	7.55	9.26	12.00	0.951	0.638	1.589	-0.318	+0.318	0.999	1.005	+0.585	+0.594	+1.179	+321.75	+237.6	+559.35	8396.50
Second season																	
Solid cotton (T_1)	7.92		27.35														5586.75
Solid onion (T_2)		14.82															5928.00
Fallow onion + cotton (T_3)	7.40	8.95		0.934	0.604	1.538	-0.278	+0.278	1.036	0.970	+0.557	+0.510	+1.067	+306.35	+204.0	+510.35	7650.00
F.berseem (onion+ cotton) (T_4)	7.82	9.22	11.50	0.987	0.623	1.610	-0.270	+0.270	1.062	0.945	+0.646	+0.555	+1.201	+355.30	+222.0	+577.30	8506.50
Combined data of the two seasons																	
Solid cotton (T_1)	7.93		27.05														5578.75
Solid onion (T_2)		14.67															5868.00
Fallow onion + cotton (T_3)	7.34	8.81		0.926	0.601	1.527	-0.279	+0.279	1.033	0.9735	+0.543	+0.501	+1.044	+298.65	+200.4	+499.05	7561.00
F.berseem (onion+ cotton) (T_4)	7.69	9.24	11.75	0.970	0.630	1.600	-0.294	+0.294	1.031	0.974	+0.6155	+0.575	+1.191	+338.53	+229.8	+568.33	8454.25

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تأثير بعض نظم الزراعة على المحصول ومكوناته للقطن والبصل

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أجريت التجربة بمحطة بحوث ملوى (مصر الوسطى) خلال الموسمين ٢٠٠٤/٢٠٠٥، ٢٠٠٥/٢٠٠٦ وذلك لدراسة تأثيربعض نظم الزراعة على المحصول ومكوناته للقطن والبصل ٠ وقد أستخدم تصميم قطاعات كاملة عشوائية فى ثلاث مكررات حيث زرعت نظم الزراعة الأربعة وهى زراعة كلا من القطن منفردا صنف جيزة ٨٣ بعد برسيم (٢ حشة) (م١) و البصل منفردا صنف جيزة ٦ محسن (م٢) و تحميل القطن على البصل بعد بور (م٣) و برسيم فحل قبل تحميل القطن على البصل (م٤)، وتوضح النتائج ما يلى:

ظهر أن محصول القطن المنزرع عقب برسيم أو برسيم فحل (م١، م٣) كان مرتفعا عن المنزرع عقب بور (م٣) ٠ كما أن محصول القطن والبصل المحمل بعد بور وأيضا مع برسيم فحل كان منخفضا بمقارنته بالمنفرد ٠ وكان النقص فى محصول القطن المحمل ٨,٣١ و ٤,٩١ % فى الموسم الأول، ٦,٥٧ و ١,٢٦ % فى الموسم الثانى، ٧,٤٤ و ٣,٠٣ % فى التحليل التجميعى للموسمين على التوالى٠ وأيضا كان النقص فى محصول البصل المحمل عن البصل المنفرد ٤٠,٢٩ و ٣٦,٢٣ % فى الموسم الأول ٣٩,٦١ و ٣٧,٧٩ % فى الموسم الثانى، ٣٩,٩٥ و ٣٧,٠١% فى التحليل التجميعى للموسمين على التوالى٠

كان معدل كفاءة استغلال الأرض ومعدل الفقد فى المحصول ومعدل التنافس والعائد النقدى مرتفعا عند زراعة البرسيم الفحل قبل زراعة القطن والبصل المحملين ٠ كما وضح أن القطن كان المحصول المسود والبصل كان هو المحصول السائد.