RESULTS AND DISCUSSION

Results on various characters will be treated under effect of fertilization, varietal differential response and environments. In most cases no significant interaction between fertilization and variety was detected, therefore, the significant interaction only will be discussed.

I) Vegetative Growth :

1- Plant height :

Data presented in Tables 3 and 4 illustrate the effect of N and P fertilizers, varieties and environments on plant height of barley.

Positive effects of fertilization on plant height were observed. The increase in plant height due to fertilization was significant at the six environments of Sidi Barrani 1990/91, Sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92, Atnooh 1991/92 and Raffah 1991/92; whereas the increase was not significant at El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in the amount of rainfall as well as to rainfall distribution. At El-Dabaa 1989/90 the amount of precipitation was too little to solubilize the fertilizer and make it available for plant root system to absorb.

Adding phosphorous fertilizer alone at the rate of 15 kg/fed. resulted in significant increase in plant height ($P < 0.5$) compared to the control at Sidi Barrani 1990/91. The difference between the two rates (15 kg/ fed. and 30 kg/fed.) was not significant. However, at the other 7

Table (3): Means of plant height of barley grown under different rainfed conditions at eight environments as influenced by some fertilization treatments. (cm)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	329	-
N	P								
0	0	26.40	54.73	62.28	42.06	46.73	43.46	72.22	46.22
0	15	27.82	62.17	60.75	39.54	45.35	44.00	73.77	48.55
0	30	28.86	57.11	65.80	43.35	46.04	46.28	73.77	46.06
15	0	28.66	66.22	68.67	53.35	49.78	43.30	80.00	47.31
30	0	28.90	69.95	69.37	58.31	51.71	49.02	85.66	46.17
15	15	31.48	68.48	67.72	53.35	57.42	50.86	86.33	51.13
15	30	35.22	70.77	71.15	52.08	56.12	50.48	87.44	49.13
30	15	29.93	75.20	74.40	57.41	56.73	49.22	92.00	48.11
30	30	36.42	78.41	76.93	57.08	62.03	49.96	95.66	47.93
Mean		30.40	67.00	68.56	50.72	52.43	47.39	82.98	47.84
LSD	5%	4.58	7.02	6.13	6.25	5.08	N.S	5.35	N.S
	1%	6.10	9.37	8.18	8.33	6.78	N.S	7.14	N.S

** Seasonal rainfall in mm

environments, applying P fertilizer using 15 ro 30 kg/fed. showed less effect. Similar results were obtained in irrigated barley by **Abd El-Latif and Salamah (1982)** they stated that plant height was not significantly affected by application of P_2O_5.

Applying nitrogen fertilizer at the rate of 15 or 30 kg/fed. resulted in significant increase in plant height compared to the control at El-Mthany 1991/92, Sidi Barrani 1991/92, Wady El-Washk 1991/92 and Raffah 1991/92. These three latter environments received more rainfall compared to other environments (Table 1). In addition, the rainfall distribution during the period from December to February was quite better coincided with the vegetative growth period, therefore, larger responses to N fertilizer with increasing rainfall were observed. The difference between the two N rate 15-30 kg/fed. was significant at Raffah 1991/92only. It is well known that when water is available for the plant, the fertilizer elements especially N could be solved and absorbed by the plants. This should illustrate why plants gave more plant height at Raffah 1991/92 where the rainfall was much than other environments.

These results could be understood in the light of the importance of N as essential element for building protein which is considered the necessary material for cell division, development and elongation especially for the meristemic tissues. Similar results were obtained by **Hooda and kalra (1977)** and **Torofder and Hossain (1991).**

The tallest plant height was recorded when N and P rates were applied at their highest rates (30 kg N+ 30 Kg P_2O_5/fed.) at most environments. These results show the important role of N and P on plant height under ranifed conditions. Such findings could be attributed to that the protein formation depends on essential elements especially N and P, therefore, deficiency of N and P cause plants to stunt. Similar results were obtained by **Singh and Misra (1980) and Abd El-Latif and Salamah (1982).**

With regard to varietal effect, data in Table 4 show that the differences in plant height among varieties were not significant at all environments. In this respect, **Mahmoud (1992)** found no significant difference between plant heights of Giza 124 and CC 89 varieties under N fertilization.

Results in Table 4 indicate that the tallest barley plants were those obtained at Raffah 1991/92. Data of average rainfall (Table 1) show that this site received 329 mm rainfall which could be considered the highest amount of seasonal rainfall. In addition, the highest rainy months were January and February which coincided with elongation stage. Therefore, the increase in plant height could be attributed to a higher rainfall. It is logic to say that water is essential factor affecting cell elongation and cell division, therefore, any water stress would decrease these physiologicall processes affecting plant height. These results are in harmony with those

Table (4): The differential response of 3 varieties of barlay on plant height at 8 environments in 1989/90, 1990/91 and 1991/92 seasons. (cm)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
variety	**	151	293.4	-	226	-	101.5	329	-
CC89		32.51	67.95	69.27	49.98	50.34	49.51	81.44	49.31
Giza 123		29.53	67.41	68.93	52.24	54.73	47.48	83.96	47.15
Giza 124		29.18	65.64	67.49	49.95	52.24	45.20	83.55	47.07
Mean		30.40	67.00	68.56	50.72	52.43	47.39	82.98	47.84
LSD	5%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
	1%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

** Seasonal rainfall in mm.

obtained by **Moursi et al. (1983)** who stated that there was a significant reduction in plant height by increasing soil moisture stress. On the other hand the shortest plants were obtained for plants grown in Sidi Barrani 1990/91 for two reasons; the first, late sowing and the second, rainfall distribution was not as good as Raffah 1991/92.

These results are in agreement with those obtained by **Hussein and Khadr (1979)** who stated that plant height decreased with the shortage of water at any stage of growth compared with the unstressed plants and the severest depression in plant height occurred when plants were subjected to drought at tillering, elongation and dough stages.

2) Spike length :

Data presented in Tables 5 and 6 illustrate the effect of N and P fertilizers, varieties and environments on spike length of barley.

Positive effects of fertilization on spike length were observed. The increase in spike length due to fertilization was significant at the six environments of, Sidi Barrani 1990/91, Sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92, Atnooh 1991/92, and Raffah 1991/92; whereas the increase was not significant at El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in amount of rainfall as well as to rainfall distribution. At El - Dabaa 1989/90, soil moisture content was not enough for nutrient availability in the soil to encourage barley root system to absorb those elements.

Table (5): Means of spike length of barley grown under different rainfed conditions at 8 environments as influenced by some fertilization treatments. (cm)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	329	-
N	P								
0	0	3.75	5.01	5.72	4.80	5.11	6.37	5.46	5.06
0	15	4.65	5.04	6.01	4.65	5.16	5.64	5.56	4.80
0	30	4.51	4.87	6.12	4.75	4.92	6.35	5.66	4.97
15	0	4.48	5.74	6.25	5.65	5.72	5.73	6.18	4.62
30	0	4.53	6.05	6.61	5.91	5.83	6.42	6.52	4.58
15	15	4.40	5.65	6.43	5.74	5.74	6.57	6.55	5.22
15	30	4.91	6.04	6.42	5.54	5.86	6.64	6.48	5.17
30	15	4.15	6.03	6.34	5.91	6.03	6.55	6.90	5.60
30	30	4.88	6.34	6.68	5.75	6.00	6.92	6.93	4.84
Mean		4.47	5.64	6.28	5.41	5.59	6.34	6.25	4.98
LSD	5%	0.53	0.49	0.43	0.50	0.50	N.S	0.58	N.S
	1%	0.70	0.65	0.58	0.66	0.67	N.S	0.78	N.S

** Seasonal rainfall in mm

Adding phosphorous fertilizer alone at the two rates (15-30 kg/fed.) resulted in significant increase in spike length compared to the control at Sidi Barrani 1990/91. However, at the other 7 environments, applying P fertilizer using (15 or 30 kg/fed.) showed less effect. Similar result was obtained in irrigated barley by **Abd El-latif and Salamah (1982)** where they stated that spike length was not significantly affected by application P_2O_5.

