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RESPONSE OF WHEAT TO SUPPLEMENTAL IRRIGATION AND FERTILIZER UNDER NORTH WESTERN COAST OF EGYPT.

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ABSTRACT : Two field experiments were carried out at El Qasr farm, Marsa Matrouh governorate, North Western Coast of Egypt, during 2000/2001 and 2001/2002 seasons, to study the effect of four irrigation depths (mm) (I_1: without supplemental irrigation (Rainfall only), I_2: supplemental irrigation by 60 mm/fad, I_3: supplemental irrigation by 90 mm/fad and I_4: supplemental irrigation by 120 mm/fad), three adding times of supplemental irrigation (A_1: sowing, A_2: tillering and A_3: after 15 days from full heading) and two fertilizer regime (F_1: no fertilizer and F_2: NPK fertilizers, i.e. 31 kg N + 22.5 kg P_2O_5 + 24 K_2O/ fad) on Yield, its components, protein % and protein yield of wheat cultivar Sakha -8.

The maximum value of water use efficiency (1.28 and 1.17 Kg grains/m^3 water) was obtained by F_2+A_2+I_3 treatment in the first and the second season, respectively. The treatment F_2+A_2+I_4 gave the highest value of grain yield (1188.1 and 1141.3 Kg/fad), number of spikes/m^2 (227.7 and 209.3), crop index (64.2 and 59.24 %) and protein yield (150.34 and 144.71 Kg/fad) in the first and the second season, respectively. The highest value of protein percentage (13.95 and 13.75 %) was recorded by F_2+A_3+I_4 treatment in both seasons, but was not significant.

Key words: Cultivar Sakha-8, Rainfed, NPK fertilizers, water use efficiency, irrigation depth, harvest index, biological Yield.

INTRODUCTION

Wheat is considered the most important cereals in Egypt, the increased demands of this crop, due to the fast growth in human population, make maximizing Wheat production in Egypt under limiting

factors is aim. In the North. West Coast of Egypt the rainfall is low (average of the last 50 Years is 133 mm/year) and the soil texture is sandy loam.

The present investigation is designed to study the effect of supplemental irrigation, adding times of supplemental irrigation and NPK fertilizers on wheat productivity under these conditions. Soil water availability is considered to be the main factor limiting crop production in the Mediterranean–type climate of West Asia and North Africa (Zhang *et al.*, 1998). The grain Yield and Yield components of Wheat increased significantly by NPK application at 90Kg N+50 Kg P_2O_5+30 Kg K_2O/ha (Mishraetal *et al.*, 1994). Adding 120 Kg N + 40 Kg P_2O_5 + 25 K_2O/ha increased significantly No. of spikes/m row length, grain weight/spike, grain yield and water use efficiency compared non-fertilizer (Singh and Bhan, 1998). Application NPK fertilizers at rate 90 Kg N+15 Kg P_2O_5 +25 Kg K/ha increased significantly grain yield, straw yield and 1000 grain weight of Winter wheat compared with the control (Singh *et al.*, 2002). Irrigation wheat prior to heading increased the grain yield of wheat even when water input was limited for crop production (Misra and chaudhary 1985). The irrigated treatments increased significantly grain Yield, Yield attributes (spike length, 1000 grain weight and harvest index) compared with unirrigated treatments (Kumar *et al.*, 1994). Oweis *et al* (1997) reported that in Syria, large increases in crop yields of wheat were obtained with the application of limited water in conjunction with rainfall.

The aim of this study is enhancing Wheat productivity in North Western Coast of Egypt under Rainfed conditions by knowledge the optimum time to apply limited amounts of water as supplemental irrigation with NPK fertilizers to obtain the best productivity of wheat.

MATERIALS AND METHODS

Two field experiments were conducted at the Desert Research Center (D.R.C.) experimental farm at El Qasr, Marsa Matrouh governorate, North Western Coast of Egypt, during two successive seasons 2000/2001 and 2001/2002, respectively. The experimental soil type was sandy loam in texture. The soil pH was 8.1 and E.C was 4.13 ds/m.

The treatments were arranged in a split–split plot design in three replications. The main plots were occupied with NPK fertilizer regime, i.e. (F_1) no fertilizers and (F_2) NPK fertilizers (31 kg N+ 22.5 kg P_2O_5 +

24 kg k_2O/fad). The sub plots were occupied with adding times of supplemental irrigation treatments, i.e. (A_1) sowing, (A_2) tillering stage (70 days after sowing) and (A_3) after 15 days from full heading (110 days after sowing). The sub-sub plots were occupied with irrigation treatments as depth (mm), i.e. (I_1) without supplemental irrigation (Rainfall only), (I_2) supplemental irrigation by 60 mm/fad, (I_3) supplemental irrigation by 9o mm/fad and (I_4) supplemental irrigation by 120 mm/fad.

The rainfall received during the crop season was 107.9 mm and 120.8 mm in the first and the second seasons, respectively. The area of the experimental unit was 45 m^2 (3 x 15 m). Number of rows was 20 /plot, 15 cm apart and length of 15 m. The soil was fallow in the summer before planting Wheat in both seasons.

Agricultural practices for wheat were carried out as followed: wheat grains were drilled at a seed rate of 35kg/fad and grains were planted on December 10th for both seasons. With respect to NPK fertilizers (F_2), Calcium super-phosphate (15% P_2O_5) fertilizer was added during soil preparation at a rate of 150kg/fad in both seasons. Both half ammonium sulfate (20.6%N) and potassium sulfate (48% K_2O) were applied at sowing and remaining ammonium sulfate and potassium sulfate top-dressed before tillering stage at a rate of 150kg/fad and 50kg/fad, respectively in both seasons. The crop was harvested on 23 April 2001 and 1 May 2002 in the first and the second seasons, respectively.

