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PRODUCTIVITY OF THE WHEAT (*Triticum aestivum*) CULTIVAR SAKHA 94 UNDER WATER DEFICIT, MINERAL NITROGEN FERTILIZER AND BIOFERTILIZER APPLICATION

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ABSTRACT: *A field experiment was conducted at Sakha Res. Station in two successive seasons 2002 / 2003 and 2003/ 2004 on wheat cultivar Sakha 94 , to study the effect of the irrigation regime treatments (two , three and four irrigations) , nitrogen fertilizer treatments (45 KgN/ fed , 70 KgN/ fed , 45 KgN/ fed + biofertilizer and 70 KgN / fed + biofertilizer) on wheat productivity and grain chemical composition.*

The result of the experiment showed that : Irrigated wheat plants by four irrigations significantly increased plant height , flag leaf area , days to heading , number of spikes / m^2 ,number of grains / spike , 1000 – kernel weight , kernel weight / spike , straw kernel and biological yield and harvest index . Protein content of grains decreased by four irrigations, whereas total carbohydrates content increased.

The application of 70 Kg N/ fed. + nitroben significantly increased plant height , flag leaf area , days to heading , number of spikes / m^2 , number of kernels / spike , 1000 – kernel weight , kernel weight / spike , straw , grain and biological yields as well as harvest index . Total carbohydrates in grains decreased by appling 70 Kg N / fed + nitroben , however protein content increased .

The interaction effect between water stress and nitrogen fertilize had a significant effect on plant height, number of kernels / spike, kernel weight / spike and biological yield.

Key words : *wheat, triticum aestivum,N-fertilizers, biofertilizer, irrigation, yield components.*

INTRODUCTION

The importance of wheat as a human main food is well known fact over the entire world. In Egypt Extensive efforts are continuously paid for increasing its productivity vertically and / or horizontally.

Reasonable water regime for wheat cultivar Sakha 94 may improve its production and water conservation. Gad EL- Rab *et al* (1995) indicated that the maximum grain and straw yield of wheat were obtained from six

irrigations . Also, increasing soil moisture stress was reported to decrease growth, yield and yield attributes (EL-Refaie and EL-Kabbany 1995, Khater et al., 1997 and Darwish 1998). Ahmed and Nadia (2004) reported that water stress for wheat cultivars Giza 168 , Sakha 69 , Sakha 93 , Giza 163 and Giza 164 significantly decreased plant height , flag leaf area yield and its components .

The optimum dose of nitrogen is very important to obtain high grain yield without luxury consumption of nutrients. Response of wheat crop to nitrogen fertilization was studied by many workers who found significant increases in plant height (EL – Nagar et al ., 1989 and Shams EL-Din and EL - Habbak , 1992), spike length (Sharaan et al . ,1986) ,number and weight of grains / spike (Gab Alla , et al , 1986 and Shams EL – Din and Habbak 1992) , grain and straw yields (Gab Alla et al ., 1986 , Sharaan et al,1986 , Khalil ,1989 and Shams EL- Din and EL Habbak , 1992) by increasing nitrogen fertilizer level .

Biological fertilization of cereals by N_2 - fixing bacteria received great attention during the last decade . Such biological fertilization minimize the environmental pollution caused by mineral fertilizers and reduce its costs . Gohar et al (1986) and Sabah (2001) found that inoculated wheat seeds with associative N- fixing bacteria increased wheat yield and reduced nitrogen fertilization requirements to 50 % . Abd el Monem et al., (2001). Reported that the application of Azospirillum brasilense or commercial biofertilizer Cerealin with half nitrogen rate (60 Kg /fed) significantly increased wheat grain yield.

The aim of this research was to study the response of wheat cultivar Sakha 94 to water deficit i.e. , number of irrigation , mineral nitrogen and biological nitrogen fertilization and their effect on growth , grain yield , yield components , total carbohydrates and grains protein content .

MATERIALS AND MATHODS

The present work was carried out during the two successive growing seasons (2002 /2003 and 2003 / 2004) at Sakha Agric . Res. Station A.R.C. to study the effect of number of irrigation , mineral nitrogen fertilizer and biofertilizer nitoben on growth , grain yield , yield components as will as total carbohydrates and grains crude protein percentages .

The experiment was laid out in split plot design with four replicates . The main plots were occupied by irrigation treatment, while sub-plots contained nitrogen fertilizer treatments. Each sub - plot was 1/400 fed (3 X 3.5 m) . To avoid the interference between irrigation treatments, 1.5 meter beds surrounded the experimental plots. The physical and chemical analysis for experimental soil sites during the two growing seasons are presented in table (1).

