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RESPONSE OF WHEAT (*Triticum aestivum*) TO SEED RATES AND STIGMASTEROL

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ABSTRACT

This work was carried out at the Kafr-Hakim, Giza, Egypt, during the two successive seasons of 1997 and 1998. The field experiments were carried out to study the effect of seed rates and stigmasterol as foliar spray on growth characters, yield and chemical constituents of wheat plants (*Triticum aestivum* L.).

The data revealed that seed rate in combination with stigmasterol had significant positive effects at most levels on growth parameters. However, no significant effect on yield components. Moreover, the maximum values of growth and yield were obtained as a result of the interaction between seed rate at 70kg/fed and foliar spray of stigmasterol at 200 ppm.

Application of seed rate at 80kg/fed, with stigmasterol at 150 increased nitrogen, protein and phosphors content in produced grains. Total sugars and total soluble sugars reached maximum values as a result of seed rate at 70 kg/fed, with stigmasterol at 100 ppm.

Keywords: Wheat, *Triticum Aestivum,* seed-rates, stigmasterol, growth, yield, chemical constituents.

INTRODUCTION

Wheat is the leading food crop in the world farming. It occupies over 50% of the crop area under all grain cultures. Wheat is the main food crop for the nations living in the temperate zone. Its yield is affected by competitive stress among the plants competition which occurred as the plant growth required water, nutrients, light, carbon dioxide and oxygen from their environment. Plants exhibit extreme plasticity in response for their size and form to the available space (Donald, 1963).

It is desirable to define quantitative relationship between plant densities, plant growth regulator (stigmasterol) and crop yield. Shaukat *et al.* (1997) reported that wheat sown on 3 sowing rates and eight different plant geometries gave the greatest seedling emergence, tiller numbers and biological yield in 30 cm rows and with the highest sowing rate 150 kg seed/ha. Fontes *et al.,* (2000) and Bairwa *et al* (2000) reported that the yield of wheat decreased with increasing seed rates and the better results were obtained with normal sowing raes.

Stigmasterol (SG) is recently known to stimulate many aspects of plant growth and development as, Malgorzata and Zdzislaw (1984) found that metabolism of stigmasterol and aclysterylglucosides took place mainly in cotyledons while Sterylesters metabolism occurred mainly in the roots. Gondet *et al.* (1994), reported that sterols accumulation in tissue were present on sterylesters. The esterification process allowed regulation of the amount of free sterols in membrane cell.

Dogra and Kaur (1994) indicated that characters of wheat such as root and shoot length, dry weight and germination percent were increased by application of steroid treatments, especially low concentrations more than higher concentrations. Alpha amylase, catalase and peroxidase activities were increased. Renu and Thukrai (1994) reported that soluble sugar and starch contents on grains of wheat were increased at low concentration of steroid. Vardhini and Rao (1998) mentioned that brassionsteroids enhanced levels of proteins and carbohydrates. Abd-El-Wahed *et al.* (2000) found that all vegetative growth characters and total sugars of maize increased with increasing concentrations of stigmasterol.

The objective of this study was to determine the effect of plant densities and stigmasterol on competitive stress among wheat plants and chemical constituents of produced grains.

MATERIALS AND METHODS

The field experiment was carried out on sandy soil at Kafr-Hakim Farm, Giza, Egypt in 1997/98 and 1998/99 seasons to study the effect of seeding rates and growth regulator (Stigmasterol) on growth, yield and chemical constituents of produced grains. Seeding rates were as follows : 60, 70, and 80 kg/fed. The sowing method was drill in rows 4 meters long and 25 cm apart.

The growth regulator treatments consisted of three concentrations of stigmasterol (Stigmasta-5, 22- Diene –3B-OL; (24S)-24- Ethylcholesta-5, 22 Diene-3B-OL) which were 100, 150 and 200 ppm in addition to control (distilled water). Growth regulator treatments was applied as foliar spray at two equal doses by the same concentrations during vegetative stage (30 days after sowing). The second application of stigmasterol was at grain milky stage. This growth regulator was purchased from Merk Co.

