RESULTS AND DISCUSSION

FIRST EXPERIMENT :

EFFECT OF NITROGEN, PHOSPHORUS AND POTASSIUM LEVELS ON THE GROWTH AND YIELD OF WHEAT GROWN UNDER CALCAREOUS SOIL CONDITION

Results will be discussed under the following topics :-

1- Heading date :

The effect of N, P and K fertilization levels and their interactions on number of days from sowing to 50% spike emergence of Sakha 69 wheat cultivar in 1990/91 and 1991/92 season are presented in Table (3).

Results indicated that N levels significantly influenced heading date in both seasons of experimentation. Increasing N level significantly delayed heading date. Increasing N level from zero to 120 kg/fad. delayed wheat heading by 2.71 and 2.58 days in 1990/1991 and 1991/1992 season, respectively. Significant differences were detected between the check treatment and 60, 90 and 120 kg N/fad. in the first season and between the check treatment and all of the other N levels in the second season.

It is well known that high levels of N will usually prolong growing period and retard maturity. Similar results were also reported by Abu-Hagaza (1977), Eissa (1979), Ibrahim (1984), Abdel Aleem (1987) and Rady (1991).

The effect of P levels was also significant on heading date in both seasons. Phosphorus application significantly

Table(3): Effect of N,P and K levels on heading date of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Number of days from sowing to heading 1990/1991 season						Number of days from sowing to heading 1991/1992 season					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	90.00	90.75	90.75	92.00	92.25	91.10	94.00	94.75	96.75	95.25	96.00	95.35
0	48	92.25	89.50	91.75	93.95	92.50	91.55	93.75	95.25	95.75	96.00	96.50	95.45
Mean		90.12	90.12	91.25	92.88	92.25	91.32	93.88	95.00	96.25	95.62	96.25	95.40
15	0	83.25	87.00	86.00	89.00	88.50	86.75	93.50	96.00	96.25	95.25	95.00	95.20
15	48	88.00	87.00	88.75	90.00	89.25	88.60	92.25	94.25	96.75	95.50	95.75	94.40
Mean		85.62	87.00	87.38	89.50	88.88	87.68	92.88	95.12	96.50	95.38	95.38	95.05
30	0	90.00	89.25	90.25	91.00	91.50	90.40	93.25	94.75	94.75	94.75	94.50	94.40
30	48	87.25	88.50	90.00	90.00	91.25	90.83	92.25	95.25	94.50	95.25	96.75	94.80
Mean		88.62	88.88	90.12	90.50	91.38	89.90	92.75	95.00	94.62	95.00	95.62	94.60
Overall mean of K_2O levels	0	87.75	89.00	89.00	90.67	90.67	89.42	93.85	95.17	95.92	95.08	95.17	94.98
	48	88.50	88.33	90.17	91.25	91.00	89.85	92.75	94.92	95.67	95.58	96.33	95.05
Overall mean of N levels		88.12	88.67	89.58	90.96	90.83	89.63	93.17	95.04	95.79	95.33	95.75	95.02

L.S.D at 0.05

	First season 1990/1991	Second season 1991/1992
N	1.32	1.05
P	2.35	0.59
K	---	---
NxP	---	---
NxK	---	---
PxK	---	---
NxPxK	---	---

accelerated heading date. This acceleration was quite clear when P was applied at a level of 15 kg P_2O_5 in the first season, and 30 kg P_2O_5/fad. in the second one. Such P levels enhanced wheat heading by 3.64 and 8 days compared with the check treatment in the first and second season, respectively.

This result indicates clearly the role of P which has been associated with early flowering of crops, particularly the cereals.

However the present result disagrees with those reported by Gardener and Jackson (1976), Eman Sadek (1985) and Abdel Aleem (1987).

With regard to the effect of K application on heading date, results in Table (3) showed no significant effect for this element on this character. This may be due to the presence of adequate amount of this element in the soil as shown in Table (1).

Also several investigators reported that wheat showed no significant response to K application such as Eman Sadek (1985) and Abdel Aleem (1987).

The interaction effects between the applied experimental factors on heading date were not significant in both seasons.

This result indicates clearly that each experimental factor acted independently in affecting heading date of wheat grown under calcareous soil conditions.

In general, the earliest heading was recorded after 83.25

days when using the combination of zero Kg N + 15 Kg P_2O_5 + zero kg K_2O/fad. in 1990/91 season, and after 92.25 days when using zero Kg N + 15-30 Kg P_2O_5 + 48 Kg K_2O in 1991/92 seasons.

The delayest heading in 1990/91 season was recorded after 93.75 days with the combination of 90 Kg N + zero Kg P_2O_5 + 48 Kg K_2O/fad., whereas in 1991/92 season the combination of 60 Kg N + zero Kg P_2O_5 + zero Kg K_2O/fad. caused the latest heading date that was achieved after 96.75 days from sowing.

2- Maturity date :

Data for the effect of N, P and K as well as their interaction on date of maturity of wheat plants cultivar Sakha 69 grown under calcareous soil conditions in 1990/91 and 1991/92 are shown in Table (4).

Result showed that the increase in N level significantly delayed maturity date of wheat in both seasons of experimentation.

In 1990/91 season, maturity has been delayed by 4.41, 11.46, 18.67 and 26.58 days when nitrogen was applied at a rate of 30, 60,90 and 120 kg/fad. as compared with the check treatment, respectively.

In 1991/92 season, the application of the same subsequent N levels delayed maturity by 4.75, 11.21, 17.95 and 27.16 days, respectively.

All differences in maturity due to the applied N levels were significant in both seasons.

Table(4): Effect of N,P and K levels on maturity date of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Number of days from sowing to maturity 1990/1991 seasons						Number of days from sowing to maturity 1991/1992 seasons					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/Fad.	K_2O levels Kg/Fad.	Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	123.25	128.50	135.00	144.50	151.00	136.45	123.25	126.75	133.00	141.75	150.75	135.10
0	48	123.75	130.50	134.50	146.50	151.25	137.30	124.75	129.00	134.75	142.00	151.00	136.30
Mean		123.50	129.50	134.75	145.50	151.12	136.88	124.00	127.88	133.88	141.88	150.88	135.70
15	0	124.75	125.75	133.00	141.75	149.75	135.00	124.25	131.50	133.25	142.50	150.50	136.40
15	48	124.75	127.50	133.50	140.00	149.75	135.10	124.00	128.00	131.75	140.75	151.25	135.15
Mean		124.75	126.62	133.25	140.88	149.75	135.05	124.12	129.75	132.50	141.62	150.88	135.78
30	0	124.75	129.25	136.00	142.50	150.75	136.65	124.00	128.75	142.25	143.00	152.75	138.15
30	48	124.00	130.25	142.00	142.00	152.25	138.10	124.75	129.50	137.25	142.75	151.75	137.20
Mean		124.38	129.75	139.00	142.25	151.50	137.38	124.38	129.12	139.75	142.88	152.25	137.68
Overall mean of K_2O levels	0	124.25	127.83	134.67	142.92	150.50	136.03	123.83	129.00	136.17	142.42	151.33	136.55
	48	124.17	129.42	136.67	142.83	151.08	136.33	124.50	128.83	134.58	141.83	151.33	136.22
Overall mean of N levels		124.21	128.62	135.67	142.88	150.79	136.43	124.17	128.92	135.38	142.12	151.33	136.38

L.S.D at 0.05:

	First season 1990/1991	Second season 1991/1992
N	1.63	1.75
P	1.44	1.21
K	---	---
NxP	2.82	3.03
NxK	---	---
PxK	---	---
NxPxK	---	---

The present results show clearly that a good supply of N will usually prolong growing period and retard maturity as well. Prolonging the growing period will certainly increase the vegetative growth and contribute much to the photosynthesis process and metabolite production in plants. Consequently a marked increase in grain and straw yields is expected.

Similar results were reported by Abou-Hagaza (1977), Eissa (1979), Ibrahim (1984), Abdel-Aleem (1987) and Rady (1991).

Phosphorus application also delayed maturity date, but to a slight extend since the differences were nearly significant. Applying P at 30 kg P_2O/fad. delayed maturity by 0.50 and 1.98 days in 1990/91 and 1991/92 season, respectively.

It is clear that the role of P on maturity date was not that great as indicated for N application.

Phosphorus application is known to be associated with the early maturity which is not the trend of the present results. This result could be due to the calcareous soil condition. In such soil the excess of calcium content may fix the applied phosphorus and or change the phosphorus to its unavailable form to the plants.

Moreover, results reported by Gardener and Jackson (1976), Eman Sadek (1985) and Abdel-Aleem (1987) showed that P application had no significant effect on maturity date of wheat.

The role of K on wheat maturity under calcareous soil condition is not evident. This may be due to adequate k content of the soil (Table 1)

The present results showed the clear effect of N on maturity date as compared with P and K.

The interaction between N and P significantly affected maturity date of wheat in the two grown seasons (Table 5).

Results showed that the effect of P on maturity date was more clear under higher N levels than for lower levels. The delayest maturity was after 151.50 and 152.25 days in 1990/91 and 1991/92 season, respectively, which were recorded with the application of 120 kg N + 30 kg P_2O_5/fad.

On the other hand, the earliest maturity was recorded with the unfertilized treatment in both seasons, which occurred after 123.50 and 124.00 days from sowing in the first and second season, respectively.

3- Flag leaf area :

Data for the effect of N, P and K fertilization levels and their interactions on flag leaf area of wheat (cv. Sakha 69) in 1990/91 and 1991/92 seasons are presented in Table (5).

Results showed that increasing N level significantly increased flag leaf area of wheat in both seasons. The highest flag leaf area was recorded at a rate of 90 kg N/fad. in 1990/91 season and at 120 kg N/fad. level in 1991/92 season.

Increasing N level from zero to 30, 60, 90 and 120 kg/fad increased flag leaf area by 5.6, 34.2, 51.9 and 39.9%, respectively in the first season. The corresponding increases in the second season were 5.6, 4.5, 5.5 and 14.7%. The increase of flag leaf area in both seasons was calculated and above the control.

Table(5):Effect of N,P and K levels of flag leaf area (cm^2) of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Flag leaf area (cm^2) 1990/1991 season						Flag leaf area (cm^2) 1991/1992 season					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	23.52	22.48	26.30	30.05	26.72	25.81	26.43	26.69	28.12	29.55	32.22	28.60
0	48	22.44	25.22	32.31	34.94	24.87	27.96	27.93	29.70	31.00	29.27	31.62	29.90
Mean		22.98	23.85	29.30	32.50	25.80	26.89	27.18	28.20	29.56	29.41	31.92	29.25
15	0	15.65	19.49	28.01	19.80	24.88	21.56	26.62	29.30	30.35	31.39	32.74	30.08
15	48	19.24	16.98	18.07	41.39	32.94	25.72	27.50	23.86	26.66	24.41	32.03	26.89
Mean		17.45	18.23	23.04	30.59	28.91	23.64	27.06	26.58	28.51	27.90	32.39	28.49
30	0	26.91	22.34	31.70	27.90	26.15	27.00	30.75	30.75	26.18	27.36	26.68	28.34
30	48	11.01	18.87	23.09	26.42	30.61	22.00	26.77	35.01	31.18	33.20	35.20	32.27
Mean		18.96	20.60	27.40	27.16	28.38	24.50	28.76	32.88	28.68	30.28	30.94	30.30
Overall mean of K_2O levels	0	22.03	21.43	28.67	25.92	25.92	24.79	27.93	28.91	28.22	29.43	30.55	29.01
	48	17.57	20.35	24.49	34.25	29.48	25.23	27.40	29.52	29.61	28.96	32.95	29.69
Overall mean of N levels		19.80	20.90	26.58	30.08	27.70	25.01	27.67	29.22	28.92	29.20	31.75	29.35

L.S.D at 0.05:

	First season 1990/1991		Second season 1991/1992
N	4.23	N	1.93
P	---	P	---
K	---	K	---
NxP	---	NxP	---
NxK	5.98	NxK	---
PxK	---	PxK	3.32
NxPxK	10.36	NxPxK	4.74

These marked increases in flag leaf area which were recorded after 100 days from sowing showed clearly that adequate supply of N is associated with vigorous vegetative growth. It is also known that flag leaf area of wheat plant plays an important role in photosynthesis activity in wheat. This in turn is reflected on metabolic activity in wheat and grain building. Similar result were reported by Nass et al. (1976), Bassiouny (1979), Saleh (1981), Gomma (1983), Abdel Aleem (1987) and Rady (1991).

