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EFFECT OF SOWING DATES ON YIELD AND QUALITY OF SOME SOYBEAN CULTIVARS

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ABSTRACT

The present investigation was carried out at the Agriculture Research Station, Faculty of Agriculture, Alexandria University in the summer seasons of 2005 and 2006, to investigate the influence of three sowing dates (April 10th, May 1st and May 20th) on seed yield and quality characters of six soybean cultivars, i.e., Crawford, Clark, Giza 21, Giza 35, Giza 111 and Giza 22.

Delaying sowing reduced seed yield/ ha of 12 kg/ ha by each day delay in sowing after April 10th. Seed protein and oil contents also decreased with delaying sowing beyond May 1st. Fatty acids composition was altered with delaying sowing where oleic and linoleic acid contents increased while that of linolenic acid decreased.

Variability between soybean cultivars was observed for seed yield and all quality characters. Cultivar Giza 111 produced the highest seed yield/ ha, but was low in protein and oil contents, and intermediate in oleic and linoleic acid contents. Significant sowing date × cultivar interaction was found for seed yield/ ha, oil content, total soluble fatty acids (T.S.F.A), linoleic and lionlenic acid contents. Also, a cultivar × season interaction was detected for seed yield/ plant, seed oil content, T.S.F.A, oleic and linoleic acid contents, indicating the environmental conditions influence on these characters.

Keywords: Soybean, Sowing date, cultivars, seed yield, quality characters.

INTRODUCTION

Soybean (*Glycine max* (Merr.)) is the world's most important oil crop whereas, in Egypt, its importance declined in the last two decades. Efforts are being directed towards the improvement of production practices to re-establish that crop, in the crop rotation, as one of the important oil crops in Egypt and to face the competition with other important summer crops such as cotton, rice and maize.

Planting date is an important production component that can be manipulated to obtain higher yields from soybean and to counter the adverse effects of environmental conditions during the growing season. Popp *et al.* (2002) reported that soybean seed yield in early planting (April and May) were generally higher than that from later plantings. They mentioned that plants would have passed critical reproduction stages before the onset of unfavorable environmental conditions at the end of the season. Board (2002) reported similar results and added that the main cause for lower yield at late planting dates is reduced day length, which results is suboptimal vegetative growth for optimum yield. Similar findings were reported by EL-Douby *et al.* (2002), Kumar *et al.* (2005), Kausale *et al.* (2004 and 2006) and Grichar *et al.* (2008) who found that early planting of soybean improved seed yield and yield attributes. Billore *et al.* (2000) added that the average soybean seed yield decreased linearly by 181.8 kg/ ha for every 5-days delay in sowing from normal date.

Several researches reported an impact of sowing date on oil content protein content and fatty acids composition. Shafshak *et al.* (1997), Billore *et al.* (2000) and EL-Douby *et al.* (2002) reported that delayed sowing generally reduced the protein and oil contents of soybean seeds. However, Shishodia and Singh (1995) found that seed oil content was decreased, while seed protein content was increased with delayed sowing. Moreover, Kumar *et al.* (2004) concluded that oleic acid content increased with delayed sowing, while linolenic acid content decreased with increasing number of days to maturity.

Cultivars is another important production component where yield is determined by the genetic make up of the cultivar and its interaction with the environmental conditions. RakChun (2002) reported cultivar differences among sowing dates on growth characteristics and yield components. Similarly, Schoffel *et al.* (2003) and Veni *et al.* (2003) found significant cultivar × sowing date interaction for seed yield/ ha and yield components. However, Singh and Hundal (2004) and Bruin and Pedersen (2008) reported insignificant cultivar × sowing date interaction for seed yield, but stated that maximum yields, for all cultivars, were obtained at early sowing dates followed by a consistent decline as planting date was delayed.

The objective of this study was to identify the components of soybean production encompassing sowing dates and cultivars that determine the productivity and quality characteristics of six soybean cultivars grown in Egypt.