Data were statistically analyzed using the appropriate analysis of variance according to Gomez and Gomez (1984), and L.S.D at 5 % was used to compare between means. Three inner square meters were harvested from three replicates at harvest and the following measurements and readings were recorded: - Number of spikes and tillers /m^2, number of grains and spikelets /spike, spike length (cm), weight of 1000 grains (g), Grain yield (kg/fad), straw and biological yield (kg/fad), tillering index (%), crop and harvest index (%). Water use efficiency (kg/m^3) was measured for grain yield as follows: WUE (water use efficiency) = grain yield (kg/fad) / a mount of total water received (m^3/fad), moreover grain protein percentage was determined by the new kjeldahle method as outlined by the A.O.A.C. (1980) after drying grains at 70 C for 24 hours, then Protein yield (kg/fad) which was measured as follows:

protein yield (kg/fad)= grain yield (kg/fed) x protein percentage.

RESULTS AND DISCUSSION

Data in table (1) and (2) show the response of wheat yield, its components and chemical composition to fertilizer regime, irrigation adding times and supplemental irrigation on number of spikes and tillers/m^2, number of grains and spikelets/spike, spike length (cm), weight of 1000 grains (g), grain and straw yield (kg/fad), biological yield (kg/fad), tillering index (%), crop and harvest index (%), water use efficiency (kg/m^3), protein content (%) and protein Yield (kg/fad) in the first and the second seasons, respectively.

NPK fertilizers had markedly effect on the all mentioned characters in both seasons, except, straw yield in both seasons, tillering index, harvest index and protein percentage in the first season only. Nitrogen fertilizer is considered the most effective elements on the plant growth, its increase cell turgidity and cell elongation so, dry matter and growth characters increase. Boquet and Johnson (1987) reported that a large part of the increase in yield of wheat due to nitrogen application resulted from increased fertile tillers per hectare, similar results were obtained by Singh and Bhan (1998) they reported that sink capacity of the plant is dependent mainly on vegetative growth of plant, vigorous vegetative growth increased due to application of nitrogen and supply of photosynthates for formation of tillers and spikes of wheat.

NPK fertilizers increased yield and yield attributes markedly compared to without fertilizers (control). Singh and Uttam (1993) found that the highest grain and straw yield of wheat were obtained with application of 60 kg N+ 30 kg P_2O_5 + 30 kg K_2O/ha, Similar results were obtained by Mishraetal *et al* (1994) they indicated that the grain yield and yield components of wheat increased significantly by NPK application at 90 kg N+ 50 kg P_2O_5 + 30 kg K_2O/ha. NPK fertilizer regime (F_2) surpassed no fertilizer treatment (F_1) in protein Yield (kg/fad) may be due to the increment in grain yield and protein percentage. These results are in harmony with Boquet and Johnson (1987) they reported that nitrogen fertilizer did not affect grain protein content but increased total protein per hectare by increasing yield of winter wheat. Also, Nakhtore and Kewat (1989) indicated that wheat grain protein content increased from 13.8

% with no fertilizer to 14.5 % at NPK fertilizers (120+60+40 kg/ha), respectively.

Irrigation adding times had markedly effect on yield, yield components, protein % and protein yield of wheat.

Irrigation adding time at tillering stage gave the highest values in number of spikes/m^2, number of tillers/m^2 and Biological yield (in the first season), number of grains and spikelets/spike, spike length, weight of 1000 grain, grain yield, crop and harvest index, water use efficiency and protein yield compared with irrigation adding time at sowing or after 15 days from full heading in both seasons. The superiority in yield and yield components of irrigation adding time at tillering stage (A_2) over irrigation adding time at sowing stage (A_1) or irrigation adding time after 15 days from full heading (A_3) treatments may be due to the irrigation at tillering stage is considered the most important stage effecting on the yield and its components. Misra and chaudhary (1985) showed that irrigation wheat prior to heading increased the grain yield of wheat even when water input was limited for crop production, this advantage was mainly due to the deep root system supporting the plants during the dry post-heading period, Irrigation wheat in this way probably forces the roots to draw water from deeper soil layers. Similar results are in harmony with Sharma *et al* (1990). Irrigation adding time at sowing stage caused the highest straw yield (in both seasons) and biological yield (in the second season). These results may be due to the effective role of irrigation to increase number of tillers, consequently straw yield.

Irrigation adding time after 15 days from full heading (A_3) gave the highest tillering index and protein percentage in both seasons. These results may be due to decrease in number of tillers/m^2 compared with (A_2) and (A_1). Concerning protein percentage the increase in protein percentage may be due to expose plants to water stress for long time until after heading so, protein percent increased. Eck (1988) obtained similar results.

Yield, yield components, protein % and protein yield i.e. grain, straw and biological yield, number of spikes and tillers/m^2, number of grains and spikelets/spike, spike length, weight of 1000 grains, tillering index, crop and harvest index, water use efficiency, protein content and protein yield affected significantly by supplemental irrigation treatments viz., I_1 (non irrigation), I_2 (60 mm/fad), I_3 (90

mm/fad) and I_4 (120 mm/fad) in both seasons. The highest values of mentioned characters were obtained by adding 120 mm/fed (I_4) except, tillering index and water use efficiency (in the first season), straw yield (in the second season) and protein percentage (in both seasons). Adding 60 mm/fad (I_2) caused the maximum straw yield in the second season only. Non-irrigated treatment (I_1) gave the highest value of protein percentage (13.32 % and 13.01 %) in both seasons. Adding 90 mm/fad (I_3) recorded the highest value of water use efficiency. The superiority of (I_4) in the yield and its components in both seasons may be due to increment in number of spikes and tillers/m^2, number of grains and spikelets/spike, spike length, weight of 1000 grains which reflected on grain and biological yield, crop and harvest index and protein Yield (table 1 & 2).