Phosphour application had no significant effect on flag leaf area in both seasons. All differences between the three P levels were far below the level of significant which indicates that P status in the soil was not so critical that a supply of P fertilizer for wheat was needed at this stage of growth.

Similarly, k application had no significant effect on flag leaf area of wheat in both seasons. This result may be due to the presence of K in the soil in adequate amount, and the requirements of wheat plant grown in calcareous soil were available.

The interaction between N and K significantly affected flag leaf area in the first season. It is clear from Table (5) that the response of flag leaf area to N level was more evident when K was applied. Similarly, K was more effective on flag leaf area under higher N levels.

The greatest flag leaf area was 34.25 cm^2 in 1990/1991 season as recorded when using the combination of 90kg N + 48kg k_2O/fad.

Also the interaction between P and K significantly affected flag leaf area in the second season. In such season the response of flag leaf area to K was markedly stimulated at the highest P level. The greatest flag leaf area in 1991/1992 season was 32.27 cm^2 which was recorded when using 30 kg P_2O_5 + 48 kg k_2O/fad.

The second order interaction significantly affected flag leaf area in both seasons (Table 4). The greatest flag leaf area was 41.39 cm^2 in 1990/1991 season which was the result of applying 120 kg N + 30 kg P_2O_5 + 48 kg k_2O/fad.

It could be concluded that the response of flag leaf area of wheat plant, which is considered as a good criteria of plant growth, to the 3 major nutrients was greatly influenced by the second order interaction. An adequate supply of the 3 elements induced a marked effect on flag leaf area of wheat.

4- Plant height :

Data for the effect of N, P and K application levels as well as their interaction on plant height of Sakha 69 wheat cultivar are presented in Table (6).

Result showed that the increase in N level significantly increased plant height of wheat in the two seasons. Applying N at a rate of 30, 60, 90 and 120 kg/fad. increased plant height by 21.0, 32,0, 32.7 and 35.7 %, over the control treatment, respectively in 1990/91 season. The corresponding increases in 1991/92 season were 18.3, 27.9, 30.7 and 31.6 %. Differences in

Table(6):Effect of N.P.K levels on plant height (cm) of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Plant height (cm) 1990/1991 season						Plant height (cm) 1991/1992 Season					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	N levels (Kg/fad.)						N levels (Kg/fad.)					
		Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	77.08	109.25	113.33	110.00	118.75	105.68	75.62	98.75	103.12	105.00	109.38	98.38
0	48	86.25	100.00	107.92	112.92	116.25	104.67	85.62	93.75	106.88	108.12	100.62	99.00
Mean		81.67	104.62	110.63	111.46	117.50	105.18	80.62	96.25	105.00	106.56	105.00	98.69
15	0	91.09	107.08	116.25	117.09	117.50	109.80	76.88	98.12	100.00	114.38	116.25	101.12
15	48	95.00	109.58	118.33	121.25	120.75	112.98	86.25	01.25	111.25	110.00	116.88	105.12
Mean		93.04	108.33	117.29	119.17	119.12	111.39	81.56	99.69	105.62	112.19	116.00	103.12
30	0	82.92	104.17	122.92	120.83	121.67	110.50	85.00	95.00	110.62	107.50	106.38	100.90
30	48	92.50	105.00	113.75	114.16	117.08	108.50	86.25	99.38	101.88	102.62	102.50	98.52
Mean		87.71	104.58	118.33	117.50	119.38	109.50	85.62	97.19	106.25	105.06	104.44	99.71
Overall mean of K_2O levels	0	83.70	106.83	117.50	115.97	119.31	108.66	79.17	97.29	104.58	108.96	110.67	100.13
	48	91.25	104.86	113.33	116.11	118.03	108.72	86.04	98.12	106.67	106.92	106.67	100.88
Overall mean of N levels		87.47	105.85	115.42	116.04	118.67	108.69	82.60	97.71	105.62	107.94	108.67	100.51

L.S.D at 0.05:

	First season 1990/1991	Second season 1991/1992
N	4.88	4.39
P	---	---
K	---	---
NxP	---	---
NxK	---	---
PxK	---	---
NxPxK	---	---

wheat plant height among the levels of 60, 90 and 120 kg N/fad. were not significant in the two seasons.

The role of N on wheat growth is clearly illustrated under the calcareous soil condition. Similar results were also reported by Saleh et al (1982), Gheith (1983), Ghosh and Mukhopadhyay (1984), Ibrahim (1984), Ghandora (1985), Kumar (1985), Gabr (1988), Ray et al (1989), Rady (1991) and Fayed (1992-a and b).

The effect of phosphorus application on wheat plant height was not significant in both seasons (Table 6). Applying P at a rate of 15 and 30 kg P_2O_5/fad. increased plant height by 5.9 and 4.1% over the check treatment in the first season, being 4.5 and 1.0% in the second one for the applied two P levels, respectively. However, these increases were below the level of significance. Results reported by Rahman and Willson (1977), Yousef et al. (1977) and Fayed (1992-b) indicated that P significantly increased plant height of wheat plants. It is quite clear that the role of P on growth of wheat plants is not pronounced as that of N.

The effect of potassium application on wheat plant height was not also significant in both seasons. Such result indicated clearly that the soil content of K was enough to supply wheat plants with their requirement.

Several investigators reported that wheat plants showed no significant response to k application (Hamissa et al 1971; Abd.

Elnaim *et al*, 1976; and Rana *et al*., 1979).

On the other hand, Fayed (1992-b) found that potassium application to wheat grown in sandy soil significantly increased plant height.

Result in Table (6) showed that the interaction effects between the applied factors on the plant height of wheat were not significant. Such result indicated that each factor acted independently on the height of wheat plants.

In general, the tallest wheat plants were obtained when using 60 kg N + 30 kg P_2O_5+ zero kg K_2O/fad. in 1990/91 season, and the combination of 120 kg N + 15 kg P_2O_5+ 48 kg K_2O in 1991/92 season. These two combinations recorded plant height of 122.92 and 116.88 cm in the first and second season, respectively.

5- Spike length :

Results in Table (7) showed the effect of N, P and K levels as well as their interaction on spike length of wheat plants cultivar Sakha 69 in 1990/91 and 1991/92 season.

It is clear from Table (7) that only N levels significantly affected spike length in both seasons.

In 1990/91 season, the application of 30, 60, 90 and 120 kg N/fad. increased spike length over untreated plants by 6.9, 13.1, 15.8 and 15.3%, respectively. While, in 1991/92 season, applying the same subsequent N level increased spike length by 15.1, 23.1, 22.1 and 29.3%, respectively compared with the control.

It is worthy to note that in both seasons, no significant

Table(7):Effect of N.P and K levels on spike length (cm) of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Spike length (cm) 1990/1991 season						Spike length (cm) 1991/1992 season					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	8.20	9.11	9.59	9.76	9.51	9.23	8.25	9.20	10.52	10.88	10.69	9.91
0	48	9.02	9.58	9.46	10.10	9.99	9.63	9.20	9.92	10.21	10.65	11.48	10.30
Mean		8.61	9.34	9.53	9.93	9.75	9.43	8.72	9.57	10.37	10.76	11.09	10.10
15	0	8.54	8.82	9.22	9.85	9.74	9.23	8.33	10.17	10.54	10.55	11.08	10.14
15	48	8.95	9.06	9.89	9.95	10.21	9.61	8.60	9.52	10.48	8.30	10.48	9.48
Mean		8.75	8.94	9.55	9.90	9.98	9.42	8.47	9.85	10.51	9.42	10.78	9.81
30	0	8.46	9.30	10.35	10.12	9.98	9.64	8.14	10.00	10.52	10.92	10.76	10.07
30	48	8.50	9.35	9.92	10.06	10.16	9.60	8.28	9.68	10.32	10.72	11.22	10.04
Mean		8.48	9.32	10.14	10.09	10.07	9.62	8.21	9.84	10.42	10.82	10.99	10.06
Overall mean of K_2O levels	0	8.40	9.08	9.72	9.91	9.74	9.37	8.24	9.79	10.53	10.78	10.84	10.04
	48	8.82	9.33	9.76	10.04	10.12	9.61	8.69	9.71	10.34	9.89	11.06	9.94
Overall mean of N levels		8.61	9.20	9.74	. 9.97	9.93	9.49	8.47	9.75	10.43	10.34	10.95	9.99

L.S.D at 0.05:

	First season 1990/1991	Second season 1991/1992
N	0.34	0.60
P	---	---
K	---	---
NxP	---	---
NxK	---	---
PxK	---	---
NxPxK	---	---

differences in spike length of wheat were detected among the 60, 90, and 120 kg N levels.

The effect of N on spike length is a good criteria for the role of N on yield components of wheat. An adequate supply of N encouraged plant growth which was reflected in turn in producing taller spikes. Similar results were also reported by Gomaa et al. (1977), Eissa (1979), Ibrahim (1984), Mahmoud (1981), Eman Sadek (1990), Ray et al. (1990) and Fayed (1992-a and b).

Concerning the effect of P application on spike length, results in Table (7) indicated that wheat plants showed no significant response for such character in both seasons.

Such results could be explained by the possibility of phosphorus fixation in the calcareous soil and its change from the available to the unavailable form. This is due to the high calcium content and the high pH of the calcareous soil.

Opposite results were reported by Rahman and Willson (1977), Yousef et al. (1977) and Fayed (1992-b) who found that P application significantly increased spike length. This contradiction of the obtained results could be due to the different soil type.

With regard to k application effect on spike length, results in Table (7) showed no significant response for this studied character in the two seasons.

Such result may be due to the availability of this element in the soil to satisfy the needs of growing plants and for the quick washing of K in drainage. Hamissa et al (1971), and Topchieva (1980) reported that potassium had no significant effect on grain yield of wheat. On the other hand, Fayed (1992-b) found that K application till 100 kg K_2O/fad. significantly increased spike length of wheat grown in sandy soil.

Results also showed that none of interactions between the applied three factors significantly affected spike length of wheat. This is an indication that each experimental factor acted independently in affecting spike length of wheat.

Generally, the tallest spikes in 1990/91 season (10.21 cm) was obtained when using the combination of 120 Kg N + 15 Kg P_2O_5 + 48 Kg K_2O/fad., while in 1991/92 season the combination of 120 Kg N + zero Kg P_2O_5 + 48 Kg K_2O/fad. produced the tallest spikes (11.48 cm). .

6- Number of spikelets per spike :

Results in Table (8) showed the effect of N, P and K levels as well as their interactions on number of spikelets/spike in 1990/91 and 1991/92 seasons.

The obtained results indicated that increasing N level significantly increased number of spikelets/spike in the two seasons. Applying N at a rate of 30, 60, 90 and 120 Kg/fad. increased number of spikelets/spike by 5.7, 8.7, 7.8 and 9.8% over the check treatment in 1990/91 season, respectively. The respective increases due to applying the same N levels in 1991/92 season were 4.7, 8.0, 9.7 and 7.6%.

Table(8): Effect of N,P and K levels on number of spikelets/spike of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Number of spiklettes/spike 1990/1991 season						Number of spiklettes/spike 1991/1992 season					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad	Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	18.25	19.95	20.22	20.02	20.55	19.80	20.10	20.67	21.62	22.05	20.86	21.06
0	48	19.40	20.55	20.35	20.18	21.04	20.30	21.10	21.50	21.90	22.50	22.94	21.99
Mean		18.82	20.25	20.29	20.10	20.79	20.05	20.60	21.08	21.76	22.28	21.90	21.52
15	0	17.60	18.86	19.21	19.70	20.00	19.07	20.85	20.45	21.11	21.65	20.95	21.00
15	48	19.68	19.18	21.08	20.12	20.58	20.13	19.05	21.10	20.34	21.55	21.08	20.62
Mean		18.63	19.02	20.15	19.91	20.29	19.60	19.95	20.78	20.72	21.60	21.01	20.81
30	0	19.00	20.30	20.90	20.92	20.65	20.35	19.56	20.10	22.28	20.55	21.74	20.84
30	48	18.30	19.72	20.17	20.00	20.44	19.73	18.60	21.10	21.56	22.58	20.75	20.92
Mean		18.65	20.01	20.53	20.46	20.55	20.04	19.08	20.60	21.92	21.56	21.24	20.88
Overall mean of K_2O levels	0	18.28	19.70	20.11	20.21	20.40	14.74	20.17	20.41	21.67	21.42	21.18	20.07
	48	19.12	19.82	20.53	20.10	20.69	20.05	19.58	21.23	21.27	22.21	21.59	21.18
Overall mean of N levels		18.70	19.67	20.32	20.16	20.54	19.90	19.88	20.82	21.47	21.81	21.39	21.07

L.S.D at 0.05:

	First season 1990/1991	Second season 1991/1992
N	0.66	0.68
P	---	---
K	---	---
NxP	1.13	---
NxK	---	---
PxK	---	---
NxPxK	---	---

The greatest number of spikelets/spike was recorded when applying 120 Kg N/fad. in 1990/91 season, and 90 Kg N/fad. in 1991/92 season.