MATERIALS AND METHODS

The present investigation was carried at the Agriculture Research Station, Alexandria University, Abbis, in the two summer seasons of 2005 and 2006, to study the effect of sowing dates on seed yield and quality characteristics of seeds in six soybean cultivars.

In each season, three sowing dates were used, i.e., April 10th (D_1), May 1st (D_2) and May 20th (D_3). The six cultivars used in both season of study were Crawford (V_1), Clark (V_2), Giza 21 (V_3), Giza 22 (V_6) and Giza 111 (V_5) from maturity group IV (115-120 days to maturity) and Giza 35 (V_4) from maturity group III (110-115 days to maturity).

The two experiments were laid out as a factorial experiment in a split plot design with four replications in each season. The three sowing dates were assigned to the main plots whereas the six cultivars were allocated to the subplots. Each subplot consisted of 12 ridges, four meters in length and 0.60 m in width (area of 28.8m^2). Cultivars were sown at the rate of 40 kg/ fad. in hills 20 cm apart and thinned to two plants per hill after three weeks from sowing. Seeds were inoculated with *BradyRhizobium japonicum* prior to sowing. Subplots were fertilized with 22.5 kg P_2O_5/ fad. during seedbed preparation (in the form of calcium superphosphate 15.5% P_2O_5), 60 kg N/ fad. in two split applications after three and five weeks from sowing (in the form of ammonium nitrate 33.5% N) and 24 kg K_2O/ fad. in a single dose after three weeks from sowing (in the form of potassium sulphate 48% K_2O). All other production practices were applied as recommended for soybean production in the region.

The recorded characters for each subplot were:

1- Seed yield per plant (g): as an average of ten random plants.
2- Seed yield (kg/ ha): Seed yield was calculated from the inner ten ridges then converted to yield per ha.
3- Seed protein content (%): using Kjeldahl method to obtain total N content then multiplying by a factor a 5.25 (A.O.A.C, 1980).
4- Seed oil content (%): using Soxhlet apparatus according to (A.O.A.C. 1980).
5- Total Saturted Fatty Acids (T.S.F.A %): using Gas Chromatography apparatus.

The analysis of variance and the test of homogeneity was performed on the two seasons data. It was found that error variance of the two seasons was not significantly different. Accordingly, the combined analysis over the two seasons and polynomial fitting equations were carried out, as outlined by Gomez and Gomez (1984), using SAS (Statistical Analyses System) ver. 8.1, 2001. Graphs were drawn and fitted to equation, using Curve Expt.

RESULTS AND DISCUSSION

A- Seed yield:

Analysis of variance for seed yield per plant and seed yield per ha (Table 1) indicated that both characters were significantly affected by planting dates and cultivars in both seasons. The two factors interaction was highly significant, for both characters, in the second season only.

Table (1): Means squares for analysis of variance of studied characters in 2005 and 2006 seasons:

Source of Variance	Degree of Freedom	Seed yield/ plant (g)		Seed yield/ ha (t)		Seed protein content (%)		Seed Oil content (%)	
		2005	2006	2005	2006	2005	2006	2005	2006
Replications	3	135.43	158.38	0.94	0.93	2.75*	26.04	1.09	4.29*
Sowing date (A)	2	391.96*	1657.90**	3.80*	9.194**	94.82**	138.39	59.75**	10.31**
Linear	1	**	**	*	**	**	n.s	**	n.s
Quadr.	1	n.s	**	n.s	**	n.s	*	n.s	*
Error (A)	6	55.69	53.10	0.49	0.24	0.446	36.70	0.69	0.84
Cultivars (B)	5	411.22**	218.39**	5.34**	3.08**	6.22**	41.81	14.91**	35.71**
A*B	10	70.92	81.31**	1.62	1.28**	0.96	29.10	2.23*	1.20
Error (B)	45	42.36	18.47	1.29	0.123	0.94	36.50	0.99	0.79

Table (1): Cont.