The experiment was arranged as split plot design, keeping sowing rates in main plots and stigmasterol treatments in subplots replicated three times. Wheat grains, cultivar, Sakha 69 were sown on 15 and 17 of November in 1997 and 1998 seasons, respectively. During the previous year, Calcium superphosphate (15.5 P_2O_5%) was added presowing at 100 kg/fed, Ammonium nitrate (33.5% N) at 100 kg N/fed. was applied at three equal doses at the first, third and fiveth irrigation. Potassium sulfate (48-52% K_2O) at the rate of 50 kg/fed. was added at two equal doses at the first and third irrigations.

The following data were recorded at heading : Plant height, tillers number/m^2, spikes number/m^2, spike length, flage leaf area and spike dry weight. Whereas, at the harvest stage only, the following data were measured; spikelets number/spike, grains number/spike, 1000 grain weight/g, grain yield kg/fed, straw weight kg/fed, harvest index as well as crop index.

Chemical constituents analysis of the produced grains : Grains samples from all treatments were dried at 70 ^oC for constant weight and ground to determine the following chemical constituents : Nitrogen and protein percentage according to the method of A.O.A.C. (1970) and protein percentage was calculated by multiplying the value of total nitrogen content by 5.70. Total sugars and total soluble sugars were determined colorimetrically according to the method described by Dubois *et al.* (1956). Phosphorus percentage was determined according to the method described by Troug and Mayer, (1939).

Combined analysis for data of the two seasons and the values of LSD. were calculated as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Growth characters :

The response to seeding rates and stigmasterol (ST) on the growth characters of wheat is presented in Table 1 (a and b). It is evident from the data presented in Table 1 (a) that significant increment in mean values of plant height at the heading and harvest stages, due to seeding rates. On the other hand, spraying with stigmasterol alone or combined with seeds rate, did not cause any significant variation in the obtained parameters of growth during the heading and harvest. These results could be in agreement with those obtained by Johnson *et al.* (1988) and Sharann and Abd El-Samie (1999). In addition, Abd El-Gawad *et al.* (1985) and Xie *et al.* (1998) found that plant height of wheat was increased with increasing seeding rate.

Table (1a): Effect of seeding rates and stigmasterol concentration on plant height, tillers number and spikes number of wheat plants.

Stigmasterol treatments (ppm)	Seeding rates Kg/fed							
	60	70	80	Mean	60	70	80	Mean
	Heading			Plant height (cm)			Harvest	
Control	81.70	88.30	89.70	86.57	103.30	94.30	94.00	97.20
100 ppm	90.00	94.30	93.30	92.53	106.30	98.30	95.70	100.10
150 ppm	86.70	93.70	91.30	90.57	104.30	94.70	93.00	97.33
200 ppm	87.70	90.30	89.70	89.23	103.00	91.00	94.70	96.23
Mean	86.53	91.65	91.00	---	104.23	94.58	94.35	---
	Tillers number $(m)^2$							
Control	713	808	575	698.67	818	1033	825	892
100 ppm	724	867	617	736.00	863	1167	832	954
150 ppm	757	1025	658	813.33	1108	1225	839	105.33
200 ppm	1080	1233	673	995.33	1136	1508	673	1105.67
Mean	818.50	983.25	630.75	---	981.25	1233.25	792.25	---
	Spikes number $(m)^2$							
Control	384.1	558.3	284.3	408.9	785	808	559	717.33
100 ppm	389.7	725.0	318.9	477.87	841	916	615	790.67
150 ppm	417.5	891.7	332.8	547.33	1041	1008	638	895.67
200 ppm	562.2	900.0	520.0	660.73	1041	1383	700	1041.33
Mean	438.38	768.75	364.0	---	927	1028.75	628	----

LSD at 5% for:	Plant height		Tillers number		Spikes number	
	Head.	Harv.	Head.	Harv.	Head.	Harv.
Seeding rates (a)	4.68	3.33	142.55	145.93	NS	179.05
Spray (b)	N.S	N.S	164.60	168.50	NS	NS
A x b	N.S	N.S	N.S	291.85	NS	NS

Table 1(b) : Effect of seeding rates and stigmasterol concentrations on spike length, spike dry weight, flage leaf area and spikelets numbers of wheat plants.