Applying nitrogen fertilizer at the rate of 15 or 30 kg/fed. resulted in significant increase in spike length compared to the control at the six environments mentioned above. Such effect of N fertilizer application could be explained by the important role of N in the formation of reproductive organs in barley (spikes). The difference between the two rates of N(15-30 kg/fed) was not significant. Similar results were obtained by **Hooda and Kalra (1977) and Abd El-Latif and Salamah (1982).**

At the same six environments when N and P fertilizers were added together in the combination treatments the increases in spike length were significant compared to the control. The increase of spike length due to fertilization with N and P resulted from the increased activity of meristimatic tissues.

Data presented in Table 6 show that there were significant differences in spike length among varieties at all environment except for plants grown at Raffah 1989/90. It is clear that the two cultivars Giza 123

and Giza 124 gave longer spikes compared to those of CC 89 cultivar. Such differences among cultivars in spike length are almost due to variations in their genetical make up. The present results are in harmony with those obtained by **Mahmoud (1992)** who stated that Giza 124 produced higher spike length than CC89 cultivar.

Data presented in Table 6 show that the highest mean spike lengths were obtained for plants grown in descending order at El-Dabaa 1989/90, El-Mthany 1991/92 and Raffah 1991/92. The shortest spikes were obtained for plants grown at Sidi Barrani 1990/91 and Raffah 1989/90. El-Dabaa 1989/90, as mentioned earlier received lesser amount of rainfall than the other environments (Table 1). The monthy rainfall was very little in November and December, therefore, less germination was detected, thus, low population density which resulted in less competition among plants in this site. In turn spike length was larger, because plants did not suffer from water deficiency during the heading period. Else at Raffah 1991/92, barley plants produced long spikes because the seasonal rainfall 329 mm as well as good rainfall distribution were enough for plants to grow well with less water stress.

At Sidi Barrani 1990/91 barley plants gave the shortest spikes for two reasons; the first late sowing and second, about 62% of total rainfall was received in January but 28% of total rainfall was received in February - April which coincided with spike initation, booting and heading stages therefore, the spike length was decreased.

Table (6): The differential response of 3 varieties of barlay on spike length at 8 environments in 1989/90, 1990/91 and 1991/92 seasons. (cm)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
variety	**	151	293.4	-	226	-	101.5	329	-
CC89		3.86	4.95	5.44	4.62	4.76	5.28	5.44	4.98
Giza 123		4.70	5.89	6.57	5.74	5.93	7.10	6.57	4.97
Giza 124		4.85	6.08	6.85	5.87	6.10	6.65	6.74	5.01
Mean		4.47	5.64	6.28	5.41	5.59	6.34	6.25	4.98
LSD	5%	0.57	0.32	0.94	0.75	0.20	0.60	0.42	N.S
	1%	N.S	0.53	N.S	N.S	0.33	0.99	0.70	N.S

** Seasonal rainfall in mm.

3) Leaf area :

Data presented in Tables 7 and 8 illustrate the effect of N and P fertilizers, varieties and environments on leaf area of barley.

positive effects of fertilization on leaf area were observed. The increase in leaf area due to fertilization was significant at the six environments of Sidi Barrani 1990/91, sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92, Atnooh 1991/92 and Raffah 1991/92; whereas the increase was not significant at El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in the amount of rainfall as well as to rainfall distribution. At El-Dabaa 1989/90, soil moisture content was not enough for nutrients availability in soil to enhance barley root system to absorb those elements.

Adding phosphorous fertilizer alone at the rate of 15 or 30 kg/fed. resulted in insignificant increase in leaf area at all environments.

Applying nitrogen fertilizer at the rate of 15 kg/fed. resulted in significant increase in leaf area compared to the control at Atnooh 1991/92, Wady El-Washk 1991/92, Sidi Barrani 1991/92, El-Mthany 1991/92 and Raffah 1991/92. Data presented in Table 1 indicated that the latter environments received the highest averages of rainfall compared to Sidi Barrani 1990/91. Therefore, larger responses to N fertilizer with increasing rainfall were observed. However, Applying of nitrogen fertilizer at the rate of 30kg/fed. resulted in significant increase in leaf area compared to the control at the six environments mentioned before. These results could be

Table (7): Means of leaf area of barley grown under different rainfed conditions at 8 environmentsas influenced by some fertilization treatments. (cm^2)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	329	-
N	P								
0	0	7.69	12.60	13.08	9.62	8.69	11.68	14.37	9.80
0	15	8.29	13.98	13.61	9.24	10.61	11.98	15.94	11.27
0	30	8.80	11.79	13.61	10.60	8.65	12.11	15.90	12.00
15	0	8.58	15.76	16.27	14.43	11.32	11.54	18.44	10.59
30	0	10.20	16.16	15.51	13.84	13.73	12.97	20.33	10.79
15	15	9.98	16.48	15.44	13.95	12.88	11.85	17.64	11.82
15	30	9.78	17.65	15.68	13.91	13.32	12.74	19.58	11.78
30	15	10.16	19.83	15.86	15.14	15.04	12.49	20.25	11.51
30	30	11.56	18.71	17.25	16.24	14.31	13.59	20.48	11.40
Mean		9.35	15.88	15.14	12.99	12.06	12.32	18.10	11.21
LSD	5%	0.94	2.37	1.73	1.88	1.97	N.S	2.49	N.S
	1%	1.25	3.16	2.31	2.51	2.63	N.S	3.32	N.S

** Seasonal rainfall in mm

explained on the basis that nitrogen would encourage protein synthesis which induces more cellular protoplasm required for the process of cell division, therefore increasing tissue of the leaves. Similar results were obtained by **Hussein and Khadr (1979).**

The highest leaf area at most environments were recorded when both N and P were used at their highest rates (30 kg N +30 Kg P_2O_5/fed.).

Data presented in Table 8 indicate that the differences in leaf area among cultivars were not significant at all environments.

The highest two mean leaf area were those obtained for plants grown at Sidi Barrani 1991/92 and Raffah 1991/92 (Table 7), because they received more rainfall in good distribution compared to other environments. The result indicates that high amount of rainfall enhances cell division and cell expansion and consequently increases leaf area. Similar results were obtained by **Lawlor et al. (1981)** who showed that weekly irrigation produced a crop with large leaf area index and maintained green leaves throughout the grainfilling period. Early drought stress decreased leaf area index by retarding expansion of main-stem leaves and decreasing the number and growth of tiller leaves. Leaf senescence was also increased with drought stress. On the other hand, plants grown at Sidi Barrani 1990/91 and Raffah 1989/90 gave the lowest leaf areas. These results could be attributed to late sowing and to that about 28% of total rainfall was received in February - April period at sidi

Table (8) : The differential response of 3 varieties of barlay on leaf area at 8 environments in 1989/90, 1990/91 and 1991/92 seasons.(cm^2)

Environment	Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
variety **	151	293.4	-	226	-	101.5	329	-
CC89	8.68	16.31	14.98	13.06	11.70	12.14	17.60	11.72
Giza 123	9.54	15.09	14.92	13.06	11.74	12.24	17.92	10.55
Giza 124	9.83	16.26	15.54	12.87	12.73	12.60	18.79	11.38
Mean	9.35	15.88	15.14	12.99	12.06	12.32	18.10	11.21
LSD 5%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
1%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

** Seasonal rainfall in mm.

Barrani 1990/91. Similar results were obtained by **Hussein and Khadr (1979)** who stated that the largest area of leaves was obtained by four irrigations at tillering, elongation, milk-ripe and dough stages, but it was depressed by the water stress at any of these stages of growth.