Source of Variance	Degree of Freedom	T.S.F.A (%)		Oleic acid content (%)		Linoleic acid content (%)		Linolenic acid content (%)	
		2005	2006	2005	2006	2005	2006	2005	2006
Replications	3	15.27	5.43	3.759	22.46	26.72	2.85	6.49	1.38
Sowing date (A)	2	82.54*	145.70**	78.88**	173.51**	292.60**	435.93**	2.76	36.43**
Linear	1	**	**	**	**	*	**	n.s	**
Quadr.	1	n.s	n.s	n.s	**	n.s	**	n.s	**
Error (A)	6	9.745	6.69	4.97	9.79	15.75	1.39	3.47	0.80
Cultivars (B)	5	86.83**	26.88**	107.00**	7.05	60.65**	45.92**	7.18	21.08**
A*B	10	4.29	14.99**	2.43	6.05	3.06	10.91**	3.00	5.25**
Error (B)	45	2.388	6.12	3.81	3.34	10.15	3.01	4.24	0.67

*, ** significant at 0.05 and 0.01 probability level, respectively.
n.s. = not significant

Moreover, partitioning of planting date variations indicated that the two characters were significantly influenced by the linear effect in both seasons and by the quadratic effect in the second season only. The significance of the linear effect in both seasons emphasizes the effect of sowing dates on those two characters, whereas the quadratic effect may be subjected to fluctuations in its effect due to environmental conditions prevailing within each season. In addition, combined analysis of variance for seed yield/ plant (Table 2) exhibited significant effects for seasons indicating the presence of significant variations in that trait from one season to another as influenced by environmental conditions. That may observed from the higher values for those traits in the first season compared to the second one (Table 3).

Table (2): Combined analysis of variance over the two seasons for seed yield, seed oil, T.S.F.A., oleic, linoliec and linolenic acid contents.

Source of variance	Degrees of Freedom	Means squraes					
		Seed yield/ plant (g)	Seed oil content (%)	T.S.F.A (%)	Oleic acid content (%)	Linoleic acid content (%)	Linolenic acid content (%)
Seasons (S)	1	1400.32**	11.85**	247.54**	2264.17**	1083.51**	6.25
R	6	146.91	2.69*	10.35	13.11	14.79	3.94
Sowing date (A)	2	1589.58**	28.59**	223.74**	232.34**	721.33**	21.51**
S*A	2	460.28**	41.21**	4.454	20.05	7.19	17.69**
Error (A)	12	54.39	0.76	8.22	7.38	8.57	2.13
Cultivars (B)	5	327.60**	21.93**	58.14**	45.96**	15.93*	22.04**
S*B	5	302.01**	28.69**	55.56**	68.09**	90.64**	6.22
A*B	10	95.60**	2.55**	5.62	3.91	7.15	3.57
S*A*B	10	56.63	0.89	13.67**	4.51	6.83	4.68*
Error (B)	90	30.42	0.89	4.28	3.57	6.58	2.46

*, ** significant at 0.05 and 0.01 probability level, respectively.

Means of seed yield/ plant and seed yield/ ha, presented in (Table 3), revealed that the earliest sowing date (April 10th) gave the highest values, for both traits, in the two seasons. Delaying sowing beyond that date tended to decrease both characters, insignificantly or significantly, in both seasons of study. With regard to seed yield/ ha, regression equations (Fig 1) indicated that seed yield decreased by 12 kg/ ha for each day delay in sowing beyond April 10th in 2005 season. In 2006 season, an insignificant increase may be observed with delaying sowing date to May 1st followed by a sharp and significant decrease when sowing was carried out on May 20th. These findings were in agreement with those reported by Billore *et al.* (2000), Motta *et al.* (2000), Hassan *et al.* (2002), Suryawanashi *et al.* (2004) and Bastidas *et al.* (2009) who concluded that seed yield and yield components decreased with delaying sowing date. They attributed that decrease to reduced vegetative growth period, due to reduced day length with delayed sowing, resulting in suboptimal vegetative growth for optimum yield and yield components. Singh and Hundal (2004) added that delayed sowing dates of soybean plants resulted in lower leaf area index (LAI) and (PAR) interception compared to earlier sowings, which may cause the suboptimal vegetative

growth of plants and reduction of yield. Bastidas *et al.* (2009) reported that delaying of sowing after May 1st led to significant linear seed yield declines of 40.8 and 103.2 kg/ ha/ day in two seasons, respectively.