Stigmasterol treatments (ppm)	Seeding rates Kg/fed							
	60	70	80	Mean	60	70	80	Mean
	Heading			Spike length (cm)			Harvest	
Control	14.5	14.8	15.7	15.00	15.9	15.8	16.5	16.07
100 ppm	15.0	15.0	16.3	15.43	17.4	16.2	17.1	16.90
150 ppm	15.3	15.8	16.8	15.97	18.6	19.1	18.0	18.57
200 ppm	14.7	14.8	16.5	15.33	18.3	18.0	17.7	18.00
Mean	14.88	15.1	16.33	---	17.55	17.28	17.33	----
	Spike dry weight/g							
Control	0.67	0.67	0.75	0.70	0.75	1.10	1.39	1.08
100 ppm	0.76	0.74	0.91	0.80	1.66	1.16	1.41	1.41
150 ppm	0.77	0.88	0.92	0.86	1.67	1.27	1.56	1.50
200 ppm	0.83	0.91	0.94	0.90	1.44	1.10	1.49	1.34
Mean	0.76	0.80	0.89	---	1.38	1.16	1.46	---
	Flage leaf area/cm^2				Spikelets number/spike			
Control	13.2	14.6	21.4	16.40	10.8	11.1	11.8	11.23
100 ppm	16.5	16.9	22.0	18.47	12.9	12.1	13.3	12.77
150 ppm	15.3	19.3	23.9	19.50	16.3	12.5	15.1	14.63
200 ppm	14.7	14.8	22.1	17.20	16.5	12.3	17.3	15.37
Mean	14.93	16.40	22.35	---	14.13	12.00	14.38	---

LSD at 5% for:	**Spike length**		**Spike dry weight**		**Flage leaf area**	**Spikelets number/spike**
	Head.	**Harv.**	**Head.**	**Harv.**		
Seeding rates (a)	0.9	NS	NS	0.21	2.28	1.29
Spray (b)	NS	0.96	0.12	0.25	2.63	1.49
a x b	NS	1.43	NS	0.43	4.55	2.57

It was also noticed that all treatments of seeding rates and stigmasterol or combined with each other led to significant increases in tillers number at harvest stage. However, the interaction between seeding rates and stigmasterol was non-significant at heading stage. The most promising effect was noticed with seeding rates at 70 kg/fed, and ST at 200 ppm at the two stages, the maximum value of tillers number in this respect recorded 983.25 and 995.33 at the heading stage, as well as 1233.25 and 1105.67 at the harvest stage respectively. Similar results were also reported by Dogra and Kaur (1994), Vireshwar Singh and Panwar (1995) and Upadhyay and Tiwari (1996).

Regarding spikes number/m^2 of wheat, data in Table 1 (a) show that spikes number was non significant as result of stigmasterol alone or in combination with seeding rates. However, seeding rates caused a significant increase in spikes number during harvest stage. The increase in spike number might be attributed to more number of effective tillers.

The data in Table 1(b) revealed that seeding rates gave significant increases in the spike length at heading stage, spike dry weight at harvest stage as well as spikelets number/spike. On the other hand, seeding rates did not reach the level of significant in spike length at harvest stage and spike dry weight at heading stage. Moreover, spike length, spike dry weight and spikelets number/spike were significantly increased at harvest stage with stigmasterol and, or interaction with seeding rates. However, stigmasterol treatments alone, also the interaction with seeds rate did not result in any significant variation in spike length and spike dry weight at heading stage, except treatment with stigmasterol at heading stage on spike dry weight.