Table (1): Phy sical and chemical analysis of the experimental soil site.

Seasons	Particle size distribution			Texture class	O.M. %	PH (1:205)	Available nutrients (ppm)		
	Fine sand %	Silt %	Clay %				N	P	K
2002 / 2003	18.30	38.30	43.40	Clay loam	1.4	8.50	30	18.70	420
2003 /2004	23.59	26.30	50.11	Clay loam	1.5	8.10	24	18.38	452

The treatments were as follows:

- Main plots (Irrigation treatments) :
  - Two irrigations (designated as low).
  - Three irrigations (designated as medium).
  - Four irrigations (designated as high)
- Sub – plots (mineral nitrogen and biofertilizer nitrogen)
  - 45 Kg N /fed.
  - 70 Kg N/ fed.
  - 45 Kg N /fed. + Nitroben
  - 70 Kg N/ fed + Nitroben .

Irrigation treatments started when wheat plants received the first irrigation (21 days after sowing) . The irrigation schedule is presented in Table (1)

Table (2) : The irrigation schedule of wheat plants during the two growing seasons .

Irrigation treatments	No. of day from sowing to irrigation				
	21	42	63	84	105
Two irrigations	I	I	N	N	N
Three irrigations	I	I	N	I	N
Four irrigations	I	I	I	N	I

I = irrigation N = No. irrigation

Wheat seeds of cultivar Sakha 94 were planted on 27 / 11 and 21 /11 in the first and second seasons, respectively. Phosphorous fertilizer in the form of calcium super phosphate (15.5 % P_2O_5) at the rate of 30 Kg P_2O_5 / fed was added before planting . Nitrogen fertilizer rates in the form of ammonium nitrate (33.5% N) were added two times , the first (1/3 of the total dose) before the first irrigation and the second (2/3 of the total dose) before the second irrigation. The biofertilizer was added before sowing by mixing grains with nitroben in a shaded place.

Nitroben is a mixture of two N-fixing bacteria spp. (2-Azo spirillum: 1-Azotobacter) which was provided by Soil Microbiology Research Department,

A.R.C. Giza ,The total quantities of rain in (mm) on Kafr EL-Sakha Governorate were 169 and 162 mm in the first and second seasons, respectively . After 110 days from sowing flag leaf area was estimated cm^2 by taking a sample of ten plants from each sub-plot.

At harvest time a sample of ¼ m^2 was randomly chosen from each sub-plot to estimate plant height , number of kernels /spike , kernel weight /spike , 1000 kernel weight and number of spikes/m^2 . Grain and strow yeild /fed as , biological yeild / fed and harvest index were determined from each sub-plot. Mature grains of two growing seasons were subjected to chemical analysis to determine each of :

- Crude protein percentage according to A.O.A.C. (1975).
- Total carbohydrates percentage as glucose % according to Dubois et al (1956).

Data of the two seasons were statistically analyzed according to Snedecor and Cochran (1990).Combined analysis for the two seasons were carried out according to the procedure outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSTION

Wheat Growth :

a. Plant Height:

Results in Table 3 showed that number of irrigation, mineral nitrogen and N-biofertilizer nitroben had a significant effect on plant height . The highest value of plant height was obtained from four irrigations treatment followed by plants which received three and two irrigations . The significant decrease in plant height caused by two irrigations treatment

could be explained by loss of turger which affects the rate of cell expansion and ultimate cell size . Such loss of turger is probably the most sensitive process to water stress , consequently caused a reduction in stem elongation.

Kramer and Boyer (1995) indicated that wet conditions enhanced the growth of wheat plants by increasing stem length . In this respect , Moursi et al (1983) demonstrated that the minimum plant length was obtained when wheat plants were exposed to drought conditions.

As for the mineral nitrogen fertilizer and N-biofertilizer nitroben data of Table 3 , showed that plant height significantly increased by appling 70 Kg N / fed. + nitroben compared with other treatments , In this connection , Abo - Ellenin *et al* (1984) found that increasing nitrogen levels from 30 to 90 Kg N / fed increased plant height of wheat plants. Also , Rabie *et al* (1995) stated that inoculation of wheat seeds with Azotobacter chroococcum and/or Azospirillum brasilense increased wheat plant height of wheat plants.