The effect of N in increasing number of spikelets/spike is agood indicator for the role of N in the metabolic accumulation. Similar results were also reported by Gomaa et al (1977), Eissa (1979), Rao and Bhardwaj (1981), Ibrahim (1984), Gami et al (1986), Mahmoud (1988), Rady (1991) and Fayed (1992-a and b).

Results in Table (8) showed that P application had no significant effect on the number of spikelets/spike in the two seasons. Such result may be due to problems encountered with the calcareous soil leading to a rapid fixation of the applied P.

Results reported by Rahman and Willson (1977), Yousef et al (1977) and Fayed (1992-b) indicated that P application increased yield components of wheat. These results were obtained in other soil types.

Potassium application did not affect the number of wheat spikelets in the tow growing seasons (Table 8).

This result could indicate that the potassium content of the soil was enough to satisfy the plant requirements and or the leaching effect of that element which masked the increase in its application rates. Similar results were reported by Hamissa et al (1971), Rana et al (1979) and Topchieva (1980) indicating that potassium did not significantly influence grain yield. On the other hand, Fayed (1992-b) found that K application at 50 and 100

Kg K_2O/fad. significantly increased number of spikelets/spike of wheat grain in new sandy soil.

The interaction effects between the three nutrients on the number of spikelets/spike of wheat were not significant in the two seasons. This result indicated that the three elements acted independently in affecting this character.

Generally, the greatest number of wheat spikelets/spike (21.08) in the first season, was obtained when using 60 Kg N + 15 Kg P_2O_5 + 48 Kg K_2O/fad. Whereas, the highest number (22.94) for the second season was obtained with 120 Kg N + zero Kg P_2O_5 + 48 Kg K_2O/fad.

7- Number of grains per spike :

Results for the effect of N, P and K levels and their interactions on number of grains per spike of wheat cv. Sakha 69 in 1990/91 and 1991/92 seasons are presented in Table (9).

Increasing N application significantly increased number of grain/spike in the two seasons. Applying N at rates of 30, 60, 90 and 120 Kg/fad. increased number of grain by 5.7, 13.1, 21.9, and 20.8 % compared with the check treatment in the first season, corresponding to 36.7, 59.7, 61.7 and 64.8% in the second season, respectively.

It is quite clear that N markedly increased number of grains/spike of wheat, particularly in the second season where the increase reached about 65% at the 120 Kg N level.

This increase is a direct result of the effect of N on spike

Table(9): Effect of N.P and K levels on number of grains/spike of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Kernels/spike 1990/1991 season						Kernels/spike 1991/1992 season					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	40.12	38.15	38.22	47.52	45.78	41.96	37.90	52.50	64.80	67.00	56.90	55.82
0	48	41.02	43.00	41.00	47.25	44.96	43.45	43.95	50.95	63.10	60.85	67.85	57.37
Mean		40.58	40.58	39.61	47.39	45.37	42.70	40.92	51.72	63.95	63.92	62.38	56.58
15	0	33.58	36.77	38.16	43.30	44.00	39.16	41.80	56.00	59.15	62.25	64.95	56.83
15	48	38.00	39.06	46.29	43.00	46.40	42.22	36.81	52.20	49.88	55.35	63.62	51.57
Mean		35.79	37.91	42.22	43.15	45.20	40.86	39.31	54.10	54.51	58.80	64.29	54.20
30	0	35.45	40.41	49.00	45.58	43.75	42.79	34.10	50.20	64.25	63.95	64.13	55.33
30	48	35.80	39.58	40.68	46.28	45.62	41.59	35.80	53.05	66.62	62.95	62.20	56.12
Mean		35.62	39.86	44.84	45.93	44.69	42.19	34.95	51.62	65.44	63.45	63.17	55.73
Overall mean of K_2O levels	0	36.39	38.35	41.80	45.47	44.51	41.96	37.93	52.90	62.73	64.40	61.99	55.99
	48	38.27	40.54	42.65	45.51	45.66	42.53	38.85	52.07	59.87	59.72	64.56	55.01
Overall mean of N levels		37.33	39.45	42.22	45.49	45.08	41.91	38.39	52.48	61.30	62.06	63.28	55.50

L.S.D at 0.05:

	First season 1990/1991	Second season 1991/1992
N	4.40	4.30
P	---	---
K	---	-
NxP	---	---
NxK	---	---
PxK	---	---
NxPxK	---	---

length as well as number of spikelets. It is a good manifestation of the role of N in plant growth and grain formation of the cereal crops. Similar results were also obtained by Frank and Bauer (1982), Saleh et al (1982), Gheith (1983), Singh et al (1985-a), Mahmoud (1988), Wang (1988), Mahgoub (1990), Rady (1991) and Fayed (1992-b).

In other studies N did not significantly affect number of grains/spike (Bishnoi et al., 1983; Singh, and Singh, 1984 and Abdel-Aleem, 1987).

Results in Table (9) showed also that neither P nor K application had a significant effect on number of grains/spike in the two growing seasons.

This result is quit expected since both elements did not significantly affect spike length and number of spikeletes/spike previously discussed.

Results reported by Rahman and Willson (1977), Yousef et al. (1977), Bhattacharjec and Chakraborty, (1986), Thimmegowda (1986), Dang et al. (1987), Fiedler et al (1989), Tell and Khattari (1989) and Fayed (1992-b) showed that P application significantly increased number of grains/spike.

Concerning the effect of potassium on number of grains /spike, Fayed (1992-b) found that K at 50 and 100 Kg K_2O/fad. significantly increased this trait under sandy soil condition.

On the other hand, Abdel-Wahab et al. (1976), Harmati and Dzemes (1978) reported that the application of N, P and K fertilizers had no significant effect on spike length, number of spikelets, grains and grain weight/spike of wheat.

Concerning the interaction effects, results in Table (9) indicated that all interactions among the three nutrients showed no significant effect on number of grains/spike in the two seasons.

However, the maximum number of grains/spike (49.00) in the first season was obtained with 60 Kg N + 30 Kg P_2O_5+ zero Kg K_2O/fad., being 67.85 in the second season by using 120 Kg N + zero Kg P_2O_5+ 48 Kg K_2O/fad.

8- Spike yield :

Results in Table (10) showed the effect of N, P and K levels as well as their interactions on spike yield of Sakha 69 wheat cultivar in 1990/91 and 1991/92 seasons,

Increasing N application levels significantly increased spike yield of wheat in the two growing seasons. Applying N at a rate of 30, 60, 90 and 120 Kg/fad. increased spike yield over the control by 24.2, 47.1, 56.9 and 55.6%, in the first season, respectively. The corresponding increases in the second season were 47.0, 64.9, 77.4 and 93.5%.

Such result is quite expected since N application significantly increased spike length, spike weight, number of spikelets/spike and number of grains/spike. Consequently, the grain yield per spike will be certainly increased.

The obtained result is also a good manifestation for the

Table(10):Effect of N.P and K levels on spike yield (gm) of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Spike yield (gm) 1990/1991 season						Spike yield (gm) 1991/1992 season					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	0	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	1.34	1.84	2.13	2.59	2.35	2.05	1.57	2.62	2.79	3.21	2.88	2.61
0	48	1.65	2.02	2.05	2.49	2.35	2.11	1.94	2.69	2.82	3.00	3.24	2.74
Mean		1.50	1.93	2.09	2.54	2.35	2.08	1.75	2.66	2.81	3.10	3.06	2.68
15	0	1.64	1.73	2.01	2.25	2.35	1.98	1.84	2.59	2.86	2.57	4.52	2.88
15	48	1.67	1.83	2.37	2.29	2.50	2.13	1.70	2.20	2.34	3.08	2.79	2.42
Mean		1.66	1.78	2.19	2.27	2.38	2.05	1.77	2.40	2.60	2.82	3.66	2.65
30	0	1.37	1.91	2.61	2.41	2.52	2.17	1.56	2.46	3.00	3.00	3.00	2.60
30	48	1.50	2.07	2.32	2.34	2.32	2.11	1.49	2.27	2.82	3.01	3.06	2.53
Mean		1.43	1.99	2.46	2.38	2.42	2.14	1.52	2.36	2.91	3.00	3.03	2.57
Overall mean of K_2O levels	0	1.45	1.82	2.25	2.42	2.37	2.06	1.65	2.56	2.88	2.93	3.47	2.70
	48	1.61	1.97	2.25	2.38	2.39	2.12	1.71	2.39	2.66	3.03	3.03	2.56
Overall mean of N levels		1.53	1.90	2.25	2.40	2.38	2.09	1.68	2.47	2.77	2.98	3.25	2.63

L.S.D at 0.05:

	First season 1990/1991		Second season 1991/1992
N	0.19	N	0.31
P	---	P	---
K	---	K	---
NxP	---	NxP	---
NxK	---	NxK	---
PxK	---	PxK	---
NxPxK	---	NxPxK	---

role of N in plant life and its great influence on cereal yield.

Similar results were also reported by Hussein et al (1974), Abu-Hagaza (1977), Eissa (1979), Hussein et al (1981), Yousef et al (1984), Mahmoud (1988) and Fayed (1992 a and b).

However, Nass et al (1976) and Abdel Aleem (1987) found that spike yield did not increase with increasing nitrogen rate.

Results in Table (10) showed that neither P nor K levels significantly affected grain yield per spike in the two growing seasons.

It is clear that the response of spike yield followed the same pattern as observed with spike length, spike weight, number of spikelets/spike, number of grains/spike.

Results reported by Rahman and willson (1977), Yousef et al (1977) and Fayed (1992-b) showed that P application significantly increased yield components of wheat. This was not true for the calcareous soil that was used in this experiment.

With regard to the effect of potassium on grain of wheat, several investigators reported also that K had no significant effect (Hamissa et al., 1971; Abd-Elnaim et al., 1976 and Topchieva, 1980). Whereas, Fayed (1992-b) reported significant increase due to potassium application of 50 and 100 Kg K_2O/fad. in sandy soil.

Results presented in Table (10) showed also that all of the interaction combinations had no significant effect on spike yield in both seasons. This result indicated clearly that the three major nutrients (N, P and K) affected spike yield of wheat independently:

However, the highest grain yield/spike was recorded with 90 kg N + zero kg P_2O_5+ zero kg k_2O/fad. in the first season and the combination of 120 kg N + 15 kg P_2O_5 + zero kg k_2O/fad. in the second season, being 2.59 and 4.52 gm, respectively,

9- Number of spikes per one square meter :

Result in Table (11) showed the effects of N, P and K levels as well as their interactions on number of spikes/m^2 of wheat cultivar Sakha 69 in 1990/1991 and 1991/1992 seasons.

Results indicated that the increase in N levels significantly and consistently increased number of spikes/m^2 in the two growing seasons.

In 1990/91 season, the application of 30,60,90 and 120 kg N/fad. increased number of spikes/m^2 by 17.6, 47.4, 58.8 and 72.2 %, respectively. The respective increases of spikes/m^2 in 1991/92 season were 50.0, 95.3, 112.8 and 167.5 %. Over the control.

The effect of nitrogen on number of spikes/m^2 is evidently demonstrated, particularly in the second season where the number of spikes per unit area was increased by 167.5% at the 120 kg N level/fad. This increase clearly indicated the prominent role of N on vegetative growth, tillering and fertility in wheat grown in the calcareous soils. Increasing the number of fertile spikes per unit area to 1.68 folds is a good manifestation for the effect of N element on wheat productivity.