The data in the same table indicated that, flag leaf area was significantly enhanced by both seeding rates and stigmasterol as well as their combination. The maximum values in this respect were obtained with seed rate of 80 kg/fed, followed by stigmastrol at 150 ppm respectively. These results are in agreement with those obtained by Johnson *et al.* (1988) and Sharaan and Abd El-Samie (1999) on wheat. Moreover, the favourable effect of stigmasterol on growth characters of wheat plants in Table (1 and 2) could be attributed to the stimulated action of stigmasterol on the phytohormones, such as auxin and cytokinins which in turn induced cell elongation and division and consequently increased growth of plant organs. This interpretation was supported by Gregory and Mandava (1982) as they concluded that the application of brassinosteroid to intact plant such as lettuce, cucumber, mustard and wheat contributed auxins and cytokinins to stimulate growth of whole plants. In addition, Braun and Wild (1984 a and b) concluded that the promoting effect of brassinosteroid on vegetative growth characters could be attributed to the stimulation of cell elongation and division. The present could be in accordance with that results obtained by Prusakova *et al.* (1995) who reported that foliar application of synthetic brassinosteroid to wheat plant at beginning of flowering increased the length of main spike, the number of spikelets /spike, the weight of grains/spike and grain yield.

Yield components :

The data in Table (2) revealed that the effect of seeding rates combined with stigmasterol on grain yield components. There is no significant differences between the effect of treatments seeding rates and stigmasterol on grain number spike, 1000 grains weight and straw weight. On the other hand, grains yield, harvest index and crop index were significantly enhanced by both seeding rates and stigmasterol. Regarding the spray with stigmasterol, the highest mean values of yield components were obtained as a result of treatments 200 ppm followed by 150 and 100 ppm compared with control. Previous studies confirmed the present obtained positive response to the folair application of barssionsteroid on different plants species, e.g. wheat (Ahmed and Shalaby, 1994) and on barely (Shalaby and Ahmed, 1994, Prusakova *et al.,* 1995 and Kurapov *et al.,* 1996). In addition, the increase in yield and its components attributed by foliar application of stigmasterol might be due that, the stigmasterol enhanced photosynthetic apparatus, growth parameters, cell division and enzymatic activity (Kalinich *et al.* 1985, Wang-Sangen and Wang, 1997 and Steven and Jenneth 1998).

Table (2) : Effect of seeding rates and stigmasterol concnetrations on grains, number/spike, 1000 grains weight, grain yield

kg/fed., straw weight kg/fed., harvest index and crop index of wheat plants.

Stigmasterol treatment (ppm)	Seeding rates Kg/fed							
	60	**70**	**80**	**Mean**	**60**	**70**	**80**	**Mean**
	Grains number/spike				**1000/grain weight/gm**			
Control	16.6	20.6	24.9	20.70	30.5	30.3	30.3	30.37
100 ppm	22.7	22.8	24.9	23.47	30.6	40.0	30.5	30.70
150 ppm	27.8	24.0	25.3	25.70	30.6	40.1	40.0	36.90
200 ppm	24.6	24.1	30.6	26.43	40.0	40.4	40.5	40.30
Mean	22.93	22.88	26.43	---	32.93	37.7	35.33	---
	Grains yield (kg/fed).				**Straw weight (kg/fed).**			
Control	1999	2032	1782	1937.67	3159	3713	3189	3353.67
100 ppm	2234	2266	1972	2157.33	3598	3801	3431	3610.0
150 ppm	2704	2363	2402	2489.67	3662	3913	3514	3696.33
200 ppm	2673	2659	2668	2666.67	3844	3980	3835	3886.33
Mean	2402.5	2330	2206	---	3565.75	3851.75	3492.25	---
	Harvest index				**Crop index**			
Control	38.76	35.37	35.85	36.66	63.29	54.73	55.88	57.97
100 ppm	38.30	37.35	36.50	37.38	62.08	59.61	57.48	59.72
150 ppm	42.48	37.65	40.60	40.24	73.85	60.39	68.35	67.53
200 ppm	41.02	40.05	41.03	40.70	69.54	66.82	69.58	68.65
Mean	40.14	37.61	38.50	---	67.19	60.39	62.82	----