Figure (1): Relationship between sowing dates* and Seed yield/ ha (kg), Seed protein (%) and Oil content (%) in 2005 and 2006 summer seasons.

Season	(a) Seed yield/ ha (ton)	(b) Seed protein (%)	(c) Oil (%)
2005	S.E= 0.1309 R^2 = 0.555 ŷ = 1.956 - 0.0081 X**	S.E= 0.457 R^2 = 0.937 ŷ = 37.74 – 0.0989 X**	S.E= 0.387 R^2 = 0.927 ŷ=25.091 – 0.078 X**
2006	S.E= 0.1167 R^2 = 0.81 ŷ = 1.697+ 0.0213X** - 0.000768X^{2**}	S.E= 2.35 R^2 = 0.480 ŷ = 40.88 + 0.3294 X – 0.00847X*	S.E= 0.576 R^2 = 0.534 ŷ=23.508+ 0.1177X -0.0026X^{2*}

* On X-axis:
0.0 = April 10th (D_1) 20= May 1st (D_2) 40 = May 20th (D_3)

Cultivars exhibited significant differences, as an average of the three sowing dates, for those traits (Table 3). The data indicated that Giza 111 gave the highest seed yield/ plant in 2005 season while Clark cultivar recorded the lowest value for that trait. However, in 2006 season, five cultivars, i.e., Crawford, Clark, Giza 21, Giza 35 and Giza 111 recorded statistically equal values for seed yield/ plant and were significantly higher than the value recorded for Giza 22 cultivars. That differential response of cultivars to seasonal environmental variations was clearly highlighted in the significant S×B component of variance (Table 2) and that was reported by several researchers (DongKwan *et al.*, 2008 and Bastidas *et al.*, 2009).

Significance of interaction indicated that cultivars were responded differently to delaying of sowing in the same season for both characters. Means for sowing date × cultivar interaction (Table 3) revealed that cultivars Crawford, Clark and Giza 21 suffered continuous significant or insignificant decrease in both characters, with each delay in sowing date. On the other

hand, cultivars Giza 35, Giza 111 and Giza 22 recorded an significant or insignificant increase, in both characters with delaying sowing date to May 1st then suffered a significant decrease with delaying sowing to May 20th. That type of response implies the necessity to determine an optimum sowing date for each cultivar, or group of cultivars, suitable for its genetic makeup and its response to environmental conditions to achieve the optimal yield. These findings were in accordance with those reported by Schoffel *et al.* (2003),Veni *et al.* (2003), HagSin *et al.* (2006) and DongKwan *et al.* (2008). However, Singh and Hundal (2004) and Bruin and Pedersen (2008) reported insignificant sowing date × cultivar interaction and that may be attributed to different soybean varieties used in their studies and different environmental conditions affecting the experimental sites.

Table (3): Means for studied characters as influenced by sowing dates, cultivars and their interaction in 2005 and 2006 seasons:

Factor	Seed yield/ plant (g)			Seed yield/ ha (t)		Seed protein content (%)	
	2005	2006	Comb.	2005	2006	2005	2006
	Sowing Date						
D_1	47.24a	41.31a	44.28a	4.66a	4.07a	37.64a	40.88a
D_2	41.45b	41.25a	41.39a	4.38a	4.36a	35.98b	43.68a
D_3	39.46b	26.88b	33.17b	3.87b	3.18b	33.68c	38.90a
	Cultivars						
V_1	38.93bc	39.13a	39.029bc	3.60bc	4.18a	35.56bc	40.03a
V_2	34.56c	35.89a	35.225c	3.49c	3.66b	36.37ab	42.54a
V_3	40.86bc	39.11a	39.985ab	4.12abc	4.13a	35.39bc	41.17a
V_4	48.25a	39.07a	43.660a	4.73abc	4.15a	36.73a	42.37a
V_5	50.18a	37.52a	43.850a	5.08a	4.18a	34.71c	42.83a
V_6	43.52ab	28.18b	35.847bc	4.80ab	2.92c	35.83ab	38.00a
	Sowing Date * Cultivars						
D_1*V_1	44.42	48.73	46.574	3.93	4.99	37.53	38.11
D_1*V_2	35.43	46.65	41.039	3.80	4.66	37.98	43.18
D_1*V_3	51.71	46.63	49.166	5.30	4.48	36.70	38.13
D_1*V_4	56.29	41.35	48.822	5.68	4.01	38.50	39.43
D_1*V_5	50.72	36.23	43.473	5.05	3.49	36.80	39.36
D_1*V_6	44.88	28.30	36.588	4.20	2.90	38.33	37.36
D_2*V_1	36.80	42.45	39.626	3.37	4.54	35.36	38.86
D_2*V_2	35.67	36.83	36.248	3.88	3.69	37.13	39.75
D_2*V_3	39.96	43.20	41.578	3.94	4.86	35.55	39.90
D_2*V_4	44.91	44.83	44.869	4.33	4.73	36.98	41.39
D_2*V_5	49.75	44.43	47.089	5.04	4.86	34.70	40.74
D_2*V_6	41.61	35.75	38.677	5.77	3.49	36.13	38.34
D_3*V_1	35.58	26.20	30.887	3.50	3.00	33.78	36.41
D_3*V_2	32.58	24.20	28.388	2.78	2.73	34.00	35.44
D_3*V_3	30.93	27.50	29.213	3.14	3.06	33.93	36.81
D_3*V_4	43.55	31.03	37.288	4.17	3.70	34.70	37.83
D_3*V_5	50.08	31.90	40.989	5.16	4.19	32.63	36.21
D_3*V_6	44.08	20.48	32.275	4.48	2.37	33.05	35.05
$L.S.D_{0.05}$	—(2)	6.12	5.48	1.62	0.50	—	---

(1) **Means followed by the same letter are not significant, but different letters are not significant**

(2) **The ignored L.S.D. indicates that (D×V) interaction was not significant.**

Table (3): Cont.

Factor	Seed oil content (%)			T.S.F.A (%)			Oleic acid content (%)		
