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Effect of Sowing Date and Nitrogen Fertilization Level on Growth and Productivity of Some Durum and Bread Wheat Varieties

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ABSTRACT

Two field experiments were conducted during the winter seasons of 2013/2014 and 2014/2015 at the Agricultural Research Station, Faculty of Agriculture, Alexandria University, Egypt, to study the response of two durum (Sohag 3 and Karim) and two bread (Misr1 and Casino) wheat varieties to three sowing dates (November 1st, November 15th and December 1st) and two nitrogen fertilization levels (95.2 and 190.4 kg N/ha). The experimental design was a split- split plot, with five replications, and the main, sub-and sub-sub- plots were assigned to sowing dates, nitrogen levels and varieties, respectively.

The November 15th sowing date was the most suitable sowing date which gave the highest values for phonological characters and grain yield and its components, whereas, December 1st showed an apparent increase in grain protein content, compared to the two other sowing dates. Increasing N fertilization level from 95.2 to 190.4 kg N/ha significantly increased all phonological traits, grain yield and its components and grain protein content characters. Misr1 variety was superior to the other cultivars in phonological characters and grain yield and its components, except for the number of spikes/m^2, harvest index and protein content where Sohag 3 showed significantly higher values than the other varieties. The three-factor interaction was insignificant, while, the two-factor interactions, D*N, V*D and V*N were significant for different characters in the two seasons. The best combination of the three factors for grain yield was Misr1, sown on November 15th and fertilized with 190.4 kg N/ha.

Key words: Wheat, Sowing date, N fertilization, Grain yield.

INTRODUCTION

Wheat (*Triticum* sp.) is the most important cereal crop in the world and Egypt, both in area and production. There is a need for increasing wheat productivity to cover the increase in consumption demand. Due to limited arable area and irrigation supply, an increase of productivity per unit land area is a necessity. That could be achieved through both management of a cultural practices, especially sowing date and nitrogen fertilization, and sowing of wheat cultivars superior in grain yield and quality characteristics.

Sowing date is an important factor that affects phenophases and grain yield and its components of wheat (Kiss *et al.*, 2013). Longer vegetative growth period, due to sowing at optimal date, resulted in higher radiation use efficiency and better dry matter mobilizahon (Sun *et al.,* 2013) and, hence, higher values for grain yield and its components (Eslami et *al.,* 2014 and Anwar *et al*., 2015). Sowing date may, also, have an impact on quality characters of wheat, especially protein content. Late sowing of wheat, compared to optimal sowing date, severely reduced protein content of wheat grains (Hussain *et al.,* 2015).

Nitrogen is an important macronutrient that affects vegetative growth of wheat plants (Tranaviciene *et al.,* 2007), wheat physiological indices, crop growth rate and leaf area index (Waraicha *et al.,* 2007), grain yield and its components of wheat (Ali *et al.,* 2011). The effect of nitrogen will depend on rate and time of application, in addition to the response of sown cultivar to the applied nitrogen. Several researchers reported that increasing N level led to an increase in grain yield and yield components (Shah *et al*, 2011 and Iqbal *et al.,* 2012), plant height (Kouzegaran *et al*., 2015) and grain protein content (Youssef *et al*., 2013 and Blandino *et al*., 2015). Benin *et al*. (2012) reported genetic variability for wheat cultivars in response to added rates of nitrogen fertilization, while, Enayat *et al*. (2013) reported variations in grain protein content of wheat cultivar with rate of applied N.

The objectives of the present study were the determination of optimal sowing date and N fertilization level for different wheat genotypes, including durum and bread wheat cultivars.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Research Station, Alexandria University, Alexandria, Egypt, during the two consecutive winter

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seasons of 2013/2014 and 2014/2015. The objectives were to investigate the influence of sowing date (November 1st, November 15th and December 1st), nitrogen fertilization levels (95.2 and 190.4 kg N/ha) on phenological, grain yield and its components and grain protein content characters of two durum (*Triticum turgidum* ssp *durum*); i.e., Sohag 3, an Egyptian cultivar, and Karim Libyan variety and two bread wheat (*T. aestivum*); i.e. Misr 1 an Egyptian cultivar and Casino Libyan variety.