Table(11): Effect of N.P.K levels on number of spike/m2 of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Number of spikes/m2 1990/1991 season						Number of spikes/m2 1991/1992 season					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	163.75	262.50	255.00	277.50	338.75	259.50	52.50	115.00	133.75	180.00	215.00	139.25
0	48	156.25	255.00	247.75	273.75	323.75	251.30	92.50	126.25	237.25	141.25	167.50	153.00
Mean		160.00	258.75	251.38	275.62	331.25	255.40	72.50	120.62	185.62	160.62	191.25	146.12
15	0	206.25	191.25	265.00	297.50	306.25	253.25	85.00	158.75	197.50	216.25	236.25	178.75
15	48	178.75	206.25	281.25	282.50	328.75	255.50	111.25	145.00	172.50	153.75	275.00	171.50
Mean		192.50	198.75	273.12	290.00	317.50	254.38	98.12	151.88	185.00	185.00	255.62	175.12
30	0	168.75	158.75	290.00	315.00	266.25	239.75	78.75	132.50	150.75	291.25	302.50	191.15
30	48	206.25	196.25	252.50	268.75	296.25	244.00	126.25	141.75	175.00	180.00	265.00	177.60
Mean		187.50	177.50	271.25	291.88	281.25	241.88	102.50	137.12	162.88	235.62	283.75	184.38
Overall mean of K_2O levels	0	179.58	204.17	270.00	296.67	303.75	250.83	72.08	135.42	160.67	229.17	251.25	169.72
	48	180.42	219.17	260.50	275.00	316.25	250.27	110.00	137.67	195.00	158.33	235.83	167.37
Overall mean of N levels		180.00	211.67	265.25	285.83	310.00	250.55	91.04	136.54	177.83	193.75	243.54	168.54

L.S.D.0.05:

	First season 1990/1991	Second season 1991/1992
N	34.98	33.81
P	---	---
K	---	---
NxP	---	---
NxK	---	47.81
PxK	---	---
NxPxK	---	---

Similar results were also reported by Biswas and Singh (1982), Dhiman et al (1982), Ral and Pakbeen (1983), Kumar (1986), Soliman (1986), Mahgoub (1990), Rady (1991) and Fayed (1992 a and b).

Other investigators found that N level had no significant effect on number of spikes per unit area (Sing and Singh, 1984 and Ghandora, 1985).

Neither P nor K levels significantly affected number of spikes/m^2 in both seasons (Table 1). However, slight increases were observed due to the increase in P application in the second season, but these increases were below the level of significance.

The present results indicated that both P and k elements were probably sufficient in the soil to supply wheat plants with their needs. It is also possible that the applied P is being fixed in the calcareous soil and due k is being leached.

Results reported by Rahman and Willson (1977), Yousef et al (1977) and Fayed (1992-b) showed that P application significantly increased yield components of wheat. Also, Hamissa et al (1971) showed that P had slight positive effect on wheat yield, while k had no any significant effect.

On the other hand, Fayed (1992-b) found that number of spikes/m^2 was significantly increased due to applying K_2O at 50 and 100 kg/fad. But his results were in the new sandy soil.

Results in Table (11) showed also that all of the interaction combinations between the three factors did not significantly influence the number of spikes/m^2 in the two seasons. This is an indication that each of the applied nutrients acted independently in affecting this studied character.

The highest number of spikes/m^2 in the first season (338.75) was obtained with 120 kg N + zero P_2O_5 + zero kg K_2O/fad., whereas in the season this number (302.5) was produced by applying 120 kg N + 30 kg P_2O_5 + zero kg K_2O/fad.

10- Weight of 1000 grains :

The effect of N, P, and K levels and their interactions on 1000-grain weight of wheat cultivar Sakha 69 in the two growing seasons are presented in Table (12).

It is clear that the increase in N application level significantly increased the 1000-grain weight in both seasons.

Applying N at a rate of 30,60,90 and 120 kg/fad. significantly increased the 1000-grain weight of wheat by 19.8, 30.8, 27.9 and 28.7% respectively, over the control in the first season.

In 1991/92 season, the corresponding N levels increased the 1000-grain weight by 0.4, 6.9, 7.6 and 12.6 % respectively, compared with the control. The greatest increase in 1000-grain weight was recorded when using 60 kg N/fad. in the first season, and 120 kg N /fad. in the second season.

Nitrogen application level showed a similar trend as that obtained with the other yield component characteristics, and that clarify the important role of N in increasing grain plumpness.

Table (12): Effect of N,P and K levels on 1000-Kernel weight (gm) of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		1000-Kernel weight (gm) 1990/1991 season						1000-Kernel weight (gm) 1991/1992 season					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	N levels (Kg/fad.)						N levels (Kg/fad.)					
		Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	35.74	48.31	55.94	55.85	52.69	49.71	41.30	43.63	48.75	47.88	50.73	46.46
0	48	40.24	49.82	49.87	52.57	52.88	49.08	44.07	48.28	44.85	49.19	49.18	47.11
Mean		37.99	49.07	52.90	54.21	52.79	49.39	42.69	45.96	46.80	48.54	49.95	46.79
15	0	47.40	49.22	52.75	51.87	51.47	50.54	44.60	46.29	47.28	44.55	52.13	46.97
15	48	43.70	49.21	51.44	52.56	53.81	49.94	45.40	42.09	47.84	46.63	48.27	46.05
Mean		45.55	48.21	52.10	52.72	52.64	50.24	45.00	44.19	47.56	45.59	50.20	46.51
30	0	39.63	50.84	55.76	53.08	57.94	51.45	45.87	40.96	46.91	46.93	46.61	45.46
30	48	41.60	52.17	58.95	50.67	50.77	50.83	41.70	42.67	45.48	47.85	49.15	45.37
Mean		40.61	51.50	57.35	51.87	54.35	51.14	43.78	41.81	46.20	47.39	47.89	45.41
Overall Mean of K_2O Levels		40.92	49.46	54.81	53.60	54.03	50.57	43.92	43.63	47.64	46.45	49.82	46.30
		41.84	49.73	53.42	52.26	52.49	49.95	43.72	44.34	46.06	47.89	48.87	46.18
Overall Mean Of N Levels		41.39	49.59	54.12	52.93	53.26	50.26	43.82	43.99	46.85	47.17	49.35	46.24

L.S.D at 0.05:

	First season 1990/1991	Second season 1991/1992
N	3.77	2.22
P	---	---
K	---	---
NxP	---	---
NxK	---	---
PxK	---	---
NxPxK	---	---

Similar results were also obtained by Abu-Hagaza(1977), Ohiman et al (1982), Patel et al (1982), Kumar (1985), Ray et al (1990), Rady (1991) and Fayed (1992-b).

In other studies it was found that the increase in N level decreased 1000-grain weight (Eissa, 1979; Singh and Singh, 1984; Singh et al., 1985-a ; Moustafa et al., (1987) and Mahmoud, 1988), while other investigators found that this trait was not significantly affected by N levels (Hamissa et al, 1978; Malik, 1981; Osman and Mahmoud, 1981; Gheith, 1983 and Eck, 1988).

Results presented in Table (12) showed that neither P nor k levels had significant effect on 1000-grain weight in both seasons.

In the first season, slight increases were observed due to applying P at 15 and 30 kg P_2O_5 compared with the control. The increases were far below the level of significance.

The lack of response of 1000-grain weight to P and k levels is expected since the two nutrients did not significantly affect all of the other yield component characters. Similar results were obtained by Yousef et al (1977) and Porter and Poulsen (1983). They showed that P application had no significant effect on 1000-grain weight of wheat.

On the other hand, Bhattacharjee and Chakraborty (1986), Thimmegowda (1986), Dang et al (1987), Fiedler et al (1989), Tell and Khattrai (1989) and Fayed (1992-b) found that P significantly increased 1000-grain weight.

Also, Hamissa et al (1971) and Rana et al (1979) reported that potassium application had no significant effect on wheat grain yield, whereas Fayed (1992-b) found that 1000-grain weight significantly increased due to k application.

Result in Table (12) showed that the interactions between the three nutrients had no significant effects on 1000-grain weight in both seasons. This indicates that the three elements were independent in their effect on this trait.

The highest 1000-grain weight (57.94 gm) in 1990/1991 season was obtained with the combination of 120 kg N + 30 kg P_2O_5 + zero K_2O/fad. whereas it was(52.13 gm) obtained in 1991/92 season with combination of 120 kg N + 15 kg P_2O_5 + zero kg K_2O/fad.

11- Grain yield per faddan :

Results in Table (13) showed the grain response of wheat, cultivar Sakha 69 to different levels of N,P,K and their interaction in 1990/91 and 1991/92 seasons.

It was clearly that increase in N levels significantly and consistently increased grain yield of wheat in the two seasons.

In 1990/91, applying N at 30, 60, 90 and 120 kg/fad. significantly increased grain yield by 125, 297, 432. and 505%, respectively, compared with the control. In 1991/92 season, the same N levels increased grain yield/fad. by 135, 254, 399 and 426%, respectively.

Results clarify that the increments in grain yield in 1990/91 were about 1.25, 3.0, 4.3 and 5.0 folds of the control yield with

Table(13): Effect of N,P and K levels on grain yield (Kg/fad.) of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Grain yield (Kg/fad.) 1990/1991 season						Grain yield (Kg/fad.) 1991/1992 season					
P_2O_5 levels kg/fad	K_2O levels kg/fad	N levels (kg/fad.)						N levels (kg/fad.)					
		Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	270.0	627.0	1125.0	1435.5	1813.5	1054.5	156.0	609.0	888.0	1098.0	1011.0	754.5
0	48	301.5	643.5	1002.0	1455.0	1462.5	973.5	268.5	540.0	909.0	1207.5	1404.0	865.5
Mean		286.5	634.5	1063.5	1444.5	1638.0	1012.5	211.5	574.5	989.5	1153.5	1207.5	810.0
15	0	277.5	657.0	1078.5	1585.0	2085.0	1137.0	207.0	666.0	1099.5	1401.0	1647.0	1003.5
15	48	412.5	646.5	1077.0	1743.0	1923.0	1161.0	358.5	674.5	966.0	1362.0	1335.0	939.0
Mean		345.0	651.0	1077.0	1663.5	2004.0	1149.0	282.0	669.0	1033.5	1381.5	1491.0	972.0
30	0	252.0	606.0	1296.0	1561.5	1320.0	1006.5	208.5	690.0	906.0	1417.5	1527.0	949.5
30	48	174.0	628.5	11475.0	1218.0	1632.0	960.0	382.5	531.0	811.5	1371.0	1369.5	892.5
Mean		213.0	616.5	1221.0	1390.5	1467.0	984.0	295.5	610.5	858.0	1393.5	1447.5	921.0
Overall mean of K_2O levels	0	267.0	630.0	1167.0	1527.0	1740.0	1065.0	190.5	655.5	951.0	1305.0	1395.0	901.5
	48	297.0	639.0	1075.5	1471.5	1672.0	1030.0	336.0	582.0	895.0	1312.5	1369.5	900.0
Overall mean of N levels		282.0	634.5	1120.5	1500.0	1705.5	1048.5	262.5	618.0	930.0	1309.5	1381.5	900.0

L.S.D at 0.05:

	First season 1990/1991	Second season 1991/1992
N	97.5	127.5
P	72.0	126.0
K	---	---
NxP	169.5	---
NxK	---	---
PxK	---	---
NxPxK	238.5	---

each increment in the applied N from 0, to 30,60,90 and 120 kg/fad., respectively.

The increments in 1991/92 season were about 1.35, 2.5, 4.0 and 4.26 folds of the control yield with the corresponding increases in N level.

The present result is a quite clear manifestation for the prominent role of N on wheat grain yield in calcareous sandy soil in Egypt.

The increase in grain yield due to the increase in N level is a result of the effect of N in increasing all yield components such as weight and length of spike, flag leaf area, plant height, number of spikelets and number of grains/spike, number of spikes /m^2 and 1000-grain weight.

The great response of wheat grain yield of wheat to N in the newly reclaimed calcareous soil of Egypt shows clearly the contribution of this major element in promoting wheat production in Egypt.

Similar results were also reported by Hussein et al (1978), Saleh et al (1985), Grami et al (1986), Abdel Aleem (1987), Mahmoud (1988), Mosaad et al. (1990), Ray et al (1990), Rady (1991) and Fayed (1992-b). Also, a high response of wheat grain yield to N level was reported by Gomaa et al (1977), and Khalil et al (1977) who found that semi-dwarf wheat cultivars responded to N levels up to 80 kg N/fad.

Under sandy soil conditions, Fayed (1992-b) found similar trend for the great response of grain yield to N level where he obtained a yield increase of 105.4 to 120.7% for N level of 160 kg/fad over 40 kg/fad. At 120 kg N/fad, he reported an increase of 78 and 99% compared with 40 kg level in 1989/90 and 1990/91, respectively.

It could be concluded that under calcareous soil condition, the optimum N level for the high yielding wheat cultivars ranges from 90 up to 120 kg/fad.

Results in Table (13) showed also that P application significantly affected grain yield of wheat in both seasons.