These results may be due to the benefit water functions in plant growth, which can be summarized as follows: 1- a major constituent of physiologically active tissue, 2- a solvent in which salts, sugars and other solutes move from cell to cell and organ to organ and 3- an essential for the maintenance of the turgidity necessary for cell enlargement and growth, consequently dry matter and growth characters. Kumar *et al* (1994) indicated that the irrigated treatments increased significantly grain yield, yield attributes (spike length, 1000 grain weight and harvest index) compared with unirrigated treatments. Singh and Bhan (1998) reported that the increase in wheat yield attributes was due to more water supply at higher IW /CPE ratio and could be due to increase in cell turgidity, better opening of stomata and finally increasing the partitioning of photosynthesis to sink.

Concerning the highest water use efficiency which recorded by I_3 (90 mm/fed), this result may be due to adding limited water which force plant to better use of water on grain yield relative to I_4 (120 mm/fad). Similar results were obtained by Zhang *et al* (1998).

The differences between I_2 and I_4 in straw yield did not reach to the level of significant although the highest value recorded by I_2 in the second season only, this result may be due to adding limited water 60 mm/fad which force plant to gave more tillers, but was given lower grain yield so, straw yield was high. Concerning protein percentage, non-irrigated treatment (I_1) gave the highest value of protein percentage. These results may be due to exposed plants to water stress all the season,

and followed by I_4 in the first and the second seasons. Parihar and Tripathi (1989) obtained similar results.

Protein yield was highest by I_4 as a result to the increase in grain yield and protein percentage.

Data in table (3) & (4) show that the significant interactions between fertilizers regime and irrigation adding times treatments at harvest on number of spikes/m^2, number of tillers/m^2 (in the second season), number of grains/spike, grain and biological yield, straw yield (in the first season), tillering index, crop and harvest index (in the first season), water use efficiency and protein yield in both seasons.

The highest values of number of spikes/m^2, number of grains per spike, grain and biological yield, water use efficiency and protein yield in the first and the second seasons were obtained by (F_2) NPK fertilizers + (A_2) irrigation adding time at tillering stage. The maximum value of number of tillers/m^2 in the second season was obtained by (F_2) NPK fertilizers + (A_1) irrigation adding time at sowing stage. The highest value of straw yield in the first season was obtained by (F_2) + (A_1). The maximum value of tillering index was obtained by (F_1) +(A_3) and (F_2) + (A_3) in the first and the second seasons, respectively. The highest values of crop and harvest index in the first season were obtained by (F_2) + (A_2).

Data in table (5) and (6) show that the interactions between fertilizers regime and supplemental irrigation treatments at harvesting were significantly on number of spikes and tillers/m^2, grain and straw yield, biological yield, tillering and crop index in the first season, harvest index, water use efficiency, protein percentage (in the first season) and protein Yield in both seasons. The highest values of number of spikes and tillers/m^2, grain yield, straw yield and crop index (in the first season), biological yield, harvest index and protein Yield were obtained by (F_2) NPK fertilizers + (I_4) supplemental irrigation treatment by 120 mm/fad In both seasons. Adding (F_2) + (I_2) caused the highest straw yield in the second season. The maximum values of tillering index (in the first season) and water use efficiency (in both seasons) were obtained by (F_2) + (I_3). The highest value of protein percentage was recorded by (F_2) + (I_1) in the first season. Hooda and Agarwal (1987) obtained similar results. Singh and Bhan (1998) reported that number of spikes/m row length, grain weight/spike, grain yield and water use efficiency were favorably affected by increased irrigation and nitrogen levels.

Data in table (7) and (8) show that the significant interactions between irrigation adding times (A) treatments and supplemental irrigation (I) treatments at harvesting on number of spikes and tillers/m^2, number of grains and spikelets/spike (in the first season), spike length (in the first season), grain and straw yield, biological yield, tillering index (in the second season), crop and harvest index, water use efficiency, protein percentage and protein Yield in both seasons. The maximum values of number of spikes and tillers/m^2, grain yield, crop and harvest index and protein yield were recorded by (A_2) irrigation adding time treatment at tillering stage + (I_4) supplemental irrigation treatment by 120 mm/fad in both seasons.

The maximum values of number of grains/spike, number of spikelets/spike and spike length in the first season were obtained by (A_2) + (I_4). The highest value of straw yield was recorded by (A_1) irrigation adding time at sowing stage treatment + (I_4) supplemental irrigation treatment by 120 mm/fad in the first season and was recorded by (A_1) + (I_3) in the second season. Adding (A_1) + (I_4) gave the maximum value of biological yield in both seasons. The maximum value of tillering index was recorded by (A_3) + (I_4) in the second season only. The highest value of water use efficiency was recorded by (A_2) + (I_3) in both seasons. The maximum value of protein percentage was recorded by (A_3) + (I_4) in both seasons.

Data in table (9) and (10) show that the interactions between fertilizers regime (F), irrigation adding times treatments (A) and supplemental irrigation treatments (I) were significantly on number of spikes and tillers/m^2, grain yield, straw yield (in the first season), biological yield, tillering index, Crop and harvest index, water use efficiency and protein yield in both seasons. Adding (F_2) + (A_2) + (I_4) gave the highest values of number of spikes and tillers/m^2, grain and biological yield, crop and harvest index and protein Yield in both seasons. The maximum value of straw yield was recorded by (F_2) + (A_1) + (I_4) in the first season only. The highest value of tillering index was obtained by (F_2) + (A_1) + (I_3) and (F_2) + (A_3) + (I_4) in the first and the second seasons, respectively. The highest value of water use efficiency was recorded by (F_2) + (A_2) + (I_3) in both seasons.

The promising treatment from the three factors as interactions were the combination between $F_2 + A_2 + I_4$ in grain and biological yield and the most yield components in both seasons.

Table (1): Effect of NPK fertilizer (F), adding times (A) and supplemental irrigation (I) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2000/2001 growing season.