Soil, at the experimental site, was clay, with pH 7.97, available N= 0.01, available P= 2.53, available K= 16.65, E.C.= 0.46 dS/m and organic matter = 1.52%, as an average of the two seasons. Nitrogen rates were applied in two equal doses, at sowing and tillering stages, as ammonium nitrate (33.5% N). Seeding rate, for all varieties, was 142.8 kg/ha. All other a cultural practices were applied, as recommended, for wheat production in the region.

Experimental design, in both seasons, was a randomized complete block, one with five replications in a split-split-plot arrangement. The main plots were assigned to the three sowing dates, the sub- plots included the two nitrogen fertilization levels, whereas, the sub-sub-plots included the four wheat genotypes. Sub-sub-plot size was 7.2 m^2 (8 rows × 0.3m width × 3m length). Sowing method was hand drill. The studied characters were plant height (cm), spike length (cm), number of spikelets/spike, number of spikes/ m^2, number of grains/spike, 1000- grain weight (g), grain yield (t/ha), biological yield (t/ha), harvest index (%) and grain protein content (%).

Data were statistically analyzed, according to Gomez and Gomez (1984). Means were compared, using the least significant difference (L.S.D.) at 0.05 level of probability.

RESULTS AND DISCUSSION

1- Effect of sowing date:

Earlier or later sowing dates significantly or insignificantly, decreased plant height, spike length and number of spikelets/spike, compared to the recommended sowing date of November 15th (Table 1). The later date gave 108.6 and 106.1 cm, 10.68 and 11.06 cm and 19.12 and 18.92 for plant height, spike length and number of spikelets/spike, in the first and second seasons, respectively. It is evident that sowing wheat at suboptimal dates affected plant establishment and growth. Early sowing subjected the wheat plants to high soil temperature, higher than optimal, resulting in restriction of proper growth of wheat plants. On the other hand, later sowing of wheat subjected the grains to low soil temperatures causing poor emergence, and high temperatures at the end of season, which might adversely affect reproductive growth stage. Ouda *et al*. (2005) and Upadhyay *et al.* (2015) reported that earlier sowing of wheat, at optimal date, resulted in better growth of wheat plants and higher phenological traits.

Protein content of wheat grains showed a reversible and significant trend to sowing dates. Delaying sowing showed an apparent increase in protein content, whereas sowing on December 1st gave protein contents of 13.18 and 13.35%, in the two successive seasons. Late sowing caused a reduction in dry matter accumulation in wheat plant due to shorter growth period and reduced vegetative growth of plant, hence, lower amounts of photosynthates, translocated to grains. That resulted in lower carbohydrate content in the grain and an apparent increase in the grain protein content. Similar findings were reported by Duary and Yaduraju (2006).

With regard to grain yield and its attributes, results, presented in Table (2), demonstrated that delaying sowing, or early sowing, significantly decreased all studied grain yield and its components, compared to the recommended sowing date of November 15th. Such date gave 540.2 and 564.4, 58.9 and 59.24, 60.88 and 60.13g, 5.49 and 5.59 t/ha, 13.19 and 12.10 t/ha, and 42.10 and 42.64% for number of spikes/m^2, number of grains/spike, 1000- grain weight, grain yield, biological yield and harvest index in the two successive seasons.

Sowing at mid-November enhanced plant growth, through avoiding restrictive conditions for earlier or later sowing (unsuitable soil temperature and heat stress at reproductive stage), thus, improving dry matter production, accumulation and translocation to the sink (grains), resulting in higher biological and grain yields. Similar results were obtained by Wajid *et al*. (2004), Malik *et al*. (2009) and Said *et al*. (2012).

2- Effect of N fertilization level:

Results in (Tables1and 2) further revealed significant increase in all phenological, protein and yield characters with increasing N fertilization level from 95.2 to 190.4 kg N/ha in the two seasons. That could be attributed to the role, played by nitrogen, as an important macronutrient, in enhancing plant growth and dry matter production through improved photosynthesis, which was expressed in higher grain yield components, especially number of spikes/m^2, 1000-grain weight and improved spikelets fertility, resulting in increased number of grains/spike, and finally higher biological and grain yields. In addition, nitrogen is an essential component in protein synthesis in plant, thus, increasing N fertilization would lead to an increase in grain protein content. These finding, were in accordance with those reported by Ali *et al*. (2011), Enayat *et al*. (2013) Youssef *et al*. (2013) and Shajaripour and Mojaddam (2014).