Applying P at a level of 15 kg P_2O_5/fad. significantly increased wheat grain yield by 13.5 and 20.0% over the control treatment in the first and second season, respectively.

Increasing P level to 30 kg P_2O_5/fad. did not induce any significant increase in wheat grain yield. Moreover, a slight decrease was observed due to applying this higher level in the first season.

It is also observed from Table (13) that increasing P_2O_5 level from 15 to 30 kg P_2O_5/fad. significantly reduced grain yield in the first season by 16.8%.

Similarly, a slight but insignificant reduction in wheat yield of 5.5% was observed in the second season due to the increase of P_2O_5 level from 15 to 30 kg/fad.

This result may be due to the chemical characteristics of calcareous soil. However, further investigation is needed in order to clarify the role of P level on wheat yield under calcareous soil conditions.

Under the conditions of the present study it could be concluded that the application of 15 kg P_2O_5/fad. is recommended for wheat grain in calcareous soil.

Results reported by Shah (1978) and (1979), Nagare (1980), Rana et al (1982), Blue et al (1990), Saad et al (1990) and Fayed (1992-b) showed a response of grain yield of wheat to P application.

Other studies indicated that P application had no significant effect on wheat grain yield (Singh and Balasubramanian, 1983; and Sharma and Sexena, 1984). While Gardner and Jackson (1976) reported that grain yield was decreased due to P application.

No significant effect was detected for wheat grain yield due to the application of 48 Kg K_2O/fad. in the two seasons (Table 13). The present result is quite expected since K application did not significantly affect all growth characteristics as well as yield components.

Similarly, Hamissa et al (1971), Abd-Elnaim et al (1976), Rana et al (1979) and Topchieva (1980) found that potassium application had no significant effect on grain yield.

On the other hand, Dwivedi and Misra (1986), Bakhsh et al (1987), Fixen (1987) and Fayed (1992-b) found that K significantly increased grain yield of wheat. Along the same line, Fayed (1992-b) recorded increases of 43.1 and 35.9% in wheat grain yield due to applying K_2O at 100 Kg/fad. compared with the control in 1989/90 and 1990/91, respectively.

The interactions effect between the three major nutrients on wheat grain yield was significant (Table 13). Results showed that the interaction of nitrogen x phosphorus and nitrogen x phosphorus x potassium significantly affected grain yield in the first seasons.

It is evident that the highest grain yield in 1990/91 season was 2004 Kg/fad. which was produced by applying 120 Kg N + 15 Kg P_2O_5/fad.

The second order interaction in 1990/91 season indicated that the highest yield (2085 Kg/fad.) was obtained by applying 120 kg N + 15 kg P_2O_5 + zero K_2O/fad. The same fertilization formula produced the highest grain yield (1647 kg/fad.) in the second growing season.

12- Straw yield :

Results of the effects of N, P, K levels and their interactions on straw yield of wheat cultivar Sakha 69 in 1990/91 and 1991/92 season are presented in Table (14).

The increase in N level significantly and consistently increased straw yield in the two growing seasons.

In 1990/91 season, the application of 30, 60, 90 and 120 kg N/fad. increased straw yield by 163, 332, 411 and 471%, respectively compared with the control.

In 1991/92 season, the same four N levels produced an

Table(14): Effect of N,P and K levels on straw yield (tons/fad.) of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Straw yield (tons/fad.) 1990/1991 season						Straw yield (tons/fad.) 1991/1992 season					
		N levels (Kg/fad.)						N levels (Kg/fad.)					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	0.66	1.53	2.71	3.46	4.19	2.51	0.33	1.76	1.90	2.65	2.42	1.81
0	48	0.84	2.21	2.71	2.93	4.24	2.59	0.78	1.12	2.57	2.52	2.70	1.94
Mean		0.75	1.87	2.71	3.20	4.21	2.55	0.56	1.44	2.24	2.59	2.56	1.88
15	0	0.47	1.67	2.32	3.65	3.99	2.42	0.27	1.39	2.52	2.97	3.45	2.12
15	48	0.96	1.53	2.81	3.54	3.18	2.40	0.74	1.42	1.62	3.00	3.44	2.05
Mean		0.71	1.60	2.57	3.6	3.58	2.41	0.51	1.40	2.07	2.98	3.45	2.80
30	0	0.57	1.63	3.70	3.59	3.80	2.66	0.81	1.63	1.50	2.66	3.34	1.99
30	48	0.41	1.72	2.58	2.76	2.89	2.07	0.81	1.46	2.22	2.27	2.58	1.87
Mean		0.49	1.67	3.14	3.18	3.34	2.37	0.81	1.54	1.86	2.47	2.96	1.93
Overall Mean of K_2O Levels	0	0.57	1.61	2.91	3.57	3.99	2.53	0.47	1.59	1.97	2.76	3.07	1.97
	48	0.74	1.82	2.70	3.08	3.43	2.35	0.78	1.33	2.14	2.60	2.91	1.95
Overall mean of N levels		0.65	1.71	2.81	3.32	3.71	2.44	0.63	1.46	2.06	2.68	2.99	1.96

L.S.D at 0.05:

	First season 1990/1991	Second season 1991/1992
N	0.38	0.37
P	---	---
K	---	---
NxP	---	---
NxK	---	---
PxK	---	---
NxPxK	---	---

These results are expected since P and K application levels showed no significant effects on plant height and number of tillers per unit area as previously discussed.

However results reported by Shah (1979), Nagare (1980), Rana et al (1982), Blue et al (1990), Saad et al (1990) and Fayed (1992-b) showed that P application increased grain and straw yield of wheat.

Meanwhile, Shukla et al (1972) and Vyas et al (1980) showed that phosphorus application had no significant effect on straw yield.

Regarding the effect of potassium, Gingrich and Smith (1953) reported that K fertilizer applied with N increased grain yield of wheat. Whereas, Haeder and Beringer (1981), Fayed (1992-b) and Mohamed et al (1992) reported that K increased straw yield.

However, Eman Sadek (1985) and Abdel-Aleem (1987) reported no effect of K on straw yield of wheat.

It seems to be true that the contradictory results may be due to the different soil texture of their experiments.

Results presented in Table (14) showed that the interaction effects of the three nutrients did not significantly influence straw yield of wheat in both seasons. This result showed the independence of each of the three elements in affecting wheat straw yield.

However, the highest straw yield (4.24 tons/fad.) was recorded when using 120 kg N + zero kg P_2O_5 + 48 kg K_2O/fad. in

1990/91 season. Whereas, the corresponding straw yield (3.45 tons/fad.) was obtained when applying 120 kg N + 15 Kg P_2O_5 + zero K_2O/fad. in 1991/92 season.

13- Protein content in wheat grains :

The effects of N, P, K and their interaction on protein percentage of wheat grains cultivar Sakha 69 (grown in calcareous soil) in 1990/91 and 1991/92 are presented in Table (15).

Results showed that increasing nitrogen application significantly increased protein % in wheat grains in both seasons.

In 1990/91, applying N at a rate of 60, 90 and 120 kg/fad. increased protein % over that of the check treatment by 0.23, 1.25 and 1.81, respectively. While, in 1991/92 season, the same N levels increased protein % by 1.52, 1.85 and 2.73 over that of the control, respectively.

It is worth noting that the 30 kg N/fad. level did not affect the protein % significantly.

It could be concluded that the increase in N application up to the highest level produced the highest protein content in wheat grains. This result proved the great response of wheat grown in calcareous soil to N fertilization.

Similar results were obtained by Rathore and Singh (1978), Saleh et al (1982), Gheith (1983), Johnson et al (1984), Abdel Aleem (1987), Singh et al (1987) Rady (1991) and Magid et al (1991).

Table(15): Effect of N.P and K levels on Protein % of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

		Protein % 1990/1991 season						Protein % 1991/1992 season					
P_2O_5 levels Kg/fad.	K_2O levels Kg/fad.	N levels (Kg/fad.)						N levels (Kg/fad.)					
		Zero	30	60	90	120	Mean	Zero	30	60	90	120	Mean
0	0	10.06	11.10	10.66	11.98	12.88	11.33	10.10	9.92	10.19	11.79	11.49	10.70
0	48	10.28	10.21	12.15	12.61	12.78	11.60	9.92	9.35	11.20	11.36	12.54	10.87
Mean		10.17	10.66	11.41	12.29	12.83	11.47	10.01	9.64	10.69	11.57	12.01	10.79
15	0	11.80	10.76	11.32	12.58	13.00	11.89	9.71	9.92	11.10	10.27	12.26	10.65
15	48	10.50	11.03	10.60	12.01	12.79	11.39	8.45	8.53	11.06	10.82	12.31	10.23
Mean		11.15	10.89	10.96	12.29	12.89	11.64	9.08	9.23	11.08	10.54	12.28	10.44
30	0	11.91	11.78	11.24	12.36	12.12	11.88	9.15	8.80	11.33	11.46	12.12	10.57
30	48	10.52	9.69	10.48	11.09	12.39	10.83	8.66	8.82	9.58	11.41	11.61	10.02
Mean		11.22	10.73	10.86	11.72	12.26	11.36	8.90	8.81	10.46	11.43	11.87	10.29
Overall mean of K_2O levels	0	11.29	11.21	11.08	12.30	12.67	11.70	9.65	9.55	10.87	11.17	11.96	10.64
	48	10.43	10.31	11.08	11.90	12.65	11.28	9.01	8.90	10.61	11.19	12.15	10.37
Overall mean of N levels		10.85	10.76	11.08	12.10	12.66	11.49	9.33	9.22	10.74	11.18	12.06	10.51

L.S.D at 0.05:

	First season 1990/1991		Second season 1991/1992
N	0.61	N	0.66
P	---	P	---
K	0.44	K	---
NxP	---	NxP	---
Nxk	---	Nxk	---
PxK	---	PxK	---
NxPxK	---	NxPxK	---

Results in Table (15) showed that in both seasons P application exhibited no significant effect on protein % in wheat grains. This could be due to the fixation of the applied P due to the abundant calcium content of the calcareous soil and to possible transfer of the available P to its unavailable from.

Results reported by Singh and Singh (1977) showed that P application did not significantly affect protein content in wheat grain.

However, Ahmed and Khan (1977) found that protein content in grains was significantly increased at lower dose of P (44.8 Kg P_2O_5/ha) but decreased at higher dose (179.2 kg P_2O_5/ha.).

Results presented in Table (15) showed that potassium aplication significantly decreased protein % in wheat in 1990/91 season. In 1991/92 season, a reduction in protein % was also observed, but the difference was not significant.

The reduction of protein % due to potassium application may be due to the increase in carbohydrates content in grains resulting from applying 48 Kg K_2O/fad. This is very well accepted due to the important role of K in carbohydrate formation and accumulation in wheat grains. Moreover, the possible increase in carbohydrates content is on the expense of the reduction of the protein content.

The interaction effects of the three nutrients on protein content of wheat grains were not significant in both seasons (Table 15).

It was generally noticed the highest protein content of wheat grains was 13.0% and 12.54% in the first and the second growing season, respectively. Such contents were produced when using the respective fertilizer formulas of 120 kg N + 15 kg P_2O_5 + zero kg K_2O/fad. and 120 kg N + zero kg P_2O_5 + 48 kg K_2O/fad.

SECOND EXPERIMENT :

EFFECT OF SEEDING RATES AND NITROGEN LEVELS ON GROWTH AND YIELD OF WHEAT GROWN UNDER CALCAREOUS SOIL CONDITION

Results will be presented and discussed under the following topics:-

1- Heading date :

The effects of seeding rates, N levels, and their interaction on heading date of wheat in 1990/91 and 1991/92 seasons are presented in Table (16).

Results showed that the increase in seeding rates did not significantly affect heading date of wheat in both of the studied seasons.

Similar results were reported by El-Shamma (1967), Mohiuddin and Croy (1980) and Gaafar (1988).

However, Abdel Rahman (1979) and Eissa (1979) found that number of days to heading was decreased with increasing seeding rates.

Results in Table (16) showed that the increase in N levels significantly delayed heading date in the two seasons.

In 1990/91 season, applying N at a rate of 30,60,90 and 120 kg/fad. delayed heading dates by 0.58,1.58,4.65 and 4.56 days, respectively, compared with the check treatment. The corresponding delay in heading date for the second season was 2.0,3.09,3.34 and 4.09 days.