Characters / Treatments	Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
F_1	120.08	176.75	23.16	14.36	7.53	33.69	547.21	1560.4	2107.6	68.44	34.35	25.34	0.73	12.6	69.05
F_2	146.26	220.34	25	14.78	7.83	34.77	651.99	1636.7	2288.8	65.19	38.56	27.34	0.85	13	84.07
L .S .D .05	10.63	19.42	0.37	0.18	0.02	0.59	14.98	NS	131.01	NS	3.55	NS	0.017	NS	12.33
A_1	128.12	200.99	23.73	14.33	7.66	34.12	562.16	1724.1	2286.3	63.29	31.55	23.81	0.74	12.08	67.92
A_2	146.17	220.81	25.35	15.27	7.98	35.18	724.58	1586.5	2311.1	65.51	43.8	29.94	0.94	12.69	91.07
A_3	125.22	173.83	23.16	14.1	7.41	33.39	512.05	1485.1	1997.1	71.64	34.02	25.27	0.69	13.63	70.7
L .S .D .05	6.91	12.13	0.25	0.1	0.11	0.15	19.6	91.81	107.86	4.29	1.39	0.73	0.029	0.22	3.15
I_1	71.3	126.08	20.13	13.29	6.92	29.76	281.04	1061.2	1342.2	58.64	26.57	20.96	0.62	13.32	36.36
I_2	119.23	184.76	23.56	14.46	7.65	33.79	588.23	1714.3	2302.6	65.56	34.38	25.42	0.83	12.42	74.36
I_3	153.94	212.13	25.58	14.96	7.96	35.62	720.61	1765.7	2486.3	72.55	40.88	28.76	0.87	12.58	91.24
I_4	188.2	271.19	27.06	15.57	8.21	37.76	808.51	1853.1	2661.7	70.5	43.99	30.23	0.85	12.88	104.28
L .S .D .05	6.45	11.28	0.51	0.2	0.12	0.5	13.54	33.72	39.9	3.78	0.98	0.52	0.022	0.07	1.8

F_1: without NPK fertilizers. F_2: NPK fertilizers. A_1: sowing. A_2: tillering stage. A_3: after 15 days from full heading stage.
I_1: Without (S.I.) supplemental irrigation. I_2: S.I. by 60 mm/fed. I_3: S.I. by 90 mm/fed. I_4: S.I. by 120 mm/fed.

Table (2): Effect of NPK fertilizer (F), adding times (A) and supplemental irrigation (I) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2001/2002 growing season.

Characters / Treatments	Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
F_1	93.75	155.4	20.16	12.38	6.66	31.51	506.29	1695	2201.3	58.18	30	22	0.61	12.3	61.65
F_2	123.08	180.93	22.14	12.8	6.91	32.69	619.67	1753.6	2401.1	66.08	34.05	24.41	0.74	12.69	77.99
L .S .D .05	8.4	12.89	0.53	0.26	0.11	0.32	19.08	NS	36.9	6.41	2.04	0.45	0.024	0.21	7.45
A_1	106.85	178.43	20.76	12.4	6.81	32.01	525.73	1875.6	2401.3	57.16	27.35	20.78	0.63	11.82	61.13
A_2	116.01	179.69	22.52	13.31	7.12	33.05	685.55	1637.8	2365.1	61.78	39.72	27.22	0.82	12.38	84.47
A_3	102.39	146.38	20.17	12.06	6.42	31.24	477.65	1659.5	2137.2	67.46	29	21.61	0.58	13.28	63.85
L .S .D .05	3.04	7.29	0.22	0.13	0.09	0.17	7.89	182.46	143.07	2.75	2.2	1.31	0.011	0.7	1.51
I_1	48.44	98.03	17.23	11.24	5.9	27.66	201.28	1284.4	1485.7	49.59	18.07	13.74	0.4	13.01	25.11
I_2	89.3	149.46	20.61	12.46	6.68	31.62	563.07	1904.7	2467.8	60.16	30.08	22.76	0.74	12.12	68.39
I_3	125.72	186.76	22.64	13.06	7.09	33.52	692.99	1873.7	2566.7	66.87	37.48	26.81	0.78	12.3	85.7
I_4	170.2	238.41	24.12	13.61	7.47	35.61	794.58	1834.4	2684.5	71.91	42.47	29.51	0.79	12.56	100.08
L .S .D .05	4.84	8.87	0.53	0.27	0.17	0.5	10.59	116.12	95.46	2.91	1.49	0.71	0.016	0.09	1.43

F_1: without NPK fertilizers. F_2: NPK fertilizers. A_1: sowing. A_2: tillering stage. A_3: after 15 days from full heading stage.
I_1: Without (S.I.) supplemental irrigation. I_2: S.I. by 60 mm/fed. I_3: S.I. by 90 mm/fed. I_4: S.I. by 120 mm/fed.

Table (3): Effect of the interaction between NPK fertilizer (F) and adding times (A) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2000/2001 growing season.

Characters / Treatments		Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
F1	A1	105.82	176.73	22.92	14.08	7.48	33.56	519.8	1631	2150.8	60.7	31.02	23.43	0.68	11.84	61.17
	A2	127.72	195.14	24.1	15.07	7.85	34.72	635.3	1525	2160	65.73	40.55	28.68	0.85	12.48	79.23
	A3	126.7	158.38	22.47	13.93	7.27	32.81	486.6	1526	2012.2	78.9	31.5	23.92	0.66	13.48	66.75
F2	A1	150.43	225.24	24.55	14.58	7.83	34.68	604.6	1817	2421.9	65.88	32.08	24.19	0.79	12.32	74.66
	A2	164.62	246.48	26.6	15.47	8.11	35.65	813.9	1648	2462.3	65.3	47.05	31.2	1.04	12.9	102.91
	A3	123.73	189.28	23.86	14.27	7.55	33.97	537.5	1445	1982.1	64.38	36.53	26.62	0.72	13.79	74.64
L .S .D .05		9.77	NS	0.36	NS	NS	NS	27.72	129.8	152.54	6.06	1.97	1.04	0.041	NS	4.46

F_1: without NPK fertilizers. F_2: NPK fertilizers. A_1: sowing. A_2: tillering stage. A_3: after 15 days from full heading stage.