4) Straw yield :

Data presented in Table 9, 10 and 11 illustrate the effect of N and P fertilizers, varieties, environments and the interaction of fertilization x variety on straw yield of barley.

Positive effects of fertilization on straw yield were observed. The increase in straw yield due to fertilization was significant at the six environments of Sidi Barrani 1990/91,Sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92, Atnooh 1991/92 and Raffah 1991/92; whereas the increase was not significant at each of El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in the amount of rainfall as well as to rainfall distribution. Similar results were obtained in the drier areas of Syria by **Mazid and Bailey (1992)** they reported that the optimum fertilizer rates varied considerably with rainfall.

The mentioned results are in harmony with those obtained for plant height, spike length and leaf area in as much as they are factors contributing to straw yield. In this respect, **Moursi et al (1983)** reported that straw yield of wheat was a function of plant height, spike length and leaf area.

Table (9): Means of straw yield of barley grown under different rainfed conditions at 8 environments as influenced by some fertilization treatments. (kg/ fed.)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	329	-
N	P								
0	0	542	1228	1295	808	549	517	1485	717
0	15	501	1419	1344	685	797	714	2352	773
0	30	537	1198	1560	986	602	639	1895	825
15	0	549	2032	1671	1376	773	666	2756	744
30	0	696	2271	1903	1516	1055	622	3681	843
15	15	708	1507	1810	1455	1256	815	3341	872
15	30	883	2013	1743	1382	1432	745	3144	864
30	15	818	2722	2172	1877	1478	740	4408	869
30	30	983	2446	2224	1790	1761	725	4413	1009
Mean		702	1871	1747	1319	1078	687	3053	835
LSD	5%	142	462	405	355	374	N.S	656	N.S
	1%	189	617	540	473	499	N.S	875	N.S

** Seasonal rainfall in mm

Adding phosphorous fertilizer alone at the rate of 15kg/fed. resulted in significant increase in straw yield($P < 0.5$) compared to the control at Raffah 1991/92. This result could be attributed to the low level of $CaCo_3$ in Raffah site compared to the other ones (Table 2). The difference between the two rates (15-30kg/fed.) was not significant. Similar results were obtained in irrigated barley by Abd El-Latif and Salamah (1982). On the contray at the other 7 environments applying P fertilizer using 15 or 30 kg/fed. showed less effect.

Applying nitrogen fertilizer at the rate of 15 kg/fed. resulted in significant increase in straw yield compared to the control at Wady El-Washk 1991/92, Sidi Barrani 1991/92 and Raffah 1991/92. Data of average rainfall (Table 1) show that these sites were received highest seasonal rainfall compared to Sidi Barrani 1990/91, therefore, the responses to N fertilizer with increasing rainfall were observed. In this respect, Cooper et al (1987) reported that responses to N are closely related to amounts of rainfall and tend to decrease with decreasing available soil moisture.

Applying N fertilizer at the rate of 30kg/fed. resulted in significant increase in straw yield at the six environments mentioned before. The differences between the two N rate (15-30 kg/fed.) was significant at Raffah 1991/92 only. It is well known that when water is available for the plant, the nutrient especially nitrogen could be solved and absorbed by

the plants. This would illustrate why plants gave more straw yield at Raffah 1991/92 where the rainfall was more than the other environments (Table 1). These results are in agreement with those obtained by **Cooper et al. (1987)** and **El-Sayed et al. (1991)**. As a matter of fact N fertilizer caused vigorous growth and this in turn increased straw yield. These results are in accordance with those obtained by **Jana et al. (1978), Khatua and Samal (1978), Ram and Singh (1978), Papastylianou (1989) and Wahbi et al. (1989).**

At the same six environments when N and P fertilizer were together in the combination treatments the increases in straw yield were significant compared to the control. The highest straw yields at Sidi Barrani 1990/91, Atnooh 1991/92, El-Mthany 1991/92 and Raffah 1991/92 were achieved when N and P fertilizers were applied at their highest rates (30kg N + 30 kgP_2O_5 /fed.) Straw yield of the barley receiving the highest rate of both (N and P) outyielded those plants of the control treatment with 81%, 222%, 71% and 197% at above mentioned four environments, respectively. On the other side, the highest straw yields of barley plants grown at Wady El-Washk 1991/92 and Sidi Barrani 1991/92 were achieved by adding (30kg N + 15 kgP_2O_5/fed.). Percentages increase due to the last treatment over the control were 132% and 121% respectively. Similar results were obtained by **Singh and Misra (1980) and Wahbi et al. (1989).**

With regard to varietal effect, data in Table 10 and Figure 1 show that the differences in straw yield among varieties were significant at Atnooh 1991/92 and Wady El -Washk 1991/92. The two varieties Giza 123 and Giza 124 produced high straw yield compared to CC89 variety. The same trend was observed at most environments eventhough the differences were not significant.

Data in Table 10 and Figure 2 show that the highest straw yields were obtained from Sidi Barrani 1991/92 and Raffah 1991/92, because these two environments received the highest amount of seasonal rainfall as well as rainfall distribution was better (Table 1). On the contrary, the lowest straw yields were obtained from Sidi Barrani 1990/91 and El-Dabaa 1989/90 because of either late sowing and low amount of seasonal rainfall at Sidi Barrani 1990/91 or low amount of seasonal rainfall at El-Dabaa 1989/90 (Table 1). Similar results were obtained by **Moursi et al (1983)** who stated that straw yield of wheat was extremely decreased by soil moisture stress. In this respect, **El-Sayed et al. (1991)** reported that growing barley in sand soil under flood irrigation and given 17 irrigations resulted in significant increase in straw yield compared to barley receiving14, 12 or 11 irrigations. Recently, **El-Sayed and Noaman (1992)** under rainfed conditions of NWC of Egypt, found that the straw yield decreased as the sowing date was delayed. The optimum sowing date was after the first shower that resulted in enough soil moisture for seed germination.

Table (10): The differential response of 3 varieties of barlay on straw yield at 8 environments in 1989/90, 1990/91 and 1991/92 seasons. (kg/ fed.)