3- Effect of varieties:

Varieties in the present study, included two durum wheats (Sohag 3 and Karim) and two bread wheat (Misr 1 and Casino). Means, presented in (Tables 1 and 2), indicated that Misr 1 was significantly superior to the other varieties in almost all studied phenological and grain yield characters in the two seasons except number of spikes/ m^2. However, Sohag 3 durum variety showed significantly higher grain protein content in both seasons, whereas Karim showed higher protein content only in the first season. That could be due to the higher content of starch in bread wheat varieties compared to durum wheat varieties. Variations in measured characters among wheat varieties might be attributed to the genetic constitution of the variety and the fact that they were of different botanical groups, i.e. tetraploids for durum and hexaploids for bread wheat varieties. Variation among wheat varieties were reported by several researches (Tahir *et al*., 2009; Gul *et al*., 2012; Lak *et al*., 2013 and Upadhyay *et al*., 2015).

4- Effect of two- factor interactions:

Since the second-order interaction, i.e. sowing dates × N fertilization levels × variety, was insignificant for all studied traits, it was imperative to present the effect of first-order interactions on studied wheat characters. The sowing dates × N fertilization levels (D×N) interaction was significant, in the two seasons (Table 3), for number of spikes/m^2, 1000- grain weight, grain and biological yields, and grain protein content, whereas it was significant for plant height and number of grains/spike in the second season only (Tables 1 and 2). Regarding plant height and grain and biological yields, increase in the values of these traits, with increasing N level in plants sown on November 15th was higher than those for earlier or later sowing dates (Table 3). That might be due to the better plant establishment and growth in that date which permitted the plants to fully benefit from higher application of nitrogen.

On the other hand, rate of increases in number of grains/spike, number of sipkes/m^2 and 1000-grain weight, with increasing N level, was higher for earlier and later sowing dates than November 15th. That indicates the influence of higher N rates to remedy the adverse effects of environmental conditions on wheat plant, in those dates, compared to the recommended date. Concerning grain protein content, later sowing date (November 1st) showed higher increase rate in that character, compared to late sowing (December 1) with increasing N fertilization level (Table 3). That could be due to the ability of late-sown plants to benefit from increased N level, compared to late- sown plants which are subjected to shorter growing season, due to higher temperatures late in the season, which limits their ability to efficiently use the applied rates of N to synthesize protein.

Table 1. Means of plant height, spike length, number of spikelets/ spike and protein content as affected by the studied factors and their interactions in the two seasons

Treatments	Plant height (cm)		Spike length (cm)		No. of spikelets/ spike		Protein content (%)	
	S1[(1)]	S2	S1	S2	S1	S2	S1	S2
Sowing dates (D)								
1/11	105.4 b[(2)]	105.1 a	10.36 a	10.56 a	16.82 b	16.10 b	11.53 c	11.64 c
15/11	108.6 a	106.1 a	10.68 a	11.06 a	19.12 a	18.92 a	11.76 b	11.97 b
1/12	92.8 c	90.4 b	8.54 b	9.03 b	14.17 c	14.36 c	13.18 a	13.35 a
N levels (kg/ha)								
95.2	84.13 b	83.24 b	8.74 b	8.74 b	15.25 b	13.92 b	11.60 b	11.62 b
190.4	120.40 a	117.98 a	10.98 a	12.01 a	18.16 a	19.0 a	12.70 a	13.02 a
Varieties (V)								
Sohag 3	96.3 c	93.4 b	9.64 b	9.46 b	16.43 b	16.22 b	13.06 a	13.48 a
Casino	106.1 b	108.1 a	10.06 b	11.02 a	16.32 b	16.11 b	10.92 c	10.83 d
Misr 1	116.4 a	113.8 a	11.46 a	11.92 a	18.64 a	18.86 a	11.67 b	12.01 c
Karim	90.3 d	87.1 c	8.28 c	8.46 b	15.43 b	14.65 c	12.98 a	12.96 b
Interactions								
D × N	ns[(4)]	*[(3)]	ns	ns	ns	ns	*	**
D × V	ns	ns	ns	ns	ns	ns	**	*
N × V	*	ns	ns	ns	ns	ns	*	**
D × V × N	ns	ns	ns	ns	ns	ns	ns	ns

[(1)] S1=2013-2014, S2=2014-2015

[(2)] Means followed by the same letters are not significantly different at 0.05 level of probability.