Table (4): Effect of the interaction between NPK fertilizers (F) and adding Times (A) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2001/2002 growing season.

Characters / Treatments		Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
F1	A1	83.84	157.69	19.92	12.18	6.69	31.36	477.6	1840	2317.6	50.95	25.93	19.58	0.57	11.61	54.83
	A2	98.53	162.91	21.17	13.1	6.98	32.58	597	1563	2160.1	58.13	37.85	26.27	0.72	12.23	72.3
	A3	98.88	145.59	19.41	11.85	6.3	30.6	444.3	1682	2126.2	65.46	26.23	20.16	0.54	13.07	57.83
F2	A1	129.85	199.17	21.6	12.61	6.93	32.67	573.9	1911	2485.1	63.38	28.77	21.99	0.69	12.04	67.44
	A2	133.48	196.48	23.88	13.52	7.26	33.53	774.1	1713	2570.1	65.43	41.59	28.18	0.91	12.54	96.64
	A3	105.9	147.16	20.94	12.27	6.54	31.88	511.1	1637	2148.1	69.45	31.77	23.07	0.63	13.49	69.88
L .S .D .05		4.3	10.31	0.32	NS	NS	NS	11.16	NS	202.33	3.89	NS	NS	0.016	NS	2.13

F_1: without NPK fertilizers. F_2: NPK fertilizers. A_1: sowing. A_2: tillering stage. A_3: after 15 days from full heading stage.

Table (5): Effect of the interaction between NPK fertilizers (F) and supplemental irrigation (I) on grain Yield, Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2000/2001 growing season.

Characters / Treatments		Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
F1	I_1	68.12	99.87	19.1	13.11	6.79	29.14	288.7	1060	1348.5	68.13	27.33	21.45	0.64	13.05	36.7
	I_2	98.74	154.14	22.67	14.24	7.49	33.27	530.8	1640	2171.2	65.37	32.57	24.27	0.75	12.22	66.11
	I_3	134.7	192.62	24.63	14.76	7.8	35.1	633.5	1718	2351.3	69.91	36.98	26.91	0.76	12.4	79.24
	I_4	178.74	260.38	26.24	15.33	8.06	37.27	735.9	1824	2559.6	70.36	40.53	28.73	0.77	12.72	94.15
F2	I_1	74.48	152.3	21.17	13.47	7.04	30.37	273.4	1063	1335.9	49.15	25.8	20.47	0.6	13.6	36.02
	I_2	139.71	215.39	24.44	14.68	7.81	34.32	645.7	1788	2434	65.75	36.19	26.56	0.91	12.62	82.62
	I_3	173.19	231.64	26.52	15.17	8.11	36.13	807.8	1814	2621.4	75.2	44.77	30.61	0.97	12.77	103.24
	I_4	197.66	282.01	27.88	15.8	8.36	38.24	881.1	1883	2763.7	70.64	47.46	31.73	0.92	13.03	114.41
L. S. D .05		9.12	15.96	NS	NS	NS	NS	19.15	47.69	56.42	5.35	1.39	0.73	0.031	0.1	2.54

F_1: without NPK fertilizers. F_2: NPK fertilizers. I_1: Without (S.I.) supplemental irrigation. I_2: S.I. by 60 mm/fed.
I_3: S.I. by 90 mm/fed . I_4: S.I. by 120 mm/fed.

Table (6): Effect of the interaction between NPK fertilizers (F) and supplemental irrigation (I) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2001/2002 growing season.

Characters / Treatments		Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
F1	I_1	43.82	93.69	15.9	11	5.79	26.92	184.8	1398	1583.1	47.05	15.65	11.74	0.36	12.78	22.87
	I_2	71.78	128.63	19.71	12.26	6.56	31.1	507	1782	2289.2	56.09	29.24	22.14	0.67	11.95	60.93
	I_3	103.63	168.49	21.76	12.86	6.97	32.98	602	1756	2358.4	61.24	35.04	25.6	0.68	12.12	72.76
	I_4	155.78	230.78	23.29	13.4	7.32	35.04	731.3	1843	2574.5	68.34	40.08	28.53	0.72	12.37	90.04
F2	I_1	53.06	102.38	18.57	11.48	6.01	28.39	217.8	1171	1388.4	52.13	20.49	15.74	0.43	13.23	27.35
	I_2	106.82	170.29	21.51	12.66	6.8	32.14	619.1	2027	2646.4	64.24	30.92	23.39	0.81	12.28	75.84
	I_3	147.81	205.02	23.53	13.26	7.22	34.06	784	1991	2775	72.49	39.91	28.02	0.88	12.48	98.63
	I_4	184.63	246.05	24.94	13.81	7.61	36.17	857.9	1826	2794.5	75.48	44.87	30.48	0.85	12.75	110.12
L. S. D .05		6.84	12.55	NS	NS	NS	NS	14.97	164.2	135	NS	NS	1	0.022	NS	2.03

F_1: without NPK fertilizers. F_2: NPK fertilizers. I_1: Without (S.I.) supplemental irrigation. I_2: S.I. by 60 mm/fed.
I_3: S.I. by 90 mm/fed . I_4: S.I. by 120 mm/fed.

Table (7): Effect of the interaction between adding time (A) and supplemental irrigation (I) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2000/2001 growing season.