Environment	Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
variet y **	151	293.4	-	226	-	101.5	329	-
CC89	667	1835	1729	1122	972	582	2709	829
Giza 123	718	1959	1759	1497	1191	732	3211	827
Giza 124	721	1819	1753	1339	1071	746	3241	849
Mean	702	1871	1747	1319	1078	687	3053	835
LSD 5%	N.S	N.S	N.S	187	99	N.S	N.S	N.S
1%	N.S	N.S	N.S	N.S	164	N.S	N.S	N.S

** Seasonal rainfall in mm.

Straw yield and Seasonal Rainfall Relationship CC 89, Giza 123, and Giza 124 Barley Varieties

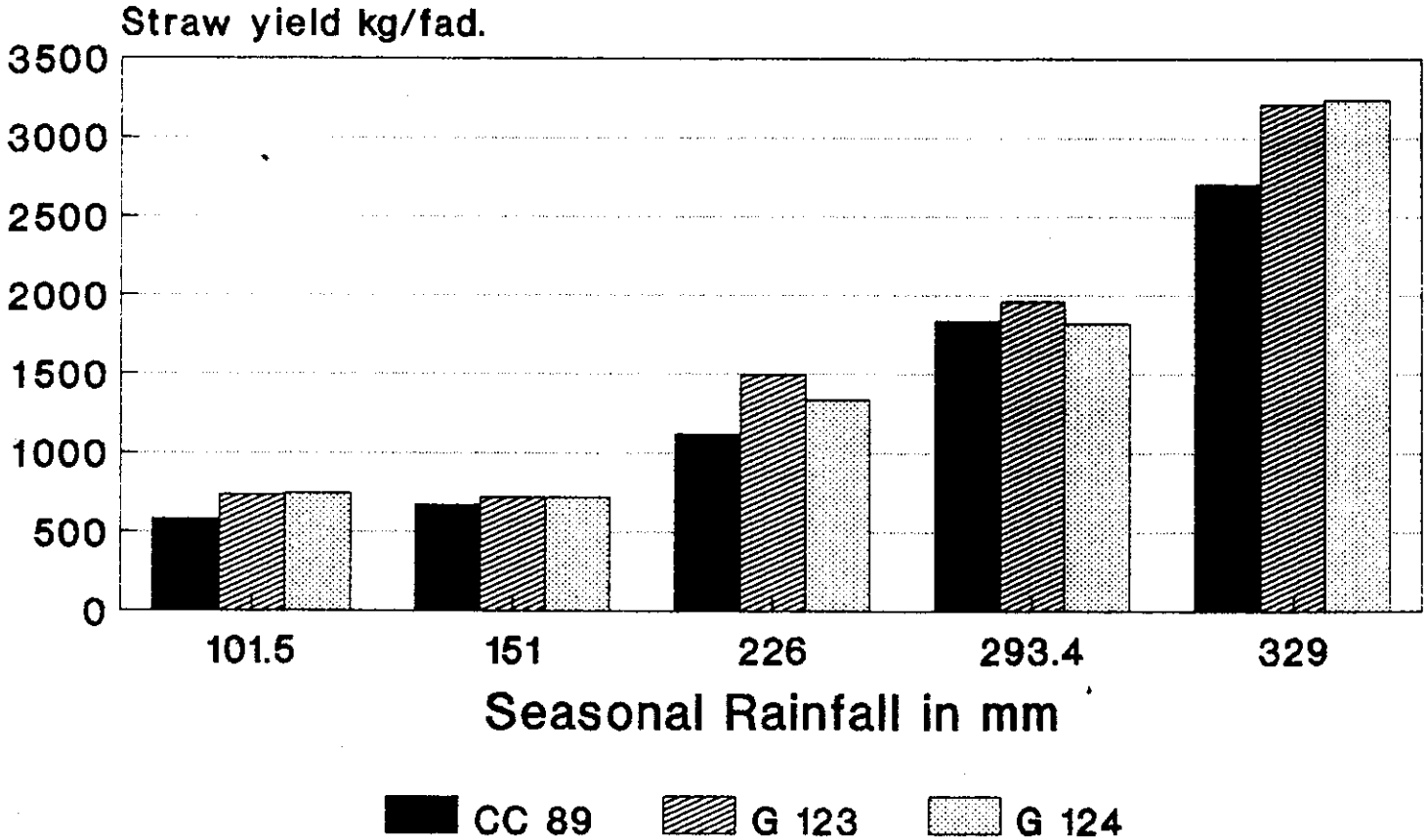

Figure 1

Straw yield and Seasonal Rainfall Relationship

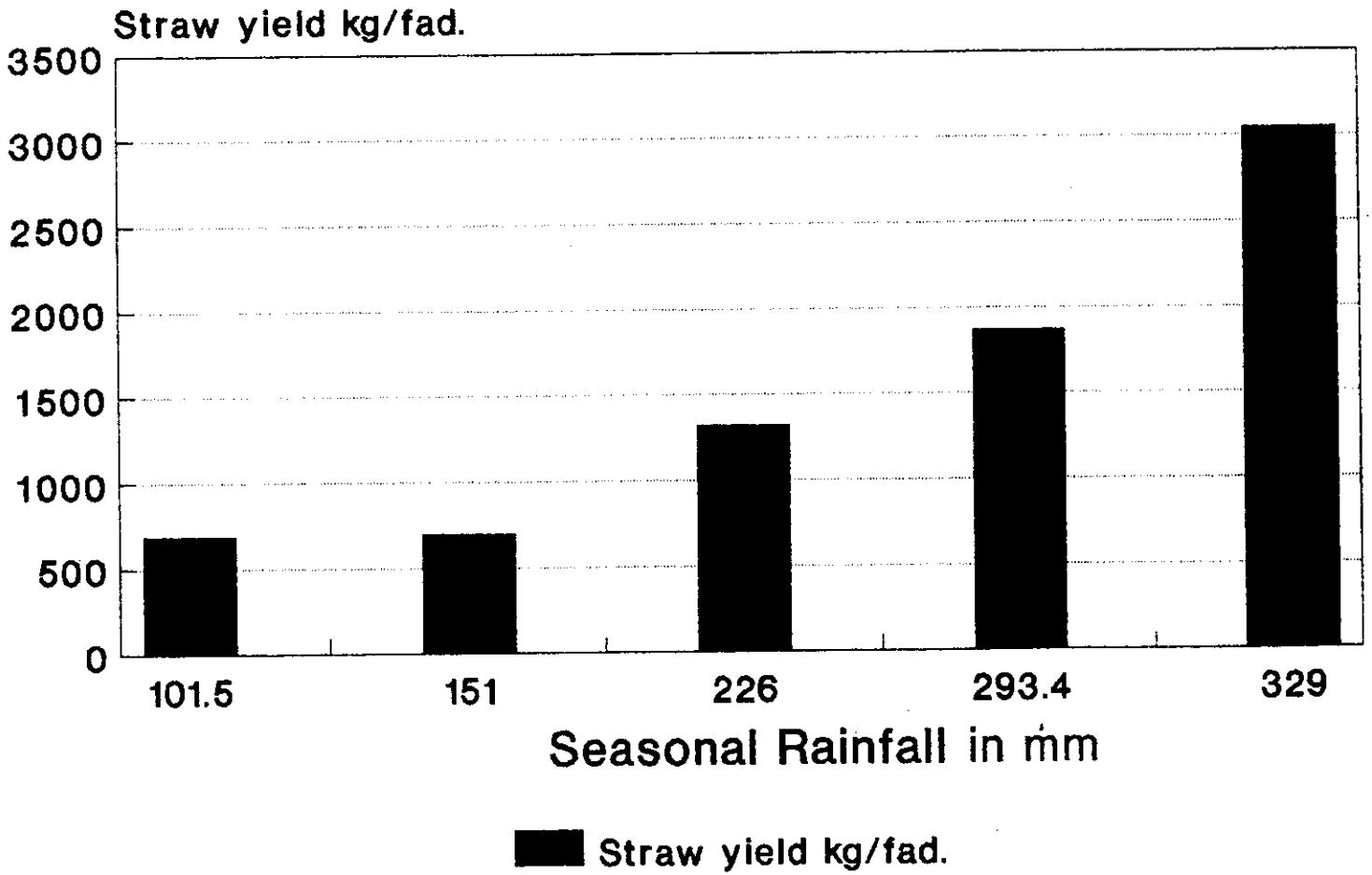

Figure 2

Data in Table 11 show that the interaction of fertilization x variety was significant at Raffah 1991/92. It is evident that with the three varieties the highest straw yields were obtained when N and P were added together. CC89 and Giza 124 gave their highest straw yields with treatments (15kg N + 15 kgP_2O_5 /fed.), (30kg N + 15 kgP_2O_5 /fed.) and (30kg N + 30 kgP_2O_5/fed.). But Giza 123 gave its highest straw yield with treatments (15kg N + 30 kgP_2O_5/fed.), (30kg N + 15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5 /fed.). Apparently treatments (30kg N + 15 kgP_2O_5 /fed.) and (30kg N + 30 kgP_2O_5 /fed.) gave the same results with the three varieties. Also Giza 123 and Giza 124 gave their highest straw yields with treatment 30kg N/fed. On the other hand, with treatment (30 kg N/ fed.) Giza 123 and Giza 124 outyielded CC 89. While with treatment (15 kg/ N/fed.) Giza 124 yielded the highest straw yield followed by Giza 123 and the lowest was CC89. With treatment (15 kg N+ 15 kgP_2O_5/fed.) Giza 124 variety yielded the highest straw yield followed by CC89 and the lowest was Giza 123. Also with treatment (15 kgN + 30kg P_2O_5/fed.)Giza 123 variety yielded the highest straw yield followed by Giza 124 and the lowest was CC89.

In conclusion, Giza 123 and Giza 124 varieties highly responded to N and P when added together, while CC89 variety showed slight response. Also, Giza 123 and Giza 124 varieties highly responded to N when added alone, but CC89 variety did not responsed as well.

Table 11 : **Effect of fertilization by variety interaction on straw yield at Raffah 1991/92. (kg/ fed.)**

Fert. treatments N	P	Variety CC89	G123	G124
0	0	876	1790	1788
0	15	2121	2646	2290
0	30	2035	2388	1262
15	0	1953	3008	3308
30	0	2835	4136	4072
15	15	3389	2330	4328
15	30	2604	3834	2994
30	15	4074	4800	4351
30	30	4493	3965	4781
LSD	5 %	1152		
	1%	N.S.		

5) Biological yield:

Data presented in Tables 12,13 and 14 illustrate the effect of N and P fertilizers, varieties, environments and the interaction of fertilization x variety on biological yield of barley.

Positive effects of fertilization on biological yield were observed. The increase in biological yield due to fertilization was significant at the six environments of Sidi Barrani 1990/91,Sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92, Atnooh 1991/92 and Raffah 1991/92; whereas the increase was not significant at El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in the amount of rainfall as well as to rainfall distribution (Table 1). Similar results were obtained by **Lekes and Zinisceva (1990)** who stated that differences in N uptake were influencd mainly by non-genetic factors such as climatic conditions.

Adding phosphorous fertilizer alone at the rate of 15kg/fed, significantly increased biological yield ($P < 0.5$) at Raffah 1991/92. This result could be attributed to the low level of $CaCo_3$ in Raffah compared to the other ones (Table 2). The differences between the two rates (15-30kg/fed.) were not significant. Similar results were obtained by **Soltanpour et al. (1987) and Ryan et al. (1991).** On the contrary, at the other 7 environments applying phosphorous fertilizer (15 or 30 kg/fed.) showed less effect.