The effect of a high supply of N in prolonging growing period and retarding heading is clearly demonstrated. These results

Table (16): Effect of seeding rate and N level on heading date of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

Seeding rate (Kg/fad.)	Number of days from sowing to heading					
	N level in (kg/fad.)					
	Zearo	30	60	90	120	Mean
	First season (1990/91)					
30	91.75	91.00	91.75	96.25	95.25	93.20
50	89.50	91.50	92.25	98.00	95.50	93.35
70	90.00	90.50	92.00	91.25	94.50	91.65
Mean	90.42	91.00	92.00	95.17	95.08	92.73
	Second season (1991/92)					
30	92.50	95.50	95.75	96.25	97.75	95.55
50	92.75	95.25	96.25	95.75	96.00	95.20
70	93.25	93.75	95.75	96.50	97.00	95.25
Mean	92.83	94.83	95.92	96.17	96.92	95.33

L.S.D at 0.05 for:

	First season(1990/91)	Second season(1991/92)
Seeding rate	n.s	n.s
N	2.59	0.94
seading rate X N	n.s	n.s

coincide with those obtained in the first experiment and are in agreement with those of Abu-Hagaza (1977), Eissa (1979), Ibrahim (1984), Abdel Aleem (1987) and Rady (1991).

The interaction effect between seeding rates and N levels on heading date was not significant in the two growing seasons (Table 16). The latest heading date was after 98 days from sowing. This heading date was obtained when using 50 kg seeding rate/fad. + 90 kg N/fad. On the other hand, the earliest heading date occurred after 89.5 days from seeding at a rate of 50 kg/fad. without N application.

2- Maturity date :

Results in Table (17) showed that seeding rates of 30,50 and 70 kg/fad. produced similar maturity dates which were after about 136 and 138 days in the first and second seasons, respectively.

Similar results were obtained by El-Shamma (1967), Mohiuddin and Croy (1980) and Gaafar (1988). Whereas Abdel-Rahman (1979) and Eissa (1979) found that increasing seeding rates caused a decrease in days to maturity.

It is obviously clear that the increase in N levels significantly delayed maturity of wheat in both seasons (Table 17). In 1990/91 season, applying N at a rate of 30,60,90 and 120 kg/fad. significantly increased days from planting to maturity by 5.33, 10.16, 18.41 and 25.58 days, respectively, compared with the control.

Similarly, in 1991/92 season, the same N levels prolonged the

Table (17):Effect of seeding rate and N level on days to maturity of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

Seeding rate (kg/fad.)	Number of days from sowing to maturity					
	N level in (kg N/fad.)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	122.50	128.00	134.75	144.25	149.75	135.85
50	125.75	132.25	135.00	142.25	150.75	137.20
70	125.75	129.75	134.75	142.75	150.25	136.65
Mean	124.67	130.00	134.83	143.08	150.25	136.57
	Second season(1991/92)					
30	128.50	134.75	138.25	142.00	150.50	138.80
50	125.50	131.00	137.75	144.50	150.25	137.80
70	129.25	134.75	138.00	142.50	150.25	138.33
Mean	127.75	133.50	138.00	143.00	150.33	138.80

L.S.D at 0.05 for:	First season(1990/91)	Second season(1991/92)
Seeding rate	n.s	n.s
N	1.94	2.21
Seeding rate X N	n.s	n.s

growing season of wheat plants by 5.75,10.25, 15.25 and 22.58 days, compared with untreated plants.

The effect of the higher doses of N application on extending the growing period of plants and consequently prolonging the photosynthetic activity is clearly demonstrated. This will certainly lead to greater plant growth and better utilization of the environmental factors for achieving higher production of grain and straw yield of wheat.

It is clear that the highest N level (120 kg/fad.) increased the growing period of wheat plants by about 26 days in the first season and 23 days in the second one, compared with untreated plants. This result clearly explains the role of N in encouraging vegetative growth of wheat plants.

Such results are very well expected since N application delayed heading date of wheat. These results coincide with those obtained in the first experiment and are in good agreement with those reported by Abu-Hagaza (1977), Eissa (1979), Ibrahim (1984), and Rady (1991).

The effect of the interaction between seeding rates and the applied N levels on maturity date was not significant in both seasons (Table 17).

Generally, the earliest maturity occurred after 122.5 days in 1990/91 season, resulting from the unfertilized plants seeded at 30 kg/fad. Whereas, in the second season the earliest maturity occurred after 125.5 days from seeding at 50 kg/fad. combined the unfertilized plants.

3- Flag leaf area :

The effect of seeding rates on flag leaf area, showed no significant response to the different seeding rates in spite of the slight increases in this trait which was observed in the first season due to using the lowest seeding rate (Table 18).

It could be concluded that under calcareous soils conditions, seeding rate did not exhibit significant influence on flag leaf area of wheat.

Concerning the effect of the applied N levels, results in Table (18) showed that flag leaf area increased significantly with the increased N level in both seasons.

In 1990/91, applying N at a rate of 30,60,90, and 120 kg/fad. significantly increased flag leaf area by 12.1, 30.3, 20.6 and 50.9 % over the control, respectively. The same N levels increased flag leaf area by 2.7,9.8,25.6 and 32.8 % over the control, in the second season, respectively.

These increases in flag leaf area were recorded after 100 days from sowing. This obtained increase of flag leaf area of wheat due to the increase in N application levels is a good manifestation of the role of this element in plant growth. Moreover, this effect will be of great value on the expected productivity of wheat, since flag leaf plays an important role in photosynthetic potentialities of wheat plants.

Such results are in line with those of the first experiment

Table (18): Effect of seeding rate and N level on rate on flag leaf area of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

Seeding rate (kg/fad.)	Flag Leaf area $(cm)^2$					
	N level in (kg/fad.)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	20.96	17.04	23.40	19.00	21.47	20.37
50	11.53	16.80	20.47	18.55	26.80	18.83
70	13.25	17.43	15.71	17.63	20.83	16.97
Mean	15.25	17.09	19.86	18.39	23.02	18.72
	Second season(1991/92)					
30	26.00	26.08	27.41	31.00	31.71	28.44
50	23.61	26.56	29.44	33.57	31.84	29.07
70	24.76	23.74	24.84	30.59	33.11	27.41
Mean	24.79	25.64	27.23	31.14	32.91	28.30

	First season(1990/91)	Second season(1991/92)
L.S.D at 0.05 for:		
Seading rate	n.s	n.s
N	5.12	2.92
seading rate X N	n.s	5.05

of this study and are in agreement with those obtained by Nass *et al* (1976), Bassiouny (1979), Saleh (1981), Gomma (1983), Abdel Aleem (1987) and Rady (1991).

Results in Table 18 showed a significant interaction effect between seeding rate and N level in the second season.

It was evident that the effect of N on flag leaf area was more evident under higher seeding rate than under the lowest one.

The largest flag leaf area was 26.80 and 33.80 cm^2 in the first and second seasons, respectively. This was recorded when using seeding rate of 50 Kg/fad. + 120 Kg N/fad.

4- Plant height :

Plant height of wheat as affected by the applied seeding rates and N levels as well as their interaction in 1990/91 and 1991/92 are presented in Table (19). Results, indicated that the effect of seeding rates on plant height, showed no significant effect in the two seasons. Slight differences in plant height were observed but without any specific trend.

Results reported by Abdel-Raheem (1979), Hagras (1981), Gaafar (1988), Mahmoud (1988) and Eman Sadek (1990) showed that plant height was increased due to increasing seeding rate, while Eissa (1979) found that increasing seeding rate decreased plant height.

Concerning the effect of N level on plant height, results in Table (19) showed significant increase in plant height in both seasons due to the increase in applied N.

Table (19): Effect of seeding rate and N level on plant height of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 season.

Seeding rate (Kg/fad)	Plant height (cm) N level in (kg N/fad.)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	93.33	100.42	102.08	109.17	114.17	103.83
50	76.67	105.00	111.67	107.08	107.50	101.58
70	89.58	99.17	110.83	109.58	106.25	103.08
Mean	86.53	101.53	108.19	108.61	109.30	102.83
	Second season(1991/92)					
30	86.88	98.75	98.75	101.25	104.38	98.00
50	93.75	98.75	101.88	106.25	112.50	102.63
70	93.75	95.63	107.50	110.00	105.00	102.38
Mean	91.46	97.71	102.71	105.83	107.29	101.00

L.S.D at 0.05 for:	First season(1990/91)	Second season(1991/92)
Seeding rate	n.s	n.s
N	6.91	7.53
Seeding rate X N	n.s	n.s

In 1990/91 season, applying N at a rate of 30, 60, 90 and 120 Kg/fad. significantly increased plant height by 17.3, 25.0, 25.5 and 26.3%, over the untreated plants, respectively.

Similarly, in 1991/92 season, the same subsequent four N levels increased plant height by 6.8, 12.3, 15.7 and 17.3, respectively.

While, the differences in plant height among 60, 90 and 120 Kg N/fad. levels were not significant in both seasons.

The present results are in line with those obtained in the first experiment of this study, and demonstrate clearly the role of N on plant growth. Similar results were also reported by Saleh et al (1982), Gheith (1983), Ibrahim (1984), Kumar (1985), Gabr(1988),Ray et al (1989), Rady(1991) and Fayed (1992-a and b).

The interaction effect between seeding rates and N levels had no significant effect on plant height in both seasons (Table 19).

Generally, the tallest plants were produced when using seeding rate of 30 Kg/fad. and fertilized with 120 Kg N/fad. in 1990/91 season, and the same N level with 50 Kg seeds/fad. in 1991/92 season. The tallest plants recorded 114.17 and 112.50 cm in the first and second season respectively (Table 19).

5- Spike length :

Results in Table (20) showed the effect of seeding rates, and the applied N levels and their interaction on spike length of wheat in 1990/91 and 1991/92 seasons.

The effect of seeding rate on spike length in Table (20) was

Table (20): Effect of seeding rate and N level on spike length of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 season.

Seeding rate (Kg/fad.)	Spike length (cm) N level in (kg N/fad.)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	9.28	9.20	9.75	9.12	9.91	9.45
50	8.45	9.33	9.33	9.95	10.25	9.46
70	8.94	8.80	9.38	8.98	9.89	9.20
Mean	8.89	9.11	9.48	9.35	10.02	9.37
	Second season(1991/92)					
30	8.75	10.18	11.19	11.12	11.21	10.49
50	9.18	9.95	10.53	10.70	10.85	10.24
70	9.86	10.85	9.89	10.33	10.80	10.35
Mean	9.26	10.33	10.54	10.71	10.95	10.36

L.S.D at 0.05 for:	First season(1990/91)	Second season(1991/92)
Seeding rate	n.s	n.s
N	0.62	0.76
Seeding rate X N	n.s	n.s

of no relevance in the both seasons.

It was expected that spike length at lower seeding rate may increase compared with that of higher seeding rate, but it seems to be true that a compensation occurred at lighter seeding rate through higher tendency of tillerage. Thus, no differences were detected among the three seeding rates concerning yield components.

Similar results were also reported by Singh and Singh (1984) and Gaafar (1988). On the other hand, results obtained by Abu-Hagaza (1977), Gomaa et al (1977), Eissa (1979), Osman and Mahmoud (1981), Gabr (1988), Mahmoud (1988) and Eman Sadek (1990) showed that spike length was decreased due to increasing seeding rates.

The effect of N levels on spike length was significant in both seasons (Table 20). Applying N at a rate of 30, 60, 90 and 120 Kg/fad. increased spike length of wheat over unfertilized treatment by 2.5, 6.6, 5.2 and 12.7%, respectively, in 1990/91 season, being 11.6, 13.8, 15.7 and 18.3% in 1991/92 season.

The effect of N application levels on spike length is a good illustration for the role of N on spike length which is considered one of the most important yield components.

The present results are in agreement with those obtained in the first experiment of this study. Also, similar results were also reported by Gomaa et al (1977), Eissa (1979), Ibrahim (1984), Mahmoud (1988), Eman Sadek (1990) and Fayed (1992-a and b).

The interaction between seeding rates and N levels on spike length was not significant in both seasons (Table 20). In general, the tallest spikes were produced by the combination of 50 kg/fad. seeding rate and fertilization with 120 kg N/fad. in the first season; and with the later N level when using 30 kg seed/fad. seeding rate in the second season. Spike length was 10.25 and 10.21 cm in the first and second season, respectively.

6- Number of spikelets per spike :

The effect of seeding rates, and N levels and their interactions on number of spikelets/spike of wheat in 1990/91 and 1991/92 are presented in Table (21).

The effect of seeding rates on number of spikelets/spike, showed no significant response in both seasons. The differences in number of spikeletes/spike were too slight to reach the level of significance.