Characters / Treatments		Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
A1	I_1	62.33	115.82	20.27	13.33	7.05	29.38	260.04	1063	1323	56.39	24.51	19.66	0.57	13.25	34.43
	I_2	125.52	207.91	23.28	14.13	7.57	33.75	521.18	1829.7	2350.9	60.6	28.24	21.87	0.74	11.43	60.87
	I_3	135.68	189.78	25.05	14.57	7.9	35.6	680.49	1925.2	2605.7	70.62	35.35	26.13	0.82	11.6	80.33
	I_4	188.95	290.43	26.33	15.3	8.12	37.75	786.92	2078.7	2865.8	65.54	38.1	27.57	0.83	12.05	96.03
A2	I_1	75.7	138	20.52	13.47	6.88	30.28	292.95	1065.2	1358.2	57.55	27.64	21.61	0.65	13.27	36.97
	I_2	122.45	186.83	24.87	15.25	8.08	34.88	709.63	1734.6	2444.2	65.7	41.07	29.09	1.01	12.27	88.39
	I_3	181.65	253.3	27.22	16	8.37	36.58	900.1	1757.1	2657.2	71.71	51.06	33.62	1.08	12.45	112.34
	I_4	204.87	305.12	28.8	16.38	8.58	38.98	995.65	1789.3	2784.9	67.09	55.41	35.45	1.04	12.75	126.58
A3	I_1	75.87	124.43	19.62	13.07	6.82	29.6	290.12	1055.3	1345.4	61.99	27.56	21.6	0.64	13.45	37.67
	I_2	109.72	159.55	22.52	14	7.3	32.75	533.88	1578.7	2112.6	70.37	33.83	25.28	0.76	13.55	73.83
	I_3	144.5	193.32	24.47	14.32	7.6	34.67	581.23	1614.9	2196.2	75.34	36.21	26.53	0.7	13.7	81.05
	I_4	170.78	218.03	26.05	15.02	7.92	36.53	642.97	1691.4	2334.3	78.86	38.47	27.67	0.67	13.82	90.24
L .S .D .05		11.17	19.54	0.89	0.35	0.21	NS	23.45	58.4	69.1	NS	1.7	0.9	0.038	0.12	3.11

A_1: sowing. A_2: tillering stage. A_3: after 15 days from full heading stage. I_1: Without (S.I.) supplemental irrigation.
I_2: S.I. by 60 mm/fed. I_3: S.I. by 90 mm/fed . I_4: S.I. by 120 mm/fed.

Table (8): Effect of the interaction between adding times (A) and supplemental irrigation (I) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2001/2002 growing season.

Characters / Treatments		Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
A1	I_1	45.68	92.38	17.2	11.2	6	27.32	192.24	1289.8	1482	49.44	16.47	13.15	0.38	13	24.12
	I_2	96.35	180.53	20.32	12.18	6.6	31.57	498.97	2048.3	2547.3	52.15	24.29	19.3	0.66	11.2	56.18
	I_3	115.1	183.35	22.18	12.85	7.05	33.5	647.93	2083.1	2731	60.8	31.49	23.72	0.73	11.38	74.42
	I_4	170.25	257.45	23.33	13.35	7.6	35.67	763.8	2081.2	2845	66.27	37.15	26.97	0.76	11.73	89.82
A2	I_1	49.52	102.15	17.97	11.55	6.03	28.2	205.22	1240.5	1445.7	48.61	19.11	14.39	0.41	12.93	25.4
	I_2	91.53	147.45	21.97	13.27	7.08	32.73	685.42	1884.5	2569.9	61.65	37.15	26.93	0.9	12	82.46
	I_3	139.26	211.15	24.28	13.98	7.55	34.58	874.82	1802.9	2677.7	65.68	48.34	32.45	0.99	12.2	107.76
	I_4	183.72	258.02	25.87	14.45	7.82	36.68	976.77	1623.5	2766.9	71.18	54.28	35.11	0.97	12.4	122.26
A3	I_1	50.12	99.57	16.53	10.97	5.67	27.45	206.38	1323.1	1529.4	50.73	18.62	13.68	0.41	13.1	25.81
	I_2	80.02	120.4	19.55	11.92	6.35	30.57	504.83	1718.3	2286.2	66.69	28.8	22.07	0.66	13.15	66.52
	I_3	122.8	165.77	21.47	12.33	6.68	32.47	556.23	1735.2	2291.4	74.12	32.6	24.26	0.63	13.32	74.9
	I_4	156.63	199.77	23.15	13.02	6.98	34.47	643.17	1798.5	2441.6	78.28	35.99	26.43	0.64	13.55	88.17
L .S .D .05		8.38	15.37	NS	NS	NS	NS	18.34	201.12	165.35	5.04	2.58	1.23	0.027	0.16	2.48

A_1: sowing. A_2: tillering stage. A_3: after 15 days from full heading stage. I_1: Without (S.I.) supplemental irrigation.
I_2: S.I. by 60 mm/fed. I_3: S.I. by 90 mm/fed . I_4: S.I. by 120 mm/fed.

Table (9): Effect of the interaction between NPK fertilizers (F), adding times (A) and supplemental irrigation (I) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2000/2001 growing season.