	2005	2006	Comb.	2005	2006	Comb.	2005	2006	Comb.
	Sowing Date								
D_1	24.98a	23.51b	24.25a	17.96b	19.99b	18.98b	29.13b	21.25b	25.19b
D_2	23.74a	24.80a	24.27a	19.75ab	22.33ab	21.04ab	30.88ab	21.63ab	26.25ab
D_3	21.85b	23.98ab	22.92b	21.67a	24.92a	23.29a	32.75a	26.08a	29.42a
	Cultivars								
V_1	25.19a	24.65b	24.92a	24.25a	21.40bc	22.83a	27.42c	23.50a	25.46b
V_2	23.08cd	25.93a	24.50ab	21.50b	23.58ab	22.54ab	29.67b	22.33a	26.00b
V_3	24.34ab	23.93b	24.13b	18.08cd	24.33a	21.21bc	30.08b	22.42a	26.25b
V_4	22.70cd	22.25c	22.56c	18.50cd	22.67abc	20.58c	34.83a	23.00a	28.92a
V_5	23.68bc	21.80c	22.74c	16.83d	20.17c	18.50d	34.33a	22.42a	28.38a
V_6	22.16d	25.87a	24.01b	19.58c	22.33abc	20.96c	29.17bc	24.25a	26.71b
	Sowing Date * Cultivars								
D_1*V_1	26.40	23.70	25.05	23.50	16.95	20.23	25.25	22.50	23.88
D_1*V_2	25.05	26.03	25.54	18.75	20.50	19.63	28.25	21.50	24.88
D_1*V_3	25.75	23.00	24.38	16.25	21.25	18.75	28.00	19.25	23.63
D_1*V_4	23.93	21.45	22.69	16.25	22.25	19.25	33.25	20.25	26.75
D_1*V_5	25.38	21.25	23.31	15.00	19.50	17.25	33.25	21.25	27.25
D_1*V_6	23.40	25.63	24.51	18.00	19.50	18.75	26.75	22.75	24.75
D_2*V_1	25.86	25.38	25.63	25.25	22.00	23.63	26.50	21.75	24.13
D_2*V_2	21.76	25.85	23.81	21.50.	24.25	22.88	30.00	21.25	25.63
D_2*V_3	24.65	24.45	24.55	17.25	26.25	21.75	30.75	21.25	26.00
D_2*V_4	23.03	23.45	23.24	18.25	22.25	20.25	34.75	22.00	28.38
D_2*V_5	24.60	22.70	23.65	16.50	19.25	17.88	34.25	19.50	26.88
D_2*V_6	22.53	27.00	24.76	19.75	20.00	19.88	29.00	24.00	26.50
D_3*V_1	23.30	24.86	24.09	24.00	25.25	24.63	30.50	26.25	28.38
D_3*V_2	22.43	25.90	24.46	24.25	26.00	25.13	30.75	24.25	27.50
D_3*V_3	22.63	24.33	23.48	20.75	25.50	23.13	31.50	26.75	29.13
D_3*V_4	21.15	22.38	21.76	21.00	23.50	22.25	36.50	26.75	31.63
D_3*V_5	21.05	21.45	21.25	19.00	21.75	20.38	35.50	26.50	31.00
D_3*V_6	20.55	24.98	22.76	21.00	27.50	24.25	31.75	26.00	28.88
$L.S.D_{0.05}$	1.42	—(2)	0.94	—	3.52	—	—	—	—