[(3)] *, ** significant at 0.05 and 0.01 levels. [(4)] ns = not significant.

Table 2. Means of number of spikes/ m^{-2}, number of grains/spike, 1000-grain weight, grain yield, biological yield and harvest index as affected by the studied factors and their interactions in the two seasons

Treatments	No. of spikes/ m^2		No. of grains/ spike		1000-grain weight (g)		Grain yield (ton/ ha)		Biological yield (ton/ ha)		Harvest index (%)	
	S1[1]	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Sowing dates (D)												
1/11	486.7 b[2]	430.4 b	50.12 b	49.78 b	55.69 b	56.26 b	4.62 b	4.74 b	11.19 b	11.72 b	41.28 a	40.44 a
15/11	540.2 a	564.4 a	58.90 a	59.24 a	60.88 a	60.13 a	5.49 a	5.49 a	13.19 a	12.10 a	42.10 a	42.64 a
1/12	370.1 c	361.4 c	46.44 c	43.33 c	49.82 c	47.65 c	3.44 c	3.49 c	9.61 c	11.11 b	36.31 b	34.11 b
N levels (kg/ha)												
95.2	342.2 b	308.0 b	43.50 b	40.86 b	51.17 b	49.22 b	3.12 b	3.44 b	8.79 b	10.08 b	35.49 b	34.12 b
190.4	589.1 a	596.2 a	60.14 a	60.70 a	59.76a	60.14 a	5.94 a	5.68 a	13.77 a	13.20 a	43.13 a	43.03 a
Varieties (V)												
Sohag 3	498.9 a	539.0 a	52.38 c	51.16 c	56.13ab	54.60ab	4.92 ab	5.11 ab	11.44 b	12.42 b	43.02 a	41.14 a
Casino	414.9 d	369.3 d	55.76 b	56.24 b	55.01ab	54.42ab	4.47 b	4.33 b	11.70 b	10.84 c	38.20 b	39.94ab
Misr 1	468.1 c	401.9 c	59.46 a	58.88 a	56.82a	57.22 a	5.16 a	5.39 a	13.67 a	14.77 a	37.74 b	36.49 b
Karim	480.8 b	498.1 b	39.68 d	36.85 d	53..90b	52.49 b	3.58 c	3.42 c	8.31 c	8.54 d	43.08 a	40.04ab
Interactions												
D × N	**[3]	*	ns	*	**	**	*	**	**	*	ns	ns
D × V	ns[4]	ns	*	**	ns	ns	ns	ns	ns	ns	ns	ns
N × V	*	*	ns	ns	ns	ns	*	*	ns	*	ns	ns
D × V × N	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

[1] S1=2013-2014, S2=2014-2015

[2] Means followed by the same letters are not significantly different at 0.05 level of probability.

[3] *, ** significant at 0.05 and 0.01 levels.

[4] ns = not significant

Table 3. Means of studied characters as affected by date of sowing × N level (D×N) interaction in the two seasons

Sowing dates	Nitrogen levels (kg/ha)	Plant height (cm)	No. of grains/ spike	No. of spikes/ m^2		1000-grain weight (g)		Grain yield (ton/ ha)		Biological yield (ton/ ha)		Protein content (%)	
		S2[1]	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
1/11	95.2	91.90 d[2]	39.69 e	374.25 e	256.23 e	50.91 e	51.70 c	3.19 e	3.67 d	8.41 d	9.62 c	11.07 d	10.48 e
	190.4	118.38 b	59.87 b	599.17 b	604.63 b	60.47 b	60.82 b	6.05 b	5.81 b	13.97 b	13.82 a	11.99 c	12.80 b
15/11	95.2	84.18 e	51.96 d	433.84 d	457.92 d	57.37 c	56.08 c	4.07 d	3.68 d	10.46 c	9.82 bc	11.17 d	11.61 d
	190.4	128.38 a	66.52 a	646.56 a	670.92 a	64.39 a	64.18 a	6.91 a	6.64 a	15.62 a	14.38 a	12.35 b	12.33 c
1/12	95.2	73.66 f	30.95 f	218.55 f	209.86 f	45.22 f	39.88 d	2.12 f	2.99 c	7.50 d	10.82bc	12.59 b	12.86 b
	190.4	107.18 c	55.71 c	521.69 c	512.90 c	54.42 d	55.42 c	4.86 c	4.59 c	11.72 c	11.40 b	13.77 a	13.92 a

[1] S1=2013-2014, S2=2014-2015

[2] Means followed by the same letters are not significantly different at 0.05 level of probability.