LSD at 5% for:	Grains number	100/grains weight	Grain yield (kg/fed)	Straw weight	Harvest index	Crop index
Seeding rates (a)	NS	NS	292.7	NS	0.988	2.35
Spray (b)	NS	NS	338.00	NS	1.140	2.71
a x b	NS	NS	585.5	NS	1.976	4.70

Concerning the effect of seeding rates on yield components of wheat, it is evident from the data presented in the same table, the application of seeds rate at 80 kg/fed, led to considerable increases in grains number/spike. Whereas, the most promising increases in 1000 grain weight/g and straw weight kg/fed was noticed with seeding rates at 70 kg/fed compared with other seeding rates treatments. On the other hand, the grain yield kg/fed and harvest index as well as crop index decreased with increasing seeding rates. While the highest values of these parameters were resulted from the lowest seeding rate 60 kg/fed. These results are in agreement with those obtained by Johnson *et al.* (1988) and Mosalem (1993) working on wheat as they found that, grain yield and 1000 grain weight were decreased with increasing seeding rate. Whereas, Abd EL-Gawad *et al.* (1986) and Abd El-Latif and El-Tuhamy (1986) found that wheat yield was increased with increasing seeding rate. On the other hand grains yield kg/fed, harvest index and crop index were decreased with increasing seeding rates. These results agreed with those obtained by Mosalem (1993) who found that sowing wheat at rate of 80 kg/fed compared to 60 kg/fed reduced the aforementioned traits. These reductions might be attributed to high plant density, the plants suffered from competition for light and nutrients due to narrow spacing, and produced more infertile tillers as well as having small sink capacity and low dry matter accumulation rate.

Chemical constituents :

The data given in Table (3) show that the interaction between seeding rates and stigmasterol for nitrogen percentage, protein and phosphorus as well as total sugars, soluble and non soluble sugars on grain wheat indicated that, seeding rate at 80 kg/fed, at treatment 150 ppm of stigmastrol gave the maximum values of N% and protein % as compared with other treatments. In addition, the maximum values of phosphorus was obtained as a result of seeding rate of 70 kg/fed and stigmasterol at 150 ppm. On the other hand, using seeding rates at 70 kg/fed, gave the best results of total sugars 59.49% and non soluble sugars 57.46%, while the highest values of soluble sugars was obtained from seeding rate at 60 kg/fed.

Table (3) : Effect of seeding rates and stigmasterol concentrations on nitrogen, protein, phosphor, total sugars, total soluble sugars and non soluble sugars percent of wheat grains.