Table (12): Means of biological yield of barley grown under different rainfed conditions at 8 environments as influenced by some fertilization treatments. (kg/ fed.)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	329	-
N	P								
0	0	699	1602	1781	983	774	710	1884	1030
0	15	692	1880	1804	861	1065	947	2876	1145
0	30	729	1554	2048	1216	879	904	2348	1193
15	0	833	2701	2251	1857	1079	917	3480	1032
30	0	894	2986	2491	2013	1432	870	4530	1192
15	15	937	2103	2514	1886	1816	1083	4159	1246
15	30	1188	2713	2374	1810	1939	1011	3979	1203
30	15	1089	3568	2875	2386	1961	1011	5413	1236
30	30	1332	3277	3027	2393	2363	1032	5421	1403
Mean		932	2487	2352	1712	1479	943	3788	1186
LSD	5%	186	575	495	398	454	N.S.	755	N.S
	1%	248	767	660	532	606	N.S	1007	N.S

** Seasonal rainfall in mm

Applying nitrogen fertilizer at the rate of 15 kg/fed. resulted in significant increase in biological yields at Wady El-Washk 1991/92, Sidi Barrani 1991/92 and Raffah 1991/92compared to the control, but added N fertilizer at the rate of 30kg/fed. significantly increased biological yield at the six environments mentioned before. The difference between the two N rates (15-30 kg/fed.) was significant at Raffah 1991/92 only. These results are in agreement with those obtained by **Cooper et al. (1987) and El-Sayed et al. (1991)**. Application of nitrogen tended to increase biological yield and this might be attributed to the increase of its components i.e. grain and straw yield.

These findings are in harmony with those obtained by **Jana et al. (1978), Hooda and Kalra (1981), Papastylianou (1989), Assey et al. (1990), Bitney et al. (1991)** and **El-Sayed et al. (1991).**

At the same six environments when N and P fertilizer were together in the combination treatments the increases in biological yields were significant compared to the control. The highest biological yields at Sidi Barrani 1990/91, Atnooh 1991/92, Wady El-Washk 1991/92, El-Mthany1991/92 and Raffah 1991/92 were achieved when N and P fertilizers were applied at their highest rates (30kg N + 30 kgP_2O_5 /fed.) Biological yield of the barley that received the highest rate of both (N and P) outyielded those of the control treatment with 9o%, 202%, 143%, 69% and 187% at the five mentioned environments respectively. On the other

side, the highest biological yields of barley at Sidi Barrani 1991/92 were achieved by adding (30kg N + 15 kgP_2O_5/fed.). Percentage increase due to the last treatment over control was 122%.

These results are in harmony with those obtained by **Singh and Parshad (1972)** who stated that under rainfed conditions the application of 40 Kg N + 20 kgP_2O_5/ha at sowing was all about the required for obtaining good yields of barley. Also, **Shepherd et al. (1987)**, reported that under rainfed condition grain and dry matter yields were increased by N+ P application at all sites in all years and **Mechergui et al. (1989)** reported that rates of N and P in combination gave the greatest amounts of biological yield.

With regard to varietal effect, data in Table 13 and Figure 3 show that the differences in biological yield among varieties were significant at Atnooh 1991/92 and Wady El -Washk 1991/92. Variety CC89 produced less biological yeild than the two varieties Giza 123 and Giza 124. While mean the differences in biological yield between the two varieties Giza 123 and Giza 124 did not reach the level of significance. The same trend was observed at most environments eventhough the differences were not significant.

Data in Table 13 and Figure 4 show that the highest biological yields were obtained for plants grown in Sidi Barrani 1991/92 and Raffah

Table (13): The differential response of 3 varieties of barlay on biological yield at 8 environments in 1989/90, 1990/91 and 1991/92 seasons. (kg/ fed.)