Data of Table 3 showed that the interaction between water regime and nitrogen fertilizer as well as biofertilizer on plant height recorded a significant effect. The tallest wheat plants were obtained from the 70 Kg N/ fed. + nitroben treatment and four irrigations.

b. Flag leaf area:

Data in Table 3 showed that water stress , mineral nitrogen and biofertilizer had a significant effect on flag leaf area . Increasing soil moisture stress i.e. two irrigations treatment significantly decreased flag leaf area compared with other water regime treatments. On the other hand the highest value of flag leaf area was obtained from wheat plants irrigated by four irrigations . Such results revealed the importance of maintaining soil moisture at a high level to increase cell division and enlargement of wheat leaves ,In this respect ,Choudhury and Kumar (1981) and Ahmed and Nadia (2004) reported that wheat leaf area decreased under moderate and server water stress.

Regarding the effect of mineral nitrogen and nitoben biofertilizer results of Table 3 revealed that the application of 70 Kg N/ fed. + nitroben significantly increased flag leaf area compared with other mineral and biofertilizers nitrogen treatments.

Concerning the interaction effect between water stress and nitrogen fertilizer as well as nitroben, data of Table 3 showed that flag leaf area scored insignificant effect . The maximum value of flag leaf area was obtained when wheat plants received four irrigations and 70 Kg N / fed . + nitroben .

c. Days to heading:

Data presented in Table 3 showed that water stress affected heading date significantly. Decreasing number of irrigation to two irrigations decreased significantly number of days to heading. The opposite was found when wheat was irrigated four irrigations. Such results may be due to drought conditions which pushed wheat plants to end life cycle early.

Data in Table 3 indicated that nitrogen and nitroben recorded a significant effect on heading date character , The highest value of heading date was obtained by the treatment 70 Kg N /fed + nitroben followed by 45 Kg N/ fed . + nitroben , with insignificant difference between such two treatments .

Data of Table 3 showed that the interaction between soil moisture stress and nitrogen fertilizer as well as nitroben was insignificant. The highest value of heading date was obtained when wheat plants irrigated by four irrigations and received 70 Kg N / fed. + nitroben.

Table (3): Means of Number of irrigations , mineral nitrogen and biofertilizer nitrogen fertilization on wheat growth characters in combined analysis over two seasons .

Irrigation treatments	Nitrogen and biofertilizer treatments	Plant height (cm)	Flag Leaf area (cm^2)	Days to heading	Total carbohydrates %	Protein %
Four irrigations	45KgN/fed	115.80	30.59	93.75	73.08	9.07
	70KgN/fed	119.30	31.47	94.63	71.21	10.05
	45KgN/fed+bio	120.80	32.53	95.00	68.63	11.07
	70KgN/fed+bio	121.90	33.36	95.75	66.57	11.78
	Mean	119.40	31.99	94.78	69.87	10.49
Three irrigations	45KgN/fed	108.30	28.79	92.38	65.53	9.58
	70KgN/fed	115.90	29.02	92.88	63.01	10.84
	45KgN/fed+bio	117.30	31.02	93.38	61.65	11.55
	70KgN/fed+bio	12.30	31.14	93.50	59.55	13.02
	Mean	115.40	29.99	93.04	62.44	11.25
Two irrigations	45KgN/fed	96.5	25.08	90.0	61.54	10.43
	70KgN/fed	100.1	25.60	90.63	59.44	11.35
	45KgN/fed+bio	104.3	26.42	90.90	57.37	12.12
	70KgN/fed+bio	107.4	27.06	91.25	55.47	13.70
	Mean	102.10	26.04	90.70	58.46	11.90
General mean of nitrogen and biofertilizer	45KgN/fed	106.8	28.15	92.04	66.72	9.69
	70KgN/fed	111.8	28.69	92.71	64.55	10.75
	45KgN/fed+bio	114.1	29.99	93.09	62.55	11.58
	70KgN/fed+bio	116.5	30.52	93.50	60.53	12.83
L.S.D.5%	Irrig.	2.98	1.33	1.15		
	N +Bio	2.32	1.03	0.82		
	Irrg. X(N+Bio)	4.06	N.S	N.S		

Bio = Nitroben (biofertilizer)

Grain yield and its components :

a. Yield components :

Results of Table 4 showed that water stress, nitrogen fertilizer and nitroben had a significant effect on number of spikes / m^2 , number of kernels / spike , 1000 – kernel weight and kernel weight / spike . The highest values of such characters were obtained from four irrigations followed by three irrigations treatment . However the lowest values were obtained from two irrigations treatment . These results revealed that decreasing number of

irrigations to two irrigations (low treatment) caused significant decrease in wheat growth which was reflected on wheat yield components.