These results were in accordance with those reported by El- Gizawy (2009), Ferrise *et al*. (2010), Dagash *et al*. (2014) and Alghabari and Al- Solaimani (2015) who reported differential response of wheat plant to N fertilization level at different sowing dates.

Concerning sowing dates × variety (D×V) interaction (Table 4), it was significant for number of grains/spike and grain protein content in the two seasons. For number of grains/spike, Sohag 3 showed progressive increase in that character with delaying sowing date from November 1st to December 1st, whereas, the other three varieties showed a significant increase from November 1st to November 15th, then that character significantly decreased with delaying sowing to December 1st. The same trend of differential response of varieties to sowing date, was observed in grain protein content, where as both durum varieties (Sohag 3 and Karim) showed progressive increase in that character with delaying sowing from November 1st to December 1st. On the other hand, grain protein content of Casino, bread wheat variety, decreased with delaying sowing, while Misr 1 showed significant decrease in that character with delayed sowing from November 1st to November 15th, then, exhibited significant increase when sowing was delayed to December 1st. Similar findings were reported by Amrawat *et al*. (2013), Costa *et al*. (2013) and Munsif *et al.* (2015). \

With regard to N fertilization level × variety (N×V) interaction (Table 5), it was significant for number of spikes/m^2, grain yield and grain protein content in the two seasons, while, it was significant only for plant height, in the first season, and biological yield in the second season. Durum wheat varieties showed higher response to increased N fertilization level, compared to bread wheat varieties. Regarding number of spikes/m^2, all varieties showed significant increase in that character with increasing N fertilization level from 95.2 to 190.4 kg N/ha, but, with different magnitudes in the two seasons. Misr 1 exhibited the highest and significant response in grain yield to increased N level, in the two seasons, whereas, Sohag 3 showed the lowest response to increase N fertilization level. With regard to biological yield, both Sohag 3 and Casino exhibited higher magnitude of response, whereas, Misr 1 and Karim were lower in their response to increased N fertilization level. Wheat cultivars, also, showed differential response to increasing N level in grain protein content, where it was high for Sohag 3, intermediate for Misr 1 and low for Casino and Karim, in the two seasons. Similar findings were reported by Ali *et al.* (2005), Bakht *et al.* (2010) and Alves *et al.* (2015) who attributed the variation in response to increasing N fertilization level, in wheat varieties, to the ability of the genetic constitution of the variety to benefit from the amount of N applied in relation to environmental conditions.

Table 4. Means of number of grain/ spike and protein content as affected by sowing date × variety (D×V) interaction in the two seasons

Sowing dates	Varieties	No. grains/spike		Protein content (%)	
		S1[(1)]	S2	S1	S2
1/11	Sohag 3	48.27 e [(2)]	46.52 e	11.24 d	11.93 de
	Casino	50.43 de	55.62 c	11.55 d	11.19 ef
	Misr 1	56.27 c	64.18 b	11.28 d	12.03 d
	Karim	45.51 f	32.80 f	12.05 c	11.41 e
15/11	Sohag 3	52.74 d	50.39 d	13.0 b	12.84 c
	Casino	68.62 a	67.94 a	10.73 f	10.72 f
	Misr 1	64.13 b	67.30 a	11.09 e	11.03 ef
	Karim	50.11e	51.33 d	12.22 c	13.29 c
1/12	Sohag 3	56.13 c	56.57 c	14.84 a	15.67 a
	Casino	48.23 ef	45.16 e	10.57 f	10.58 f
	Misr 1	57.98 c	45.17 e	12.64 c	12.97 c
	Karim	23.42 g	26.42 g	14.67 a	14.34 b

(1) S1=2013-2014, S2=2014-2015

(2) Means followed by the same letters are not significantly different at 0.05 level of probability.