Environment	Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
variety **	151	293.4	-	226	-	101.5	329	-
CC89	910	2396	2289	1476	1322	818	3365	1198
Giza 123	930	2583	2380	1911	1626	992	3967	1172
Giza 124	957	2484	2386	1750	1491	1019	4033	1190
Mean	932	2487	2352	1712	1479	943	3788	1186
LSD 5%	N.S	N.S	N.S	261	139	N.S	N.S	N.S
1%	N.S	N.S	N.S	N.S	230	N.S	N.S	N.S

** Seasonal rainfall in mm.

Biological yield and Seasonal Rainfall Relationship CC 89, Giza 123, and Giza 124 Barley Varieties

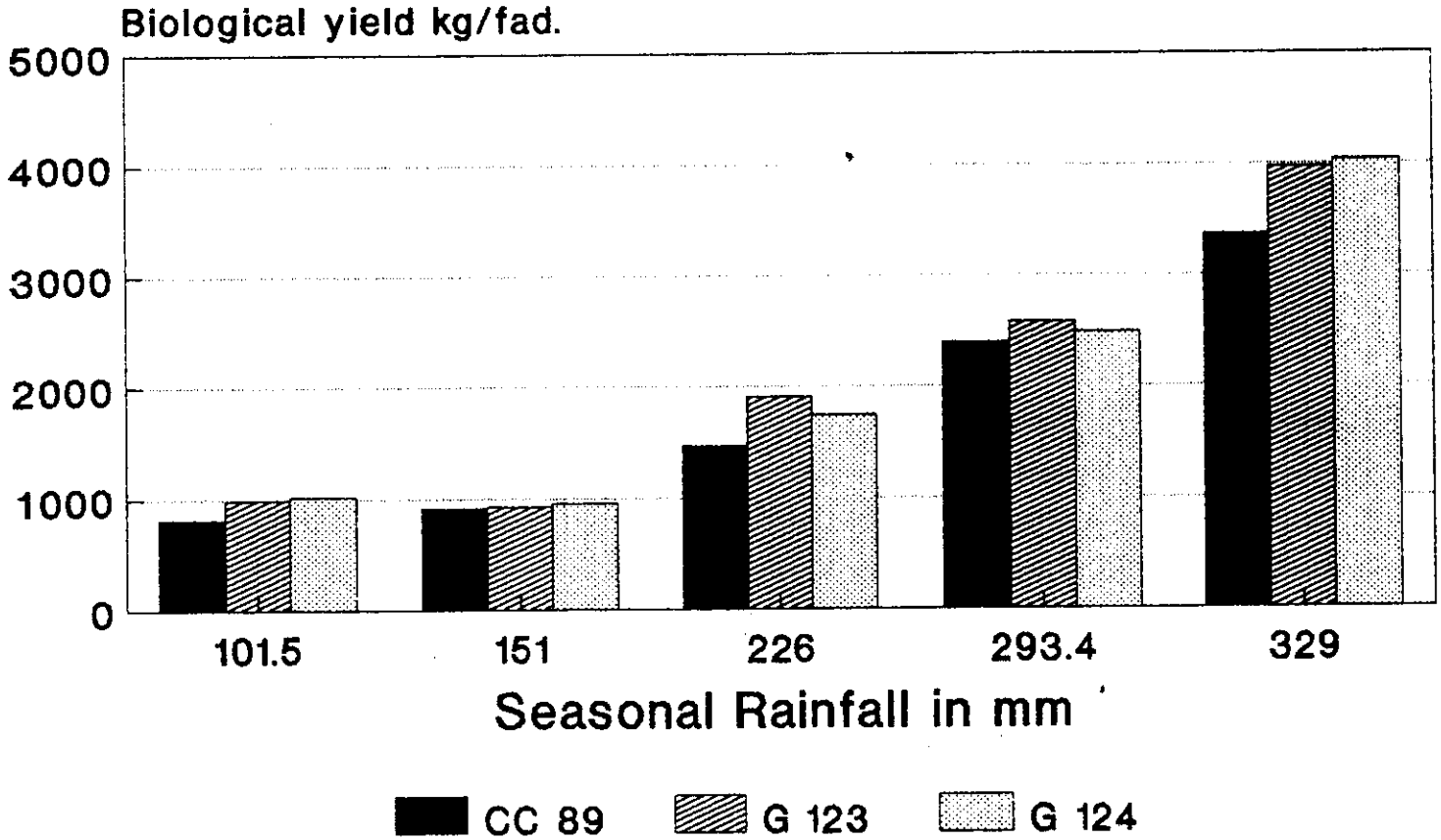

Figure 3

Biological yield and Seasonal Rainfall Relationship

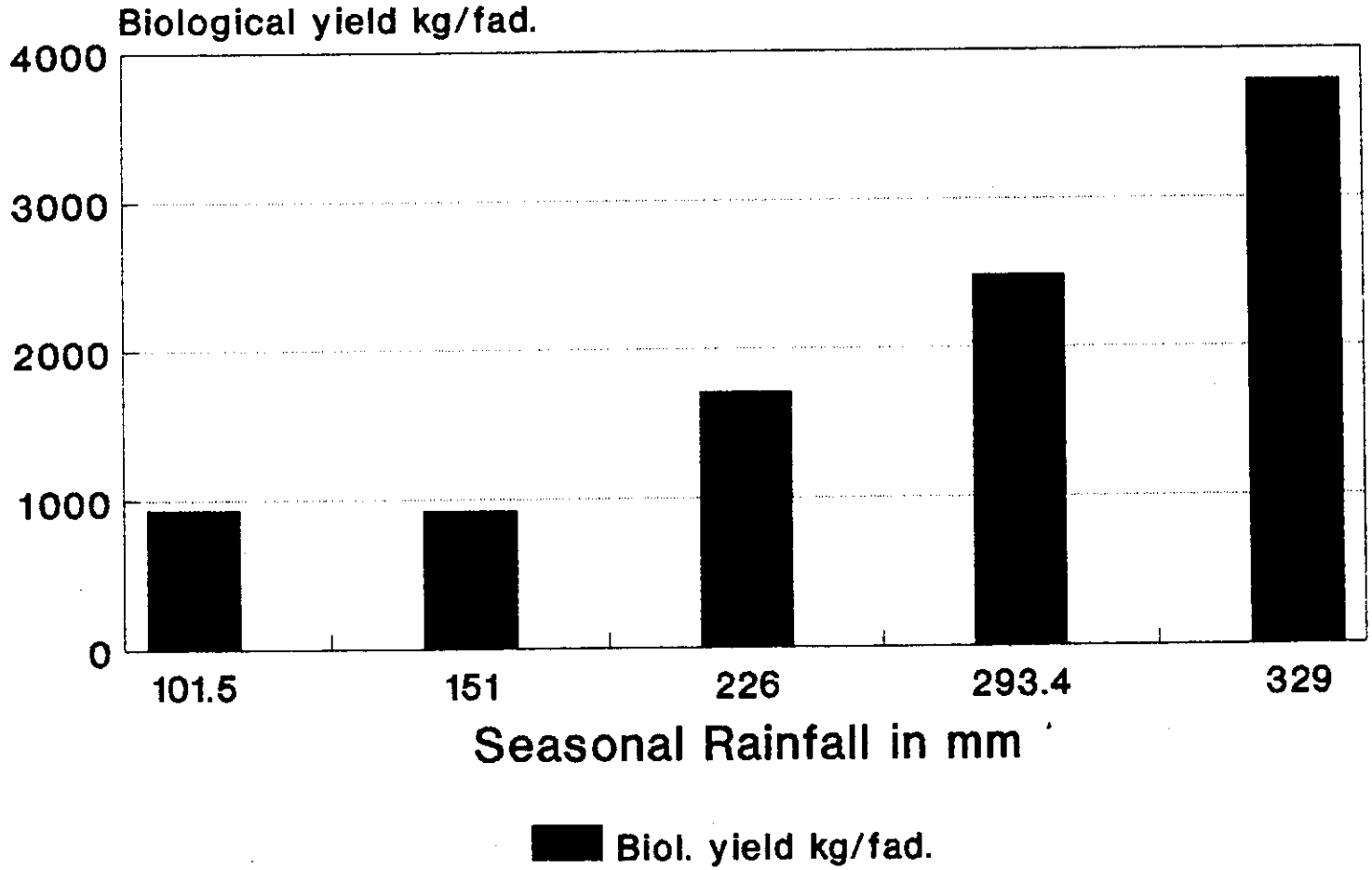

Figure 4

1991/92, because these two environments received the highest amount of seasonal rainfall as well as rainfall distribution was better (Table 1). On the contrary the lowest biological yields were obtained for plants grown in Sidi Barrani 1990/91 and El-Dabaa 1989/90. These results could be attributed to scarcity of rainfall at the two environments compared with the others (Tabl 1). Similar results were obtained by **El-Sayed et al (1991)**. With this respect **Ryan et al. (1991)** reported that the analysis of dry matter showed the significance of site effect, where increasing the amount of rainfall caused progressive increase in dry matter of barley.

Data in Table 14 show that the interaction of fertilization x variety was significant at Raffah 1991/92. It is evident that with the three varieties the highest biological yields were obtained when N and P were added together. CC89 and Giza 124 gave their highest biological yield with treatments (15kg N + 15 kgP_2O_5/fed.), (30kg N + 15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5/fed.). But Giza 123 gave its highest biological yield with treatments (15kg N + 30 kgP_2O_5/fed.), (30kg N + 15 kgP_2O_5/ fed.) and (30kg N + 30 kgP_2O_5/fed.). Apparently the two treatments (30kg N + 15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5/fed.) gave the same results with the three varieties. Also Giza 123 and Giza 124 varieties gave their highest biological yields with treatment 30kg N/fed. On the other hand with treatment (30 kg N/fed.) Giza 123 and Giza 124 varieties outyielded CC 89variety. Also with treatment (15kg N + 15 kgP_2O_5 /fed.)

Table I4 : **Effect of fertilization by variety interaction on biological yield at Raffah 1991/92.** (kg/ fed.)

Fert. treatments N	P	Variety CC89	G123	G124
0	0	1231	2197	2225
0	15	2597	3280	2753
0	30	2530	2906	1608
15	0	2622	3680	4141
30	0	3445	5093	5053
15	15	4205	2932	5342
15	30	3276	4760	3902
30	15	4880	5946	5414
30	30	5506	4892	5866
	5%	1325		
LSD	1%	N.S.		

Giza 124 yielded the highest biological yield followed by CC89 and the lowest was Giza 123. With treatment (15kg N/ fed.) Giza 124 yielded the highest biological yield followed by Giza 123 and the lowest was CC89. Also, with treatment (15 kg N + 30 kg P_2O_5/fed.) Giza 123 yielded the highest biological yield followed by Giza 124 and the lowest was CC89.

In conclusion, Giza 123 and Giza 124 varieties highly responded to N and P when added together, while CC89 variety showed slight response. Also, Giza 123 and Giza 124 varieties highly responded to N when added alone, but CC89 variety did not responsed as well.

II) Yield of Grains and Yield Component :

1- Number of spikes per m^2 :

Data presented in Tables 15,16,17 and 18 illustrate the effect of N and P fertilizers, varieties, environments and the interaction of fertilization x variety on number of spikes/m^2 of barley.

Positive effects of fertilization on number of spikes/m^2 were observed. The increase in number of spikes/m^2 due to fertilization was significant at the five environments of Sidi Barrani 1990/91, Sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92 and Atnooh 1991/92, whereas the increase was not significant at each of El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in the amount of rainfall as well as to rainfall distribution.