On the other hand , the high moisture level (four irrigations) enhanced wheat growth and yield components. In this connection , Kramer (1980) showed that plants subjected to water stress did not only show a general reduction in size but exhibited modification in structure , leaf area , cell size and intercellular volume . Also, similar results were obtained by Abd -EL-Rahman and Khalifa (1980) and Singh et al (1986) .

Regarding the effect of nitrogen fertilizer and nitroben biofertilizer, (Table 4) a significant effect was recoreded . The maximum values of number of spikes/ m^2, number of kernels / spike , 1000-kernel weight and kernel weight / spike were obtained by appling 70 Kg N/ fed + nitroben.

Table (4): Means of Number of irrigation, mineral nitrogen and biofertilizer nitrogen on wheat yield components in combined analysis over two seasons.

Irrigation treatments	Nitrogen and biofertilizer treatments	Number of spikes / m^2	Number of kernels /spike	1000 – kernel weight (gm)	Kernel weight /spike (gm)
Four irrigations	45KgN/fed	494.0	56.38	47.12	2.53
	70KgN/fed	551.0	61.63	46.37	2.65
	45KgN/fed+bio	551.0	63.25	46.19	2.66
	70KgN/fed+bio	585.0	65.25	48.45	3.22
	Mean	545.00	61.63	47.04	2.77
Three irrigations	45KgN/fed	477.00	51.13	43.15	2.40
	70KgN/fed	494.00	52.50	43.50	2.62
	45KgN/fed+bio	540.00	52.63	44.80	2.74
	70KgN/fed+bio	554.00	54.13	45.48	2.74
	Mean	514.00	52.59	44.23	2.63
Two irrigations	45KgN/fed	348.00	42.50	40.28	2.14
	70KgN/fed	373.00	42.63	40.55	2.11
	45KgN/fed+bio	388.00	42.13	40.83	2.16
	70KgN/fed+bio	408.00	42.38	41.64	2.24
	Mean	379.00	42.41	40.83	2.17
General mean of nitrogen and biofertilizers	45KgN/fed	440.00	50.00	43.51	2.36
	70KgN/fed	473.00	52.25	43.47	2.46
	45KgN/fed+bio	490.00	52.67	43.94	2.52
	70Kg/fed+bio	516.00	53.92	45.19	2.73
L.S.D.5%	Irrig.	17.30	1.66	1.04	0.17
	N +Bio	12.00	1.17	0.62	0.12
	Irrg. X(N+Bio)	N.S	2.04	N.S	0.20

Bio = Nitroben (biofertilizer)

Such results may prove the importance of appling 70 Kg N /fed in addition to biofertilizer nitroben to increase wheat productivity . In this connection ,

Abdel Monem *et al* (2001) , revealed that the application of Azospirillum or commercial biofertilizer cerealin with half nitrogen rate (60 Kg / fed) , significantly increased wheat yield and its components.

The interaction effect between water stress and nitrogen fertilizer + nitroben is shown in Table 4 . The results indicated a significant effect for , number of kernels / spike and kernel weight / spike . The interaction effect was insignificant for number of spikes and 1000 kernel weight. The maximum values of all yield components characters were obtained by using four irrigations treatment and the addition of 70 Kg N / fed + nitroben.

b.Grain yield :

The effect of soil moisture stress, nitrogen fertilizer and nitroben on the productivity of wheat expressed as straw, grain and biological yields Kg / fed and harvest index are presented in Table 5. Results indicated that the two factors under study significantly affected the productivity of wheat.

The highest values of straw , grain and biological yields as well as harvest index were scored from the high treatment (four irrigations) followed by medium treatment (three irrigations) . The lowest productivity of wheat was recorded from severe water deficit (irrigated by two irrigations) Such findings were found to be clear in both seasons under study and combined analysis . This trend could be due to the effect of water deficit on wheat growth and yield components which was in turn reflected on wheat productivity. These results are in line with those reported by Ahmed and Nadia (2004) who indicated that wheat plants exposed to water stress showed reduction in grain yield and its components.