The present result could be attributed to the compensation effect under low seeding rate by producing more tillers per plant. This equalized that produced spikelets under higher seeding rate.

Results reported by Abu-Hagaza (1977), Gomaa et al (1977), Eissa (1979), Osman and Mahmoud (1981), Gabr (1988), Mahmoud (1988) and Eman Sadek (1990) showed that number of spikelets /spike decreased with increasing seeding rate. Whereas, Singh and Singh (1984) and Gaafar (1988) showed that this trait was not influenced by the various seeding rates.

Table (21): Effect of seeding rate and N level on number of spikletes/spike of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

Seeding rate (Kg/fad.)	Number of spikletes/spike					
	N level in (kg N/fad.)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	19.50	19.43	20.73	18.78	20.73	19.83
50	18.84	19.61	18.70	20.53	20.46	19.63
70	19.43	18.85	19.08	19.10	19.98	19.29
Mean	19.25	19.29	19.50	19.47	20.39	19.58
	Second season(1991/92)					
30	18.29	20.13	20.46	21.60	20.86	20.27
50	18.88	20.45	20.93	19.86	20.83	20.19
70	20.14	20.85	19.28	19.73	21.10	20.22
Mean	19.10	20.48	20.22	20.40	20.93	20.23

L.S.D at 0.05 for:	First season(1990/91)	Second season(1991/92)
Seeding rate	n.s	n.s
N	n.s	1.19
Seeding rate X N	n.s	n.s

Results revealed that the increase in N level increased the number of spikelets/spike of wheat in both seasons, but this increase reached the significant level only in the second season.

In 1990/91 season, applying N at rate of 30, 60, 90 and 120 kg/fad. increased number of spikelets/spike over the control by 0.20, 1.30, 1.14 and 5.90 %, respectively. The same N levels caused an increase in the number of spikelets/spike by 7.2, 5.9, 6.8 and 9.6 %, respectively.

The favorable effect of N on number of spikelets/spike demonstrated clearly its major role in increasing the grain yield of wheat. Such results are in line with those obtained in the first experiment of this study and are in agreement with those reported by Gomaa et al (1977), Eissa (1979), Ibrahim (1984), Mahmoud (1988), Rady (1991) and Fayed (1992- a and b).

The interaction effect between seeding rates and N levels on number of spikelets/spike was not significant in both seasons (Table 21). In general, the highest number of spikelets/spike was 20.7 in the first season. This was obtained by using 30 kg fad. seeding rate and nitrogen fertilization with 120 kg/fad. Whereas the highest value of this character was 21.60 in the second season produced by seeding rate of 30 kg/fad. and nitrogen fertilization rate of 90 kg/fad.

7- Number of grains per spike :

The effects of seeding rates, N levels and their interaction on number of grains/spike of wheat plants in 1990/91 and 1991/92

Table (22): Effect of seeding rate and N level on number of grain/spike of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 season

Seeding rate (kg/fad.)	Number of grain/spike					
	Nitrogen levels in kg (N/fad)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	45.81	40.55	47.93	39.23	47.18	44.14
50	37.63	42.03	44.13	42.90	53.18	43.97
70	44.55	46.83	40.53	41.25	47.13	44.06
Mean	42.66	43.14	44.19	41.13	49.16	44.06
	Second season(1991/92)					
30	40.23	51.25	59.01	60.76	67.31	55.71
50	40.20	51.10	50.46	57.72	66.30	53.16
70	48.96	61.20	52.21	55.88	59.60	55.57
Mean	43.13	54.52	53.90	58.12	64.40	54.81

L.S.D at 0.05 for:	First season(1990/91)	Second season(1991/92)
Seeding rate	n.s	n.s
N	5.94	7.15
Seeding rate X N	n.s	n.s

seasons are presented in Table (22).

No significant differences were detected among the applied three different seeding rates on the number of grains/spike in both seasons (Table 22). This result is expected since seeding rate did not significantly affect spike length and number of spikelets/spike (Tables 20, 21).

Results reported by Willey and Holliday (1971), Mohiuddin and Croy (1980), Joseph et al (1985) and Eman Sadek (1990) showed that the number of grains/spike decreased with the increase in seeding rates.

Results in Table (22) indicated that the increase in N levels significantly increased the number of grains/spike in the two seasons.

In the first season, applying 30, 60, 90 and 120 kg N/fad. increased grains number/spike by 1.12, 3.59, 3.6, and 10.35 %, respectively compared with untreated plants. The respective increases in the grains number/spike for the second season were 26.41, 24.97, 34.76 and 49.32 %.

It was observed that the response of the number of grains/spike was more evident in the second season compared with the first one where the subsequent N levels produced significant increase in this trait over the control. While in the first season, only the highest N level (120 kg N/fad.) showed significant increase in this character. No differences for this character were detected among 0, 30, 60 and 90 kg N/fad. levels.

The response of the grains number/spike to the applied N levels is mainly due to its effect on spike length and number of spikelets/spike. This results explains the important role of N on grain yield of wheat.

The present results are in agreement with those obtained in the first experiment of this study and are in agreement with the results of Frank and Bauer (1982), Saleh et al (1982), Gheith (1983), Wong (1988), Rady (1991) and Fayed (1992-a and b).

The interaction effect between the applied seeding rates and N levels on the number of grains/spike was not significant in both seasons (Table 22). This result indicated that each experimental factor acted independently in affecting this trait.

In general, it is shown from Table (22) that the greatest number of grains/spike was 53.18 and 66.30 in the first and second season, respectively. These grains/spike numbers were obtained at seeding rate of 50 kg/fad. and fertilization rate of 120 kg N/fad.

8- Spike yield :

The responses of spike yield of wheat to seeding rates, N levels and their interaction in 1990/91 and 1991/92 are resented in Table (23).

No Significant differences were detected in spike yield due to use of the different seeding rates in both seasons as shown in Table (23). Slight increases were noticed in spike yield of wheat at the lower seeding rates, but differences did not reach

Table (23): Effect of seeding rate and N level on spike yield of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 season.

Seeding rate (Kg/fad.)	Spike Yield (gm)					
	N level in (kg N/fad.)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	2.14	2.05	2.38	2.14	2.31	2.20
50	1.54	2.23	2.20	2.25	2.84	2.21
70	1.83	2.25	2.09	2.21	2.36	2.15
Mean	1.83	2.18	2.22	2.20	2.50	2.19
	Second season(1991/92)					
30	1.89	2.57	2.73	2.99	3.29	2.69
50	1.87	2.36	2.54	2.99	3.20	2.59
70	2.40	2.58	2.23	2.59	2.85	2.53
Mean	2.05	2.50	2.50	2.85	3.12	2.60

L.S.D at 0.05 for:	First season(1991/90)	Second season(1991/92)
Seeding rate	n.s	n.s
N	0.36	3.37
Seeding rate X N	n.s	n.s

the level of significance.

Nitrogen application significantly increased spike yield in both seasons. Applying N at a rate of 30, 60, 90 and 120 kg/fad. significantly increased spike yield over the control by 19.1, 21.3, 20.2 and 36.6 %, respectively in the first season. The respective significant increases in spike yield in the second season were 22.0, 22.0, 39.0, and 52.2%.

These marked increases in spike yield due to the increase in N application levels particularly in the second season clearly explain the role of N in increasing grain yield of wheat, since spike yield is one of the most important yield components. Such result is expected since N significantly increased spike length, number of spikelets/spike, and number of grains/spike discussed previously.

The present results coincide with those obtained in the first experiment of this study and are in agreement with what was reported by Hussein et al (1974), Abu-Hagaza (1977), Bassiouny (1979), Eissa (1979), Yousef et al (1984), Mahmoud (1988), Ray et al (1990) and Fayed (1992- a and b).

The interaction effect between the applied seeding rates and N levels on spike yield was not significant in both season (Table 23). This result indicated that each experimental factor acted independently in affecting this character.

Generally, the highest spike yield in 1990/91 season (2.84 gm) was recorded with 50 kg seeding rates/fad + 120 kg N/fad.

whereas, in 1991/92 season the highest spike yield (3.29 gm) was obtained when using 50 kg seeding rate/fad. + 120 kg N/fad.

9- Number of spikes per one square meter :

The effect of the applied seeding rates, nitrogen levels and their interaction on number of spikes/m^2 in the two growing seasons is presented in Table (24).

Seeding rate significantly affected number of spikes/m^2 of wheat in the two seasons.

In 1990/91 season the increase in seeding rate from 30 to 50 and up to 70 kg/fad. significantly increased number of spikes m^2 by 7.5 and 28.7%, respectively. The corresponding increase in the number of spikes/m^2 for the second season was 8.5 and 17.5 %,. Such increase in the number of spikes/m^2 indicates that the optimum seeding rate of wheat in calcareous soil is 70 kg/fad.

This recommended seeding rate of wheat seemed to be the satisfactory rate for the appropriate plant population density per unit area of wheat.

Among the researchers who found that increasing seeding rate of wheat markedly increased the number of spikes/m^2 were Willey and Holliday (1971), Mohiuddin and Croy (1980), Joseph et al (1985), Gaber (1988), Eman Sadek (1990) and Fayed (1992-a and b).

Results presented in Table (24) showed that increasing N application levels increased number of spikes/m^2 in both seasons significantly and consistently.

In the first season, applying N at a rate of 30, 60, 90 and

Table (24): Effect of seeding rate and N level on number of spikes/m2 of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 season.

Seeding rate (kg/fad.)	Number of Spikes/m2 Nitrogen level in (kg N/fad)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	142.50	176.25	226.25	255.00	255.00	211.00
50	132.50	245.00	230.00	265.00	261.25	226.75
70	191.25	310.00	281.25	327.50	247.50	271.50
Mean	155.42	243.75	245.83	282.50	254.58	236.42
	Second season(1991/92)					
30	72.50	98.75	106.25	151.25	201.25	126.00
50	96.25	123.75	143.75	178.25	141.25	136.65
70	101.25	112.50	133.75	187.50	205.00	148.00
Mean	108.75	101.25	127.92	172.33	182.50	138.55

L.S.D at 0.05 for:	First season(990/91)	Second season(1991/92)
Seeding rate	32.01	n.s
N	55.55	32.29
Seeding rate X N	n.s	n.s

120 Kg/fad. significantly increased number of spikes/m² over the control plants by 56.8, 58.2, 81.8 and 63.8%, respectively. Similarly in the second season the four N levels significantly increased number of spikes/m² by 24.1, 42.1, 91.5 and 102.8%, respectively compared with the control.

The increase in number of spikes per unit area is a good indication for the effect of N on tillering of wheat which in turn is reflected on the increase in grain yield. These results coincide with those obtained in the first experiment of this study and are in line with those reported by Biswas and Singh (1982), Pal and Pakbeen (1983), Kumar (1985), Soliman (1986), Mahgoub (1990) and Rady (1991).

The interaction effect between the applied seeding rates and N levels on the number of spikes/m² was not significant in both seasons as shown in Table (24). This result indicated that each of the applied experimental factors affected the number of spikes /m² of wheat independently.

Generally, the highest number of spikes/m² was 327.5 in the first season that obtained when using seeding rate of 70 Kg/fad. and N fertilization at a rate of 90 Kg/fad. whereas, in the second season the highest number of spikes/m² (205.0) was obtained when using the same seeding rate and N fertilization rate of 120 Kg/fad.

10- Weight of 1000 grains :

Results for the effects of seeding rates, N levels and their interaction on 1000-grain weight for the two growing seasons are presented in Table (25).

The effect of seeding rate on 1000-grain weight of wheat was significant in the second season. The increase in seeding rate markedly reduced the 1000- grain weight in the two seasons. Increasing seeding rate from 30 to 70 Kg/fad. decreased 1000-grain weight by 2.8 and 3.4% in the first and second season respectively. The reduction in 1000-grain weight in the second season reached the level of significance (Table 26).

The decrease in 1000-grain weight due to the increase in seeding rate is a result of the increase in competition among growing plants at the higher population density per unit area of land.

Similar results were recorded by Willey and Holliday (1971), Mohiuddin and Croy (1980), Joseph et al (1985), Gaber (1988), Mahmoud (1988) and Eman Sadek (1990).

However, no significant effect was observed on the 1000-grain weight due to the different seeding rates (Kassem and Khalifa, 1972; Eissa, 1979; Osman and Mahmoud, 1981; Singh and Singh, 1984; and Gaafar, 1988).

The applied nitrogen levels caused significant differences in the 1000-grain weight for the two growing seasons (Table 25).