Adding phosphorous fertilizer alone at any used rate of 15 or 30 kg/ fed. showed less effect on number of spikes/m^2 at all environments.

Applying nitrogen fertilizer at the rate of 15 kg/fed. significantly increased the number of spikes/m^2 compared to the control at Wady El-Washk 1991/92 and Sidi Barrani 1991/92. Also applying N fertilizer at the rate of 30 kg/fed. resulted in significant increase in number of spikes/m^2 compared to the control at Wady El-Wask 1991/92, Atnooh 1991/92 and Sidi Barrani 1991/92. Data of average rainfall (Table 1) show that Wady El-Washk 1991/92 and Sidi Barrani 1991/92 received higher rainfall than sidi Barrani 1990/91, therefore, the responses to N fertilizer with increasing rainfall were observed. Similar results were obtained by **Cooper et al. (1987)**. Such increase may be attributed to the increase in tillering capacity and to the N fertilizer enhancment of the production of spikes mainly through the stimulation of plant capacity in building metabolites to which the dry matter content of plant could be a reliable index. Similar results were obtained by **Hooda and Kalra (1977), Jana et al. (1978), Ram and singh (1978), El-Sayed et al. (1991) and Torofder and Hossain (1991).**

When N and P fertilizers were together in the combination treatments the increases in number of spikes/m^2 were significant compared to the control at Sidi Barrani 1990/91, Antooh 1991/92, Wady El-Washk 1991/92, El-Mthany 1991/92 and Sidi Barrani 1991/92. The

Table (15): Means of number of spikes/m^2 of barley grown under different rainfed conditions at 7 environments as influenced by some fertilization treatments.

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	-
N	P							
0	0	150	199	280	120	150	114	188
0	15	137	223	278	129	176	139	213
0	30	137	189	293	152	177	146	193
15	0	138	288	301	260	175	141	187
30	0	161	295	311	242	201	125	213
15	15	159	248	350	225	263	149	218
15	30	183	307	300	202	257	145	188
30	15	201	362	377	266	232	146	221
30	30	219	341	410	292	271	155	211
Mean		165	272	322	210	211	140	203
LSD	5%	28	57	59	45	43	N.S	N.S
	1%	37	77	79	60	58	N.S	N.S

** Seasonal rainfall in mm

Data for Raffah 1991/1992 was not available.

highest number of spikes/m^2 were achieved when N and P fertilizers were applied at their highest rates (30kg N + 30 kgP_2O_5/fed.) at most environments.

It could be concluded that application of N and P improved the number of spikes/m^2. These results are logic since N and P fertilization increase the meristemic activity in barley plants.

With regard to varietal effect, data in Table 16 show that the differences in number of spikes/m^2 among varieties were significant at Atnooh 1991/92. Variety Giza 123 produced the highest number of spikes/m^2 followed by Giza 124 and the lowest was CC89 variety. The same trend was observed at most environments eventhough the differences were not significant.

The highest number of spikes/m^2 was obtained for plants grown in El-Mthany 1991/92 and Sidi Barrani 1991/92. Data in Table 1 show that Sidi Barrani 1991/92 received the highest amount of seasonal rainfall in addition better rainfall distribution. This environment received the highest amount of rainfall during November-January period compared with other environments which coincided with Seed germination time and tillering stage, therefore high number of spikes/m^2 was detected in this environment. On the contrary, the lowest number of spikes/m^2 was

Table (16): The differential response of 3 varieties of barlay on number of spikes/m^2 at 7 environments in 1989/90, 1990/91 and 1991/92 seasons.