(1) **Means followed by the same letter are not significant, but different letters are not significant**

(2) **The ignored L.S.D. indicates that (D×V) interaction was not significant.**

B- Quality characters:

Analysis of variance (Table 1) indicated that all studied quality characters, i.e., seed protein and oil contents, seed oil content, total saturated fatty acids (T.S.F.A), oleic acid, linoleic acid and linolenic acid contents were significantly affected by sowing dates and cultivars in both seasons, except seed protein content in 2006 season and linolenic acid content in 2005 season (for both studied factors), and oleic acid content in 2006 season as affected by cultivars. Moreover, the sowing date × cultivar interaction was significant for seed oil content in 2005 season, and for T.S.F.A., linoleic and linolenic acid contents in 2006 seasons. Combined analysis of variance (Table 2) revealed significant effects for seasons on seed oil content, T.S.F.A., oleic acid and linolenic acid contents, where mean values for these characters varied from one season to the other (Table 3). Schnebly and Fehr (1993) reported significant differences among years, planting dates within the same year and for fatty acid composition in seeds of ten soybean genotypes.

Table (3): Cont.

Factor	Linoleic acid content			Linolenic acid content		
	2005	2006	Comb.	2005	2006	Comb.
	Sowing Date					
D_1	47.08.a	53.21a	50.15a	5.46a	5.58.a	5.52.a
D_2	44.46ab	50.17b	47.31.b	4.92a	6.67a	5.79.a
D_3	40.17b	44.79.c	42.48c	4.83.a	4.21b	4.52.b
	Cultivars					
V_1	42.08.c	51.67a	46.88ab	4.75a	3.50d	4.13d
V_2	44.33.abc	49.67b	47.00a	4.00a	4.42c	4.21cd
V_3	47.08.a	46.92c	47.00a	4.67a	6.33ab	5.50ab
V_4	41.33.c	48.67bc	45.00b	5.08a	5.67b	5.38bc
V_5	42.75bc	51.58a	47.17a	5.92a	5.83b	5.88ab
V_6	45.83ab	47.83bc	46.83ab	6.00a	7.17a	6.58a
	Sowing Date * Cultivars					
D_1*V_1	46.25	56.25	51.25	5.00	4.50	4.75
D_1*V_2	48.00	52.75	50.38	3.50	5.25	4.38
D_1*V_3	50.00	52.25	51.13	5.75	7.25	6.50
D_1*V_4	44.50	51.50	48.00	6.00	6.00	6.00
D_1*V_5	45.00	54.75	49.88	6.00	4.50	5.25
D_1*V_6	48.75	51.75	50.25	6.50	6.00	6.25
D_2*V_1	42.75	52.75	47.75	5.50	3.50	4.50
D_2*V_2	45.00	50.00	47.50	3.50	4.50	4.00
D_2*V_3	46.75	45.50	46.13	5.00	7.00	6.00
D_2*V_4	42.50	49.00	45.75	4.75	6.75	5.75
D_2*V_5	43.75	52.75	48.25	5.50	8.50	7.00
D_2*V_6	46.00	51.00	48.50	5.25	9.75	7.50
D_3*V_1	37.25	46.00	41.63	3.75	2.50	3.13
D_3*V_2	40.00	46.25	43.13	5.00	3.50	4.25
D_3*V_3	44.50	43.00	43.75	3.25	4.75	4.00
D_3*V_4	37.00	45.50	41.25	4.50	4.25	4.38
D_3*V_5	39.500	47.25	43.38	6.25	4.50	5.38
D_3*V_6	42.75	40.75	41.75	6.25	5.75	6.00
$L.S.D_{0.05}$	—(2)	2.47	—	—	1.16	—

(1) Means followed by the same letter are not significant, but different letters are not significant

(2) The ignored L.S.D. indicates that (D×V) interaction was not significant.

With regard to the effect of sowing dates on quality characters of the six soybean cultivars, means presented in (Table 3) indicated that seed protein content decreased significantly, in the first year, with delaying sowing dates, while it was insignificantly affected in the second year. Data from (Fig 1) showed that seed protein content decreased linearly, in 2005 season, by about 0.09% for every day delay in sowing beyond April 10th. Robinson *et al.* (2009) reported variable response of seed protein content, in three soybean cultivars, with different seasons and attributed that to the environmental conditions prevailing in each season. Meanwhile, Shishodia and Singh (1995), Shafshak *et al.* (1997), Billore *et al.* (2000) and EL-Douby *et al.* (2002) reported that seed protein content decreased with delayed sowing dates. A similar trend was observed for seed oil content, where D_1 and D_2

gave significantly higher values for that character, in the first season, compared to D_3, whereas D_2 was significantly superior to D_1 and D_3 in the second season.

From (Fig 1) it could be noticed that seed oil content, in 2005 season, decreased linearly by about 0.06% for every day delay in sowing beyond April 10th. Robinson *et al.* (2009) reported a decrease in mean oil of about 12 g/ kg as planting date was delayed, whereas Karaaslan (2008) found variations in seed oil percent as influenced by seasonal environmental conditions. On the other hand, total saturated fatty acids (T.S.F.A.) and oleic acid content increased significantly with delaying sowing from D_1 to D_3, while linoleic acid content and linolenic acid content decreased significantly with delaying sowing. Kumar *et al.* (2004) and Ray *et al.* (2008) reported similar results, whereas, Oliva *et al.* (2006) concluded that seed development at higher temperatures (late sowing dates) resulted insignificant decreases in linoleic and linolenic acid contents and a significant increase in oleic acid content. They added that changing the proportions of these fatty acids in soybean seed to increase oleic acid and reduce linolenic acid will enhance food, fuel and other applications of the oil.

Concerning the performance of the six soybean cultivars, overall sowing dates, with regard to the studied quality characters, means presented in (Table 3) showed variability for quality characters among cultivars. Giza 35 exhibited the highest seed protein content (in 2005 season) while Crawford produced the highest values, combined over the two seasons, for seed oil content and total saturated fatty acids. Meanwhile, Giza 35 and Giza 111 cultivars had the lowest content of oleic acid, Crawford and Giza 35 had the highest contents of linoleic acid, and Giza 22 had the highest content of linolenic acid, combined over the two seasons. Similar findings were reported by Carrao-Panizzi and Erhan (2003).