In the first season, applying N at a rate of 30, 60, 90 and 120 kg/fad significantly increased the 1000-grain weight by 15.7, 15.4, 19.8 and 16.9 %, respectively. The obtained response of

Table (25): Effect of seeding rate and N level on 1000-grain weight of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

Seeding rate (Kg/fad.)	Weight of 1000 grains (gm)					
	N level in (kg N/fad)					
	Zero	30	60	90	120	Mean
	First season (1990/91)					
30	50.60	50.64	49.17	51.40	49.21	50.20
50	39.52	52.54	51.02	51.57	53.81	49.69
70	40.86	48.33	50.94	53.94	50.06	48.83
Mean	43.66	50.50	50.37	52.30	51.03	49.57
	Second season(1991/92)					
30	43.29	48.03	46.49	49.12	49.04	47.19
50	48.04	48.06	47.22	46.12	48.04	47.49
70	49.11	41.74	42.74	46.69	47.99	45.65
Mean	46.81	45.94	45.48	47.31	48.36	46.78

L.S.D at 0.05 for:	Eirst seàson(1990/91)	Second season(1991/92)
Seading rate	n.s	1.47
N	4.33	3.38
Sèading rate X N	n.s	n.s

1000 - grain weight to N application clearly clarified the important role of this nutrient on the growth and development processes of wheat plant.

In 1991/92 season, the effect of N levels was significant on the 1000-grain weight when comparing the response due to the highest N application rate and the control, where the difference was 3.3 %. The obtained results for the effect of N in increasing the 1000-grain weight are in approval with those of the first experiment and agree with those reported by Abu-Hagaza (1977), Ohiman et al (1982), Patel et al (1982), Kumar (1985), Rady (1991) and Fayed (1992-a and b).

Meanwhile, Hamissa et al (1978), Malik (1981), Osman and Mahmoud (1981), Gheith (1983) and Eck (1988) found that 1000-grain weight of wheat was not significantly affected by the applied N levels.

The interaction effect between seeding rates and N levels on 1000-grain weight was not significant in both seasons (Table 25). Results showed clearly that each experimental factor acted independently in affecting this trait.

In general, the highest values of 1000-grain weight were 53.94 and 49.12 gm in the first and second season, respectively,. These values were recorded when seeding rate of 70 kg/fad.in 1990/91, and 30 kg/fad. in 1991/92 season was combined with 90 kg N/fad.

Table (26): Effect of seeding rate and N level on grain yield of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

Seeding rate (Kg/fad.)	Grain Yield in (kg/fad)					
	N level in (kg N/fad)					
	Zero	30	60	90	120	Mean
	First season (1990/91)					
30	192.00	517.50	1074.00	1137.00	1491.00	882.00
50	150.00	763.50	1021.50	1428.00	1162.50	906.00
70	391.50	813.00	1177.50	1440.00	1479.00	1060.50
Mean	244.50	697.50	1092.00	1335.00	1422.00	949.50
	Second season (1991/92)					
30	555.00	808.50	1005.00	627.00	480.00	694.50
50	583.50	601.50	885.00	1237.50	1533.00	970.50
70	558.00	862.50	1221.00	1327.50	1249.50	1044.00
Mean	470.00	757.50	1036.50	1036.50	1087.50	903.00

L.S.D at 0.05 for:	First season(1990/91)	second season(1991/92)
Seeding rate	130.50	118.50
N	294.00	177.00
Seeding rate X N	N.s	238.50

Also, in Egypt a seeding rate of 60 kg/fad. was reported by Kassem and Khalifa (1972), Assey and Ibrahim (1976), Abu-Hagaza (1977), and Eman Sadek (1990).

On the other hand, Mahmoud (1988) reported that no significant difference in grain yield was found between 50 and 75 kg/fad.

Results showed that increasing N application level caused significant and consistent increase in grain yield of wheat in the two seasons (Table 26).

In 1990/91 season, applying N at a rate of 30, 60, 90 and 120 kg/fad. significantly increased grain yield over the control by 185, 347, 446 and 482 %, respectively. The excessive grain yield increase recorded in the first season reached 4.8 folds of the control yield. This is a clear illustration for the prominent role of N in increasing grain yield under the calcareous soil conditions.

Such result is expected since the applied nitrogen levels significantly increased flag leaf area, plant height, spike length, number of spikelets/spike number of grains/spike, and 1000-grain weight leading in turn in the excessive increase in wheat yield. Similar result was also obtained in the first part of this study.

Also, many investigators found similar results as those of Hussein et al (1978), Saleh et al (1985), Abdel Aleem (1987), Mahmoud (1988), Rady (1991), and Fayed (1992-a and b).

The interaction effect between seeding rates and N levels on grain yield of wheat was significant in 1991/92 season (Table 26). It was clear in this season that the effect of seeding rate on grain yield was more evident at the higher N levels as compared with the lower ones.

The highest grain yield in the second season was 10.22 ardabs/fad. (1533 kg/fad.) obtained when using seeding rate of 50 kg/fad. and N fertilization at a rate of 120 kg/fad.

12- Straw yield :

Straw yield was significantly increased with increasing seeding rate in the two seasons (Table 27). In 1990/1991 season, increasing seeding rate from 30 to 50 and up to 70 kg/fad. increased straw yield by 6.3 and 27.1 %, respectively. In 1991/92 season increasing seeding rate fróm 30 to 50 kg/fad. significantly increased straw yield/fad. by 75.7%. The extra increase in seeding rate (70 kg/fad) did not induce further increase in straw yield.

It could be concluded that under calcareous soil conditions seeding rate of 70 kg/fad. is recommended for better production. This is mainly due to the increase in number of plants/m² at the higher seeding rate. It could be also concluded that at the higher population density of plants per unit area of land created severe competition for light. This will definitely stimulate elongation and produce more stemmy plants. Thus wheat plants will be of more straw production.

Table (27): Effect of seeding rate and N level on straw yield of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 season.

Seeding rate (Kg/fad.)	Straw yield (Ton/fad.)					
	N level in (kg N/fad.)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	0.52	1.75	3.43	2.89	4.15	2.55
50	0.50	1.86	2.09	4.10	4.97	2.71
70	1.14	2.44	3.59	4.56	4.46	3.24
Mean	0.72	2.02	3.04	3.85	4.53	2.83
	Second season(1991/92)					
30	1.02	1.26	1.84	1.47	1.62	1.44
50	1.05	1.88	2.41	3.00	4.32	2.53
70	0.98	1.79	3.59	3.25	2.99	2.52
Mean	1.02	1.26	2.61	2.58	2.97	2.16

L.S.D at 0.05 for:	First season(1990/91)	Second season(1991/92)
Seeding rate	0.30	0.48
N	0.59	0.54
Seeding X N	1.02	0.93

Similar results were reported by Assey and Ibrahim (1976), Osman and Mahmoud (1981), Vaishya and Singh (1981), Mahmoud (1988), and Eman Sadek (1990). They proved that increasing seeding rate significantly increased straw yield of wheat.

Along the same line, Kassem and Khalifa (1972), Assey and Ibrahim (1976), Abu-Hagaza (1977) and Eman sadek (1990) showed that the optimum seeding rate for wheat was 60 kg/fad. However, Eissa

(1979) found that the optimum seeding rate was 55 kg/fad. whereas Mahmoud (1988) found no significant deference between the applied seeding rates.

Results showed that increasing N levels significantly and consistently increased the straw yield of wheat in the two seasons (Table 27).

In the first season, applying N at a rate of 30,60, 90 and 120 kg/fad. significantly increased straw yield over the unfertilized treatment by 181, 322,435 and 529 %, respectively. The respective increases in straw yield in the second season were 24,155, 153 and 191 %.

The response of grain yield to the applied factors under study followed the same pattern as that of grain yield. The role of N on straw yield is quite evident, particularly in the first season. In this particular season, straw yield was increased to about 5.3 folds over the control due to applying 120 kg N/fad. These results showed clearly the role of N in affecting plant height,tillering,leaf area and the other growth characteristics.

The present results are in line with those obtained in the first experiment and agree with those reported by Nagare (1980), Hussein et al (1984), Eweida et al (1985), Abdel-Aleem (1987) and Fayed (1922-a and b).

The interaction effect between seeding rates and N levels on straw yield/fad. was significant in the two growing seasons (Table 27). It is clear that the effect of N level on straw yield was more evident at lower seeding rate.

The highest straw yield was 4.97 and 4.42 tons/fad. in the first and second season, respectively. This straw yield was recorded when using seeding rate of 50 Kg/fad. and fertilization with 120 kg N/fad. in the two growing seasons.

13- Protein content in wheat grains :

Results in Table (28) showed that the applied seeding rates exhibited no significant effect on the protein content in wheat grain for the two seasons.

Results reported by Abdel Rahman (1979), Hagras (1981), Khalid and Wali (1988) and Mahmoud (1988) indicated that protein content in wheat grain was increased with increasing seeding rate, whereas Read and Warder (1982) and Gabr (1988) showed that protein percentage decreased with increasing seeding rate.

Results showed that increasing N levels significantly increased protein content in wheat grain for two seasons (Table 28).

Table (27): Effect of seeding rate and N level on protein content % of wheat (Sakha 69 cv.) in 1990/1991 and 1991/1992 seasons.

Seeding rate (kg/fad.)	Protein content%					
	Nitrogen level in (kg N/fad)					
	Zero	30	60	90	120	Mean
	First season(1990/91)					
30	10.46	10.60	10.85	12.28	12.49	11.34
50	10.51	10.96	11.63	12.79	13.69	11.92
70	10.85	11.40	11.40	13.16	12.64	11.89
Mean	10.61	10.99	11.29	12.74	12.94	11.71
	Second season(1991/92)					
30	11.08	10.17	11.10	12.08	12.64	11.41
50	8.97	9.36	11.29	11.38	12.40	10.68
70	9.18	9.34	10.31	11.51	11.85	10.44
Mean	9.74	9.63	10.90	11.66	11.66	10.84

L.S.D at 0.05:	First season(1990/91)	Second season(1991/92)
Seeding rate	n.s	n.s
N	0.855	0.66
Seeding rate X N	n.s	n.s

Applying N at a rate of 60, 90 and 120 kg/fad. increased protein % by 0.68, 2.13 and 2.33 respectively, over the control in the first season. The respective N levels increased protein % by 0.16, 1.92 and 2.56, respectively in second second season.

It is worth mentioning that the increase in protein % reached the significant level only at 90 and 120 kg N/fad. However, increase in protein % was not significant due to the lower N levels i.e. 30 and 60 kg/fad. compared with the check treatment.

The present results coincide with those of the first study and are in general agreement with those reported by Saleh et al (1982), Gheith (1983), Abdel-Aleem (1987) and Rady (1991).

The interaction effect between seeding rates and N levels on protein % of wheat grain was not significant in the two seasons (Table 28). This result indicated that each of the applied experimental factor acted independently in affecting this studied character.

It was generally noticed that highest protein percentage was recorded when using seeding rate of 50 and 30 kg/fad.in the first and second season, respectively fertilized with the highest N level (120 kg/fad.)for the two seasons. The highest protein content in wheat seed was 13.69 and 12.64% in the first and second season, respectively (Table 28).

SUMMARY

The target of this study is to find out the optimum requirements of wheat crop to N,P, and K fertilization as well as the appropriate seeding rate under the newly reclaimed calcareous soil conditions of Nubaria.

Two separate field experiments were designed for such study and carried out at Nubaria Agricultural Research Station, Agriculture Research Center. Those experiments were for repeated two successive winter growing seasons (1990/91 and 1991/92).

Calcareous soil structure of the experimental units contained 75.0 -77.5% sand and 22.5 - 25.0% calcium carbonate.

The first experiment was designed to study the response of wheat to various N,P and K fertilization in a split-plot design with four replications. Thirty treatments were used. These were the combination of 5 N levels (Zero,30,60,90 and 120 KgN/fad.), 3 P levels (Zero,15,and 30 Kg P_2O_5/fad.), and 2 K levels (Zero and 48 K_2O/fad.). The second experiment was conducted to find out the appropriate seeding rate of wheat under different N fertilization levels under the calcareous soil conditions. Experiments were laid out in a split -plot design in four replications. Seeding rates were 30,50 and 70 Kg/fad. and N levels were Zero,30,60,90 and 120 Kg/fad. (as ammonium nitrate, 33% N).

Sakha 69 wheat cultivar generated by the ARC was used in these studies.

Data on growth characteristics, yield components, grain yield, straw yield and protein percentage in grain were collected