Regarding mineral nitrogen fertilizer and nitroben ,the results presented in Table 5 showed that the heighest values of straw , grain and biological yield as well as harvest index were gained by the treatment 70 Kg N / fed + nitroben . In this respect , Abdel – Messih and Eid (1999) reported that the addition of 50 Kg N /fed . to wheat plants significantly increased grain and straw yield / fed . Also , Galal *et al* . (2000) concluded that the inoculation with Azospirillum brasilense increased the accumulation of wheat shoot dry matter and grain yield by 35 % .

It is worthy to mention that , insignificant effect was observed between the application of (45 Kg N / fed + nitroben and 70 Kg / fed + nitroben) with respect to grain , straw biological yields , and harvest index .

The interaction effect between water stress and nitrogen fertilizer as well as nitroben recorded a significant effect on biological yield only.

The highest values of straw , grain and biological yield as well as harvest index were obtained when wheat plants irrigated by four irrigations received

70 Kg N/ fed + nitroben . On the other hand the lowest value for all characters were obtained with low irrigation and 45 KgN/ fed .

Table (5): Means of number of irrigations, nitrogen mineral and N- biofertilizer on wheat yield in combined analysis over two seasons.

Irrigation treatments	Nitrogen and biofertilizer treatments	Grain Yield Ard / fed	Straw Yield Ton / fed	Biological Yield Ton / fed	Harvestidex %
Four irrigations	45KgN/fed	20.93	4.71	7.80	40.04
	70KgN/fed	22.31	4.81	8.16	41.05
	45KgN/fed+bio	22.47	4.92	8.29	40.66
	70Kg/fed+bio	24.94	5.18	8.89	42.08
	Mean	22.67	4.92	8.29	40.96
Three irrigations	45KgN/fed	19.21	4.08	6.97	39.79
	70KgN/fed	20.01	4.25	7.29	40.85
	45KgN/fed+bio	20.74	4.53	7.63	40.54
	70KgN/fed+bio	21.59	4.57	7.81	41.43
	Mean	20.39	4.37	7.43	40.66
Two irrigations	45KgN/fed	15.81	3.68	6.05	38.95
	70KgN/fed	16.48	3.77	6.24	39.34
	45KgN/fed+bio	16.50	3.87	6.35	38.94
	70KgN/fed+bio	16.04	3.91	6.46	39.70
	Mean	16.45	3.81	6.28	39.24
General mean of nitrogen and biofertilizers	45KgN/fed	18.65	4.16	6.94	39.59
	70KgN/fed	19.60	4.28	7.23	40.41
	45KgN/fed+bio	19.90	4.44	7.42	40.05
	70KgN/fed+bio	21.18	4.56	7.72	41.07

Bio = Nitroben (biofertilizer)

Chemical composition of wheat grains :

a. Protein content :

Variations in protein content of wheat grains as affected by water stress (decreasing number of irrigations) and nitrogen fertilizer as well as nitroben addition are presented in Table 3 Results clearly showed that the level of soil moisture i.e. high, medium and low treatments is an important factor controlling protein content of wheat grains. Decreasing number of irrigations

to two irrigations increased protein content of wheat grains , while it decreased by frequent irrigations (four irrigations) .

In this respect Ahmed and Nadia (2004) reported that skipping an irrigation either at tillering ,heading and / or milk –rip stages increased protein content of wheat grains .

As for the effect of mineral nitrogen fertilizer and nitroben ,Table 3 showed that the maximum value of protein content was obtained by the application of 70 Kg N / fed + nitroben. Such result could be ascribed to the function of nitrogen in plant metabolism such as , constituents of amino and nucleic acids and cellular compounds. In this connection , Ibrahim (1988) reported that protein content of wheat grains increased significantly by raising nitrogen rate up to 100 Kg N /fed .

The interaction between soil moisture stress and nitrogen fertilizer as well as nitroben (table 3) indicate that the highest value of protein could be obtained from plants irrigated by dry treatment (two irrigations) and received (70 Kg N / fed + nitoben) .

b.Total carbohydrates content :

Carbohydrates content of wheat grains (table 3) showed a reverse trend to that obtained with protein . Under high conditions (four irrigations) , total carbohydrate of wheat grains increased , while increasing water deficit by prolonged irrigation intervals (two irrigations) decreased the total carbohydrates percentage in wheat grains . In other words, the increase in total carbohydrates were on account of the decrease in protein content of grains.

Such result may be explained by the fact that water shortage causes stomatal closure and this in turn prevents co_2 diffusion into the air inside the plants tissue and consequently lowers the photosynthetic efficiency .