Stigmasterol treatments (ppm)	**Seedling rates kg/fed.**							
	60	**70**	**80**	**Mean**	**60**	**70**	**80**	**Mean**
	Nitrogen %				**Protein %**			
Control	1.71	1.77	1.93	108	9.75	10.09	11.00	10.28
R	100	100.	100	100	100	100	100	100
100 ppm	1.82	1.78	1.99	1.86	10.37	10.15	11.34	10.62
R	106.	101	103	103	106	101.	103	103
150 ppm	2.15	2.00	2.03	2.06	12.26	11.40	11.57	11.74
R	126	113	105	114	126	113	105	114
200 ppm	2.05	1.85	2.12	2.01	11.69	10.55	12.08	11.44
R	120	105	110	112	120	105	110	111
Mean	1.93	1.85	2.02		11.02	10.55	11.50	
R	113	105	105		113.03	105	105	
	Phosphorus %				**Total Sugar**			
Control	0.37	0.42	0.40	0.40	57.03	68.81	55.84	60.56
R	100	100	100	100	100	100	100	100
100 ppm	0.36	0.42	0.39	0.39	59.08	73.06	51.59	61.24
R	94	100	98	0.98	104	106	92	101
150 ppm	0.41	0.46	0.49	0.45	54.93	50.19	63.54	56.22
R	111	110	123	113	96	73	114	97
200 ppm	0.38	0.49	0.43	0.42	40.04	45.91	46.80	44.25
R	103	117	108	105	70	67	84	73
Mean	0.38	0.45	0.43		52.77	59.49	54.45	
R	103	107	108		93	87	98	
	Total soluble sugars %				**Non-soluble sugars %**			
Control	1.67	2.44	1.00	0.70	55.36	66.37	54.84	58.86
R	100	100	100	100	100	100	100	100
100 ppm	2.95	1.75	1.95	2.22	56.13	71.30	49.64	59.03
R	177	72	195	130	101	107	91	100
150 ppm	2.76	1.70	1.71	2.06	52.17	48.49	61.83	54.17
R	165	70	171	121	94	73	113	92
200 ppm	1.36	2.26	1.47	1.7	38.68	43.65	45.33	42.55
R	81	93	147	100	70	66	83	72
Mean	2.19	2.04	1.53		50.59	57.46	52.91	
R	131.	84	153		91	87	97	

R= Relative to control

Moreover, applications of stigmasterol at 100 ppm resulted in increments in the total sugars, soluble sugars and non soluble sugars percent, compared with other treatments. It might be concluded that the increases in protein and total sugars in wheat grains, which plants treated with stigmasterol. It might be mention, that Kalinich *et al.* (1985) reported that treatment with brassinosteroid significantly increased RNA and DNA polymerase activities and the synthesis of RNA, DNA and protein in bean and mung bean. In addition, Petzold *et al.* (1992) found that brassinosteroids promoted sucrose uptake in faba bean plant and this probably due to the activation of modulation of H* ATP.

From the above mentioned results, it can be concluded that the application of different concentrations of stigmasterol, resulted in pronounced increases in growth characters, yield components and some chemical constituents (nitrogen, protein, total sugars and soluble sugars percentage in the produced grains). However, most of the previous characteristics, were decreased by increasing seeding rate from 60 to 80 kg/fed. Similar results were obtained by other authors e.g. Renu *et al.* (1994) on wheat and Abd El-Wahed *et al.* (2000) on maize .

REFERENCES

Abd El-Gawad, A.A.; Abo Shetaia, A.M. and Edris, A.S. (1985). Potential productivity of wheat in Egypt. 1. Yield and yield attributes of certain wheat cultivars. Annals Agric. Sci., Fac. Agric. Ain Shams Univ., Cairo, 30 (2) : 815-833.

Abd El-Gawad, A.A.; Tabbakh, A.E. El.; Edris, A.S. and Abo Shetaia, A.M. (1986). Potential productivity of wheat in Egypt. III. Effect of seeding rates on yield and its components. Annals Agric. Sci., Fac. Agric., Ain Shams Univ., Cairo, 31 (2) : 1173-1182.

Abd El-Latif, L.L. and El-Tuhamy, M.K. (1986). Effect of nitrogen fertilization levels and seeding rates on growth and yield of wheat. Annals Agric. Sci., Fac. Agric., Ain Shams Univ., Cairo, 31 (1) : 265-272.

Abd El-Wahed, M.S., Amin, A.A. and Ali, Z.A. (2000). Effect of different concentrations of stigmasterol on growth, yield and its components of maize plants. Jour. Agric. Sci. Mansoura Univ., Egypt, 25 (1) 201-215.

Ahmed, M.A. and Shalaby, M.A.F. (1994). Yield response of wheat plants growth, promoters; brassinosteriods under some complete foliar fertilizer compounds. Egypt. J. Appl. Sci., 9 (10) : 104-117.