Table 5. Means of studied characters as affected by N level × variety (N×V) interaction in the two seasons

Nitrogen levels (kg/ha)	Varieties	Plant height (cm)	No. of spikes/ m^2		Grain yield (ton/ ha)		biological yield (ton/ ha)	Protein content %	
		S1[1]	S1	S2	S1	S2	S2	S1	S2
95.2	Sohag 3	71.75 f [2]	311.31 g	437.56 e	3.81 d	4.24 c	10.76 d	11.65c	11.96c
	Casino	92.92 e	340.86 f	185.62 h	3.22de	3.30 d	8.97 e	11.43c	9.95 e
	Misr 1	103.59d	335.36 f	223.56 g	3.44de	3.80cd	13.32 bc	10.42d	12.25c
	Karim	68.26 f	381.31 e	385.28 f	2.03 e	2.44 d	7.29 f	12.96b	12.25c
190.4	Sohag 3	120.87 b	686.61 a	640.36 a	6.03 b	5.98 b	14.08 b	14.47a	15.0 a
	Casino	119.24 b	488.98 d	553.02 d	5.72bc	5.36 b	12.71 c	10.41d	11.71d
	Misr 1	129.13 a	600.88 b	580.24 c	6.88 a	6.98 a	16.22 a	12.92b	11.77d
	Karim	112.36 c	580.17 c	610.98 b	5.13 c	4.40 c	9.79 de	13.0 b	13.67b

[1] S1=2013-2014, S2=2014-2015

[2] Means followed by the same letter are not significantly different at 0.05 level of probability.

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الملخص العربي

تأثير ميعاد الزراعة ومستوي التسميد النتروجينى علي نمو وإنتاجيه بعض أصناف قمح المكرونه والخبز

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أجريت تجربتان حقليتان خلال الموسمين الشتويين ٢٠١٣/٢٠١٤ ، ٢٠١٤/٢٠١٥ – بمحطة البحوث الزراعية بكلية الزراعة(الشاطبى)– جامعة الاسكندرية لدراسة استجابة صنفي قمح المكرونة (سوهاج ٣، كريم) وصنفي قمح الخبز (مصر١، كاسينو) لثلاثة مواعيد للزراعة (أول نوفمبر، منتصف نوفمبر، أول ديسمبر) ومستويين من التسميد النتروجيني (٩٥،٢، ١٩٠،٤ كجم ن/هكتار) وذلك باستخدام تصميم القطع المنشقة مرتين في خمس مكررات، حيث وزعت مواعيد الزراعة عشوائياً على القطع الرئيسية، ومستويات السماد النتروجيني على القطع الفرعية وأصناف القمح التي تم دراستها على القطع تحت الفرعية. وقد أوضحت النتائج أن الزراعة في منتصف نوفمبر كانت الأفضل حيث أعطت أعلى القيم في الصفات الخضرية، ومحصول الحبوب ومكوناته، بينما أدت الزراعة في أول ديسمبر إلى زيادة محتوى الحبة من البروتين مقارنة بموعدى الزراعة الآخرين.

كذلك فأن زيادة مستوى التسميد النتروجيني من ٩٥،٢ إلى ١٩٠،٤ كجم ن/هكتار أدت إلى زيادة معنوية في جميع الصفات التي تم دراستها.

من ناحية أخرى، فأن النتائج أوضحت تفوق صنف القمح "مصر١" في جميع الصفات تحت الدراسة عدا عدد السنابل بالمتر المربع ودليل الحصاد ومحتوى الحبة من البروتين حيث أظهر الصنف "سوهاج ٣" تفوقاً في هذه الصفات.

ولم تتأثر الصفات التي تم دراستها معنوياً بالتفاعل الثلاث بين العوامل الثلاثة تحت الدراسة، في حين تأثرت معنوياً بالتفاعلات الثنائية(مواعيد الزراعة × مستويات السماد النيتروجيني، مواعيد الزراعة × الأصناف، ومستويات السماد النتروجيني × الأصناف) في كلا موسمى الدراسة حيث أدت زراعة الصنف "مصر ١" في منتصف نوفمبر وكذلك التسميد بمعدل ١٩٠,٤ كجم ن/هكتار لإنتاج أعلى محصول من الحبوب.