In this connection Anton and Ahmed (2001) reported that exposing barly plants to drought conditions decreased total carbohydrate content of grains.

Regarding the effect of mineral nitrogen biofertilizer fertilizer and nitroben data of Table 3 indicated that total carbohydrates content of grains decreased gradually with increasing nitrogen rate from 45 Kg N / fed . up to 70 Kg N / fed. , These results are in line with Abd EL-Fattah (1995) who concluded that raising nitrogen fertilizer levels up to 105 Kg N / fed . , was accomping a negative correlation between total carbohydrates and crude protein content of wheat grains .

Concerning the interaction between water stress and nitrogen fertilizer as well as nitroben , data of Table 3 indicated that the maximum value of total carbohydrates content of wheat grains was obtained when wheat plants received the high treatment (four irrigations) and applying 70 Kg N /fed + nitroben .

CONCLUSION

It can be concluded that the maximum straw and grain yields , also total carbohydrates of grains of the wheat cultivar Sakha 94 was obtained from high irrigation treatment (four irrigations) and 70 Kg N/ fed + nitroben

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إنتاجية القمح صنف سخا ٩٤ تحت ظروف نقص المياه والتسميد النيتروجيني المعدني والحيوي

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الملخص العربى

أقيمت تجربة حقلية بمحطة البحوث الزراعية بسخا في موسمي الزراعة ٢٠٠٢ / ٢٠٠٣, ٢٠٠٣ /٢٠٠٤ علي صنف القمح سخا ٩٤ لدراسة أثر نقص مياه الري (ريتان , ثلاث ريات , أربع ريات) , وكذلك التسميد النيتروجيني المعدني والحيوي (النيتروبين) بإضافة ٤٥ , ٧٠ كجم نتروجين / للفدان , ٤٥ كجم نيتروجين + نيتروبين و ٧٠ كجم نتروجين + نيتروبين علي إنتاجية القمح , وكذلك محتوي الحبوب الكلي من البروتين , والكربوهيدرات . وكانت الصفات المدروسة هي : ارتفاع النبات و مساحة ورقة العلم و ميعاد طرد السنابل وميعاد النضج الفسيولوجي وعدد سنابل / م٢ و عدد ووزن الحبوب / سنبلة ووزن ١٠٠٠ حبة ومحصول الحبوب والقش والمحصول البيولوجي للفدان ودليل الحصاد ومحتوي الحبوب من البروتين والكربوهيدرات . واستخدم في تصميم التجربة القطع المنشقة حيث وضعت معاملات الري في القطع الرئيسية ومعاملات التسميد في القطع الفرعية .

أدي ري القمح بالمعاملة (أربع ريات) إلي زيادة معنوية في طول النبات و مساحة ورقة العلم و ميعاد طرد السنابل و عدد السنابل / م٢ و عدد الحبوب / سنبلة و وزن ال ١٠٠٠ حبة و وزن الحبوب / سنبلة و محصول القش والحبوب / فدان و المحصول البيولوجي و دليل الحصاد في حين أدي ذلك إلي نقص محتوي الحبوب من البروتين بينما ارتفع محتواها من الكربوهيدرات الكلية .

أدي تسميد النباتات بالمعاملة ٧٠ كجم نيتروجين معدني للفدان + النيتروبين إلي زيادة معنوية في طول النبات و مساحة ورقة العلم و عدد الأيام إلي طرد السنابل و عدد السنابل / م٢ و عدد الحبوب / سنبلة و وزن ال١٠٠٠ حبة و وزن الحبوب / سنبلة و محصول القش والحبوب للفدان و المحصول البيولوجي و وكذلك دليل الحصاد .

وقد أدي إضافة ٧٠ كجم نتروجين معدني للفدان + النتروبين إلـــي نقـــص محتـــوي الحبوب من الكربوهيدرات الكلية بينما ارتفع محتواها من البروتين .

كان لتأثير التفاعل بين الإجهاد المائي والتـــسميد النيتروجينـــي المعـــدني و وكـــذلك النتروبين تأثيراً معنوياً علي طول النبات و عدد الحبوب / سنبلة و وزن الحبـــوب / ســـنبلة , وكذلك المحصول البيولوجي .

يمكن التوصية بتسميد ٧٠ كجم / نيتروجين معدني وإضافة التسميد الحيوي مع أربع ريات للصنف سخا ٩٤ للحصول علي أعلي إنتاجية .