Characters / Treatments			Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
F_1	A_1	I_1	57.67	87.4	19	13.1	6.9	28.7	273.57	1078.4	1352	66.08	25.38	20.26	0.6	13	34.94
		I_2	83.6	149.99	22.47	13.97	7.37	33.23	392.9	1723.2	2116.08	57.64	22.87	18.56	0.56	11.2	44.57
		I_3	93.03	168.93	24.43	14.3	7.7	35.1	619.67	1786.9	2406.53	56.1	34.76	25.8	0.75	11.35	70.93
		I_4	188.97	300.6	25.77	14.97	7.97	37.2	792.93	1935.5	2728.46	62.98	41.06	29.08	0.83	11.8	94.26
	A_2	I_1	70.77	103.33	19.5	13.3	6.77	29.77	301.33	1006.7	1308.03	68.43	29.96	23.04	0.66	12.9	37.16
		I_2	102.53	172.27	23.77	14.97	7.97	34.4	700.03	1667.6	2367.57	59.75	42.11	29.6	0.99	12.1	85.79
		I_3	155.53	222.24	25.7	15.83	8.23	36.17	736.5	1697.4	2433.92	70.27	43.49	30.3	0.89	12.25	91.15
		I_4	182.03	282.73	27.43	16.2	8.43	38.53	803.23	1727.1	2530.31	64.45	46.62	31.78	0.84	12.65	102.82
	A_3	I_1	75.93	108.87	18.8	12.93	6.7	28.97	291.17	1094.2	1385.33	69.89	26.66	21.05	0.64	13.25	37.99
		I_2	110.1	140.17	21.77	13.8	7.13	32.17	499.47	1530.4	2029.82	78.72	32.72	24.66	0.71	13.35	67.98
		I_3	155.53	186.7	23.77	14.13	7.43	34.03	544.2	1669.2	2213.39	83.35	32.7	24.63	0.66	13.6	75.65
		I_4	165.23	197.8	25.53	14.83	7.77	36.07	611.5	1808.6	2420.09	83.66	33.9	25.32	0.64	13.7	85.38
F_2	A_1	I_1	67	144.23	21.53	13.57	7.2	30.07	246.52	1047.5	1294	46.7	23.63	19.07	0.54	13.5	33.92
		I_2	167.43	265.83	24.1	14.3	7.77	34.27	649.47	1936.2	2585.65	63.57	33.6	25.19	0.92	11.65	77.18
		I_3	178.33	210.63	25.67	14.83	8.1	36.1	741.32	2063.5	2804.81	85.13	35.95	26.45	0.89	11.85	89.74
		I_4	188.93	280.27	26.9	15.63	8.27	38.3	780.9	2221.8	3003.05	68.11	35.14	26.06	0.82	12.3	97.8
	A_2	I_1	80.63	172.67	21.53	13.63	7	30.8	284.57	1123.7	1408.3	46.67	25.33	20.18	0.63	13.65	36.78
		I_2	142.37	201.4	25.97	15.53	8.2	35.37	719.23	1801.6	2520.82	71.65	40.03	28.58	1.02	12.45	90.99
		I_3	207.77	284.37	28.73	16.17	8.5	37	1063.7	1816.7	2880.44	73.15	58.63	36.94	1.28	12.65	133.54
		I_4	227.7	327.5	30.17	16.57	8.73	39.43	1188.1	1851.5	3039.58	69.73	64.2	39.12	1.24	12.85	150.34
	A_3	I_1	75.8	140	20.43	13.2	6.93	30.23	289.07	1016.5	1305.51	54.1	28.45	22.15	0.64	13.65	37.35
		I_2	109.33	178.93	23.27	14.2	7.47	33.33	568.3	1627.1	2195.4	62.03	34.94	25.91	0.8	13.75	79.68
		I_3	133.47	199.93	25.17	14.5	7.37	35.3	618.27	1560.7	2178.94	67.33	39.71	28.43	0.74	13.8	86.45
		I_4	176.33	238.27	26.57	15.2	8.07	37	674.43	1574.2	2248.6	74.06	43.04	30.01	0.7	13.95	95.1
L.S.D.05			15.8	27.64	NS	NS	NS	NS	33.16	82.59	97.72	9.26	2.41	1.27	0.054	NS	4.4

F_1: without NPK fertilizers. F_2: NPK fertilizers. A_1: sowing. A_2: tillering stage. A_3: after 15 days from full heading stage.
I_1: Without (S.I.) supplemental irrigation. I_2: S.I. by 60 mm/fed. I_3: S.I. by 90 mm/fed . I_4: S.I. by 120 mm/fed.

Table (10): Effect of the interaction between NPK fertilizers (F), adding times (A) and supplemental irrigation (I) on grain Yield ,Yield attributes, protein % and protein yield of Sakha-8 wheat cultivar during 2001/2002 growing season.

Characters / Treatments			Number of spikes/ m^2	Number of tillers/ m^2	Number of grains/ spike	Number of spikelets / spike	Spike length (cm)	Weight of 1000 grains (g)	Grain Yield kg/fad	Straw Yield kg/fad	Biological Yield kg/fad	Tillering index %	Crop index %	Harvest index %	W.U.E kg/m^3	Protein %	Protein yield Kg / fad
F_1	A_1	I_1	39.9	83.86	15.73	10.87	5.83	26.57	189.48	1440.4	1629.9	47.63	15.08	11.66	0.37	12.7	23.51
		I_2	60.3	131.2	19.53	12.1	6.5	30.9	365.43	1947.7	2313.13	46.21	19.34	15.82	0.48	11.05	41.1
		I_3	73.03	151.33	21.6	12.63	6.93	33	581.33	1940.9	2522.27	48.62	30.74	23.12	0.66	11.2	65.6
		I_4	162.13	264.37	22.8	13.13	7.5	34.97	774.17	2030.9	2805.1	61.34	38.55	27.71	0.77	11.5	89.08
	A_2	I_1	44.13	98.03	16.4	11.4	5.93	27.6	183.43	1337.8	1521.27	45.55	16.63	12.13	0.36	12.7	22.47
		I_2	74.43	130.47	20.87	12.93	6.93	32.4	679.5	1665.1	2344.57	57.04	41.09	29.04	0.89	11.9	81.13
		I_3	117.43	188.77	22.87	13.77	7.4	34.1	712.87	1615.1	2327.93	62.24	44.37	30.66	0.81	12.05	85.82
		I_4	158.13	234.37	24.53	14.3	7.67	36.2	812.27	1634.3	2446.57	67.68	49.31	33.25	0.8	12.25	99.8
	A_3	I_1	47.44	99.17	15.57	10.73	5.6	26.6	181.5	1416.6	1598.07	47.97	15.24	11.43	0.36	12.95	22.63
		I_2	80.6	124.23	18.73	11.73	6.23	30	476.2	1733.7	2209.9	65.01	27.29	21.55	0.63	12.9	60.57
		I_3	120.43	165.37	20.8	12.17	6.57	31.83	511.83	1713.2	2225	72.87	30.01	23.01	0.58	13.1	66.88
		I_4	147.07	193.6	22.53	12.77	6.8	33.97	607.47	1864.4	2471.9	76	32.37	24.63	0.6	13.35	81.23
F_2	A_1	I_1	51.47	100.9	18.67	11.53	6.17	28.07	195	1139.2	1334.2	51.24	17.87	14.63	0.38	13.3	24.72
		I_2	132.4	229.87	21.1	12.27	6.7	32.23	632.5	2149	2781.47	58.09	29.24	22.78	0.83	11.35	71.26
		I_3	157.17	215.37	22.77	13.07	7.17	34	714.53	2225.2	2939.73	72.97	32.23	24.31	0.8	11.55	83.24
		I_4	178.37	250.54	23.87	13.57	7.7	36.37	753.43	2131.4	2884.83	71.2	35.75	26.23	0.74	11.95	90.55
	A_2	I_1	54.91	106.27	19.53	11.7	6.13	28.8	227	1143.1	1370.1	51.67	21.59	16.66	0.45	13.15	28.33
		I_2	108.63	164.43	23.07	13.6	7.23	33.07	691.33	2103.9	2795.27	66.26	33.2	24.82	0.91	12.1	83.79
		I_3	161.09	233.53	25.7	14.2	7.7	35.07	1036.8	1990.8	3027.53	69.12	52.31	34.25	1.17	12.35	129.71
		I_4	209.3	281.67	27.2	14.6	7.97	37.17	1141.3	1612.7	3087.3	74.67	59.24	36.98	1.13	12.55	144.71
	A_3	I_1	52.8	99.97	17.5	11.2	5.73	28.3	231.27	1229.6	1460.83	53.49	22.01	15.94	0.45	13.25	28.99
		I_2	79.43	116.57	20.37	12.1	6.47	31.13	533.47	1829	2362.47	68.37	30.31	22.58	0.7	13.4	72.47
		I_3	125.17	116.17	22.13	12.5	6.8	33.1	600.63	1757.3	2357.8	75.37	35.18	25.51	0.68	13.55	82.93
		I_4	166.2	205.93	23.77	13.27	7.17	34.97	678.87	1732.5	2411.37	80.57	39.6	28.24	0.67	13.75	95.1
L.S.D .05			11.85	21.74	NS	NS	NS	NS	25.93	NS	233.84	7.13	3.65	1.74	0.039	NS	3.51