A.O.A.C. (1970). Kjeldahl nitrogen determination "Official Methods of Analysis of Association Agriculture Chemists". 11th Ed. Assoc. Official Agric. Chemists, Washington.

Bairwa, O.P.; Dadheech, R.C. andSumeriya, H.K. (2000). Effect of seed rate, methods of sowing and varieties on yield, N,P and K uptake and economics in wheat (*Triticum aestivum* L.). Annals of Biology, 16 (1) 75-78.

Braun, P. and Wild, A. (1984a). The influence of Brassionsteroids, a growth promoting steroidal lactone on development and carbon dioxide fixation capacity of intact wheat and mustard seedling. In Advances in Photosynthesis. Res., Proc. 6th Congr. Photosynthsis C. Sybesma. 3 : 461-464. The Hage Nijhoff.

Braun, P. and Wild, A. (1984 b). The influene of brassinosteriods on growth and parameters of photosynthesis of wheat and mustard plants. J. Plant Physiol., 16 : 189-196.

Dogra, R. and Kaur, A. (1994). Effect of steroids on some growth and biochemical parameters of *Triticum aestivum* during germination. Crop Research Hisar, 8, (3) 611-620.

Donald, C.M.C. (1963) : Competition among crop and pasture plants. Adv. Agron., 159, 1-118.

Dubois, M.; Gilles, K.S.; Hamibition, J.; Rebers, R. and Smith, F. (1956). Colorimetric methods for determination of sugar and related substances. Anal. Chem. 28 : 350.

Fontes, J.R.M.; Cardoso, A.A.; Souza, M.A.D.E. and Cruz, C.D. (2000). Relationship of spacing and sowing rate to yield and other agronomic characteristics of wheat. Revista Ceres, 47 (269) 61-73.

Gondet, L.; Bronner, R. and Benveniste, P. (1994). Regulation of sterol content in membranes by subcellular compartmentation of steryl esters accumulating in sterol overproducing tobacco mutant. Plant Physiol., 85 (2) 509-518.

Gregory, L.E. and Mandava, N.B. (1982). The activity and interaction of brassinolide and gibberellic acid in mung bean epictoyls. Physiol. Plant 53 : 239-243.

Johnson, J.W.; Hargrowe, W.L. and Moss, R.B. (1988). Optimizing row spacing and seeding rate for soft red winter wheat. Agron. J., 80 (2) : 1027-1030.

Kalinich, J.F., Mandava, N.B. and Todhunter, J.H. (1985). Relationship of nucleic acid metabolism to brassinolide induced response in beans. J. Plant Physiol. 120 : 207-214.

Kurapov, P.B.; Skorobogatova, T.V.; Siusheva, A.G. and Kozik, T.A. (1996). Hormonal balance and productivity of wheat, barely and potato plants under the influence of epibrassinolide treatemnt. Sel, Skokhozyaistvennaya, Biologiya-5 : 99-104 (C.F. Computer Res.)

Malgorzata, K. and Zdzislaw, A. (1984). Sterol conjugate interconversions during germiantion of white mustard. Phytochemi., 23 (11) 2485-2488.

Mosalem, M.E. (1993). Response of wheat cultivars to nitrogen level and seeding rate. J. Agric. Sci., Tanta Univ., 19 (4) : 791-805.

Petzold, V.; Peschel, S. Dahs, I. and Adam, G. (1992). Stimulation of source-applied C^{14}. Sucrose export in *Vicia faba* plants by brassinosteroids, GA3 and IAA. Acta. Bot., Neerlandica, 41 (1) : 469-479 (C.F. Computer Res.).

Prusakova, L.D.; Chizhov, S.I. and Khripach, V.A. (1995). Lodging resistance and productivity of spring barely and perennial wheat under the effect of Brassionsteroids. Sel, Skokhozyaistvennaya-Biologiya 1 : 93-97 (C.F. Computer Res.).