With regard to sowing date × cultivar interaction for quality characters, data in (Table 3) revealed variable response of cultivars, either in magnitude or direction, to the three sowing dates. For seed oil content (in 2005 season), all cultivars showed progressive decrease with delaying sowing date, except Clark which exhibited a slight increase from D_1 to D_2 and a sharp decrease from D_2 to D_3. An opposite trend was observed for T.S.F.A. in 2006 season, where all cultivars showed an incremental increase from D_1 to D_3, except Giza 21 which showed a significant increase from D_1 to D_2 followed by a slight decrease from D_2 to D_3. Concerning linoleic acid content (in 2006 season), all cultivars showed a progressive decrease with delaying sowing date from D_1 to D_2 to D_3 but differed in the magnitude of that reduction. Finally, for linolenic acid content (in 2006 season), Giza 21 cultivar exhibited an insignificant decrease from D_1 to D_2 followed by a significant decrease from D_2 to D_3. On the other hand, cultivars Giza 35, Giza 111 and Giza 22 showed a significant increase in linolenic acid content from D_1 to D_2 followed by a significant reduction from D_2 to D_3. Karaaslan (2008) and Ray *et al.* (2008) reported significant sowing dates × cultivar interaction effects over oleic acid linoleic acid contents, in addition to oil and linolenic acid contents.

In conclusion, the results obtained from this investigation revealed that the appropriate sowing date for soybean, in Egypt, should not be later than May 1st because delaying sowing beyond that date led to substantial reductions in both yield and quality characteristics of seeds. In addition, early sowing improved the fatty acid composition of oil with regard to oleic, linoleic and linolenic acid contents which may enhance the use of soybean oil for healthy foods, fuel and other applications. Giza 111 cultivar was the highest yielding cultivar, but was of low protein and oil contents, in addition to low linolenic acid content and intermediate in oleic and linoleic acid contents. Improvement of protein and oil contents of that cultivar, through breeding programs, may encourage its cultivation and use for industrial purposes.

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تأثير ميعاد الزراعة على محصول البذور وصفات الجودة فى بعض أصناف فول الصويا

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أجريت تجربتان حقليتان بمحطة البحوث الزراعية – بكلية الزراعة- جامعة الإسكندرية فى الموسم الصيفى لعامى ٢٠٠٥ و ٢٠٠٦ لدراسة تأثير ثلاثة مواعيد زراعة (١٠ ابريل و ١ مايو و ٢٠ مايو) على محصول البذور وصفات الجودة لستة أصناف من فول الصويا هى كراوفورد، كلارك ، جيزة ٢١ ، جيزة ٣٥ ، جيزة ١١١ وجيزة ٢٢ .

أظهرت النتائج أن التأخير فى ميعاد الزراعة عن ١٠ ابريل أدى إلى انخفاض معنوى فى المحصول البذرى بمقدار ١٢ كجم / هكتار عن كل يوم تاخير بالإضافة إلى نقص محتوى البذور من البروتين والزيت والحامض الأمينى الليلنويك فى الزراعة المتأخرة عن الأول من مايو فى حين زاد محتوى البذور من الأحماض الدهنية الأوليك واللينوليك.

كذلك شوهدت اختلافات معنوية بين الأصناف فى المحصول البذرى وكل صفات الجودة المدروسة، وأعطى الصنف جيزة ١١١ أعلا محصول بذرى وأقل محتوى من البروتين والزيت وكان ذو قيمة متوسطة فى الأحماض الدهنية الأوليك واللينوليك.

كما وجدت تأثيرات معنوية للتفاعل بين مواعيد الزراعة والأصناف فى المحصول البذرى/ هكتار، نسبة الزيت، الأحماض الدهنية، عدا الأوليك من ناحية أخرى كان التفاعل بين الصنف × الموسم معنوى لكل من محصول البذور/ نبات، نسبة الزيت، الاحماض الدهنية المشبعة (الأوليك واللينوليك) مما يشير إلى تأثر تلك الصفات بالظروف البيئية.