F_1: without NPK fertilizers. F_2: NPK fertilizers. A_1: sowing. A_2: tillering stage. A_3: after 15 days from full heading stage.
I_1: Without (S.I.) supplemental irrigation. I_2: S.I. by 60 mm/fed. I_3: S.I. by 90 mm/fed . I_4: S.I. by 120 mm/fed.

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استجابة القمح للري التكميلي والتسميد تحت ظروف الساحل الشمالي الغربي بمصر

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أجريت تجربتان حقليتان على محصول القمح صنف سخا٨ بمنطقة القصر – محافظة مرسي مطروح – الساحل الشمالي الغربي لمصر أثناء موسمي ٢٠٠٠/٢٠٠١ و ٢٠٠١ / ٢٠٠٢ واشتملت كل تجربة على٢٤ معاملة هي التوافيق بين مستويين من التسميد: بدون تسميد ، تسميد (٣١ كجم نتروجين + ٢٢,٥كجم فوسفور + ٢٤كجم بوتاسيوم /فدان) ، و ثلاث مواعيد أضافه (عند الزراعة، طور التفريع القاعدي، بعد اكتمال طرد السنابل بـ ١٥ يوم) ، وأربع مستويات من عمق ماء الري (مم) كري تكميلي (بدون ري تكميلي (أمطار فقط)، ري

تكميلـــي بمقـــدار ٦٠مم/ فدان ، ري تكميلي بمقدار ٩٠مم/فدان ، ري تكميلي بمقدار ١٢٠ مم /فـــدان) وذلـــك في تصميم القطع المنشقة مرتين حيث وضع التسميد في القطع الرئيسية بينما وضـــعت معـــاملات مواعيد الإضافة في القطع الفرعية ووضعت معاملات الري التكميلي في القطع تحت الفرعية في ثلاث مكررات . واتضح من النتائج أن:-

١- أزداد معـــنويا عـــدد الســـنابل والأشطاء/م٢ ، عدد الحبوب والسنيبلات/سنبلة ، طول الســـنبلة، ووزن ١٠٠٠ حبة ، محصول الحبوب والبيولوجي ، دليل المحصول ،كفاءة استخدام المياه ومحصول البروتين عند الحصاد بإضافة التسميد (٣١ كجم نيتروجين + ٢٢,٥ كجم فوسفور + ٢٤ كجم بوتاسيوم/فدان).

٢- زادت معـــنوياً كلاً من عدد السنابل والأشطاء /م٢ ، عدد الحبوب والسنيبلات /سنبلة ، طـــول الســـنبلة ، وزن ١٠٠٠حـــبة ، محصول الحبوب والبيولوجي ، دليل المحصول والحصـــاد ، كفاءة استخدام المياه ومحصول البروتين بميعاد إضافة الري التكميلي عند طور التفريغ القاعدي.

٣- أعطت إضافة ١٢٠مم/فدان (عمق الري) كري تكميلي اكبر زيادة معنوية لصفات عدد السنابل والأشطاء /م٢ ، عدد الحبوب والسنيبلات /سنبلة ، طول السنبلة ، وزن ١٠٠٠ حبة ، محصول الحبوب والبيولوجي، دليل المحصول والحصاد ومحصول البروتين.

٤- أعطي التفاعل بين الثلاث عوامل تحت الدراسة:-إضافة التسميد (٣١ كجم نيتروجين + ٢٢,٥ كجـــم فوســـفور + ٢٤ كجم بوتاسيوم/فدان) + ميعاد إضافة الري التكميلي عند طـــور الـــتفريغ القـــاعدي + عمق الري بمقدار ١٢٠مم/فدان كري تكميلي اكبر زيادة معـــنوية لصـــفات عدد السنابل والأشطاء /م٢ ، محصول الحبوب والبيولوجي ، دليل المحصول والحصاد ومحصول البروتين.