Renu, D. and Thukrai, A.K. (1994). Effect of steroid pretreatment to the carbohydrate content of wheat plants. Indian J. Agric. Res., 38 (4), 291-294.

Shalaby, M.A.F. and Ahmed, M.A. (1994). Yield response of barley plants as affected by promoter brassinosteroids under three complete foliar fertilizer compounds. Egypt. J. Appl. Sci., 9 (10) : 304-314.

Sharaan, A.N. and Abd El-Samie, F.S. (1999). Effect of seeding rates and N fertilization levels on growth and yield of two wheat varieties (*Triticum aestivum*, L). Annals Agric. Sci., Ain Shams Univ., Cairo, 44 (2) 589-601.

Shaukat, A.; Paigham, S.; Ishtias, A. and Murad, A. (1997). Influence of seeding density and geometry of planting on emergence, tillering and biological yield of wheat. Sarhod Jour. Agric., 13 (3) 219-22.

Snedecor, G.W. and Cochran, W.G. (1980). Statistical methods. 6^{th} Ed., Iowa. State Univ. Press, Ames Iowa, USA.

Steven, D.C. and Jenneth, M.S. (1998). Brasinosteroids : Essential regulators of plant. Growth and development. Annu. Rev. Plant Physiol. Mol. Biol. 49 : 427-451.

Troug, E. and Mayer, A.H. (1939). Improvement deiness colorimetric method for phosphorus and arsenic. Ind. Eng. Chem. Anal. Ed., 1 : 136-139.

Upadhyay, V.B. and Tiwari, J.P. (1996). Influence of nitrogen, seed rate and mulch on wheat (Triticum aestivum) varieties under late-sown conditions. Indian, J. Agron. 41 (4) : 562-565.

Vardhini, V.B., and Rao, S.S.R. (1998). Effect of brassinosteroids on growth, metabolite content and yield of Arachis hypogaea. Phytochem., 48 : 927-930.

Vireshwar Singh, R.P. Singh and Panwar, K.S. (1995). Response of wheat (Triticum aestivum) to seed rate and date of sowing. Indian J. Agron. 40 (4) : 697-699.

Wang- Sangen and Wang, S.G. (1997). Influence of brassionsteriod on rice seedling growth. Intern. Rice. Res. Notes. 22, 20-21.

Xie, H.S.; Rourke, D.R.S. and Hargrave, A.P. (1998). Effect of raw spacing and seed/fertilizer placement on agronomic performance of wheat and canola in zero tillage systems. Canad. Jour. Plant Sci. 78 (3) 389-394.

إستجابة نبات القمح لمعدل التقاوى والاستجماستيرول

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تمت هذه التجربة فى عامين متتاليين ١٩٩٧/٩٨ و ١٩٩٨/٩٩، لدراسة تأثير معدل التقاوى والرش بالإستجماستيرول على صفات النمو والمحصول لنبات القمح والمكونات الكيماوية فى الحبوب الناتجة.

ودلت التجارب على أن معدل البذور مع الإستجماستيرول أعطت فى أغلبها تأثيرات معنوية بالنسبة لصفات النمو، بينما لم تعطى تأثيرات معنوية على المحصول، وكانت أعلى المعدلات بالنسبة لصفات النمو والمحصول نتيجة المعاملة بمعدل بذور ٧٠ كجم للفدان مع الإستجماستيرول ٢٠٠ مجم.

وكان استخدام معدل بذور ٨٠ كجم للفدان مع الإستجماستيرول ١٥٠ مجم أعطى أعلى زيادة فى كمية النتروجين والبروتين والفوسفور، بينما وصلت السكريات الكلية والسكريات الذائبة فى الحبوب الناتجة لمعدلات عالية بالمعاملة بمعدل بذور ٧٠ كجم للفدان مع الإستجماستيرول بتركيز ١٠٠ مجم.