Environment	Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1989/90
variety **	151	293.4	-	226	-	101.5	-
CC89	171	224	279	188	177	127	203
Giza 123	164	310	353	232	241	152	210
Giza 124	160	283	335	210	216	141	198
Mean	165	272	322	210	211	140	203
LSD 5%	N.S	N.S	N.S	N.S	19	N.S	N.S
1%	N.S	N.S	N.S	N.S	25	N.S	N.S

** Seasonal rainfall in mm.

Data for Raffah 1991/92 was not available.

obtained for plants grown in El-Dabaa 1989/90 and Sidi Barrani 1990/91 because these two environments received the lowest amount of seasonal rainfall (Table 1). Similar results were obtained by **El-Sayed et al. (1991).**

Data in Tables 17 and 18 show that the interaction of fertilization x variety was significant for number of spikes/m^2 at Atnooh 1991/92 and Sidi Barrani 1991/92. It is evident that at Atnooh 1991/92 the three varieties gave their highest number of spikes/m^2 when N and P were together in the combination treatments. Also Giza 123 gave its highest number of spikes/ m^2 with treatment (30 kg N/fed.) But Giza 124 variety gave its highest number of spikes/m^2 with (30kgP_2O_5/fed.) On the other hand, with treatment (30 kgP_2O_5/fed.) Giza 124 outyielded Giza 123 and CC89 varieties. Also with treatments (30 kg N/fed.) Giza 123 variety outyielded Giza 124 and CC89 varieties. With treatment (15 kg N/fed.) giza 124 variety gave its highest number of spikes/m^2 followed by Giza 123 and the lowest was CC89. With treatment (15 kgN+15 kgP_2O_5/fed.) Giza 123 variety gave its highest number of spikes/m^2 followed by CC89 and the lowest was Giza 124. Also with treatment (30 kgN+30 kg P_2O_5/fed.) Giza 123 variety gave its highest number of spikes/m^2 followed by giza 124 and the lowest was CC89. At sidi Barrani 1991/92 CC89 gave its highest number of sipkes/m^2 with treatment (15 kgN/fed.), (30 kg/N /fed.), (30 kg N + 15 kgP_2O_5/fed.) and (30 kg N + 30 kgP_2O_5/fed.). Also Giza 123 gave

Table 17 : Effect of fertilization by variety interaction on number of spikes/m^2 at Atnooh 1991/92

Fert. treatments N	P	Variety CC89	G123	G124
0	0	142	178	131
0	15	156	191	180
0	30	126	155	251
15	0	126	187	211
30	0	150	290	163
15	15	270	299	220
15	30	213	270	289
30	15	196	271	229
30	30	214	331	270
LSD	5 %	76		
	1 %	N.S.		

Table 18 : Effect of fertilization by variety interaction on number of spikes/m^2 at Sidi Barrani 1991/92

Fert. treatments N	P	Variety CC89	G123	G124
0	0	160	179	259
0	15	206	250	215
0	30	142	196	231
15	0	224	410	230
30	0	301	275	309
15	15	186	350	210
15	30	201	421	300
30	15	281	390	415
30	30	317	323	385
	5%	100		
LSD	1%	133		

its highest number of spikes /m^2 with treatments (15 kg N/fed.), (15 kg N + 15 kgP_2O_5/fed.), (15 kg N + 30 kgP_2O_5/fed.), (30 kg N + 15 kgP_2O_5/fed.) and (30 kg N + 30 kgP_2O_5/fed.). But Giza 124 gave its highest number of spikes/m^2 with treatments (30 kg N + 15 kgP_2O_5/fed.) and (30 kg N + 30 kgP_2O_5/fed.). On the other hand with treatments (15 kg N/fed.), (15 kg N + 15 kgP_2O_5/fed.) and (15 kg N + 30 kgP_2O_5 /fed.) Giza 123 outyielded Giza 124 and CC 89 varieties. Also with treatment (30 kg N + 15 kgP_2O_5 / fed.) Giza 123 and Giza 124 outyielded CC89.

2- Number of grains per spike :

Data presented in Tables 19 and 20 illustrate the effect of N and P fertilizers, varieties and environments on number of grains per spike of barley.

Positive effects of fertilization on number of grains per spike were observed. The increase in number of grains per spike due to fertilization was significant at the six environments of Sidi Barrani 1990/91, Sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92, Atnooh 1991/92, and Raffah 1991/92; whereas the increase was not significant at each of El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in the amount of rainfall as well as to the pattern of rainfall distribution.

thus, the low population density resulted in less competition among plants at this site. In turn spike length and number of grains /spike were high, because plants did not suffer from water deficiency during the heading period. Nevertheless at Sidi Barrani 1991/92, the barley plants gave **highest number of grains /spike because of high seasonal rainfall** (293.4mm) as well as a good rainfall distribution enough for plants to grow well with less water stress. At Sidi Barrani 1990/91 barley plants gave the fewest grains/spike for two reasons; the first, late sowing and the second, rainfall distribution was not as good as Sidi Barrani 1991/92 because about 28% of total rainfall was received in February - April period and this coincided with spike initiation, booting and heading stages, therefore, the number of grains /spike was decreased.

3- Grain weight per spike :

Data presented in Tables 21 and 22 illustrate the effect of N and P fertilizers, varieties and environments on grain weight per spike of barley.

Positive effects of fertilization on grain weight per spike were observed. The increase in grain weight per spike due to fertilization was significant at the six environments of Sidi Barrani 1990/91, Sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92, Atnooh 1991/92 and Raffah 1991/92; whereas the increase was not significant at each of El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in the amount of rainfall as well as the parttern of rainfall distribution.

Table (21): Means of grain wieght per spike of barley grown under different rainfed conditions at 8 environments as influenced by some fertilization treatments. (gram)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	329	-
N	P								
0	0	1.012	1.703	1.663	1.559	1.529	1.711	1.633	1.420
0	15	1.366	1.791	1.577	1.399	1.522	1.617	1.716	1.521
0	30	1.369	1.794	1.616	1.569	1.576	1.776	1.708	1.642
15	0	1.239	2.336	1.873	1.752	1.841	1.762	2.216	1.614
30	0	1.217	2.320	1.834	1.921	1.862	1.997	2.162	1500
15	15	1.401	2.387	1.921	1.790	2.040	1.836	2.303	1.511
15	30	1.593	2.292	2.052	2.030	1.920	1.832	2.118	1.780
30	15	1.327	2.337	1.742	1.838	2.007	1.979	2.346	1.617
30	30	1.591	2.366	1.792	1.979	2.151	1.969	2.259	1.754
Mean		1.346	2.147	1.785	1.759	1.827	1.831	2.051	1.595
LSD	5%	0.282	0.416	0.248	0.245	0.170	N.S	0.274	N.S
	1%	0.376	0.555	0.331	0.327	0.227	N.S	0.365	N.S

** Seasonal rainfall in mm

Adding phosphorous fertilizer alone at used rates (15 or 30 kgP_2O_5 / fed.) resulted in significant increase in grain weight per spike ($P < 0.5$) compared to the control at Sidi Barrani 1990/91. Similar results were obtained in irrigated barlay by **Abd El-Latif and Salamah (1982)**. On the contrary, at the other seven environments applying P fertilizer using (15 or 30 kgP_2O_5/fed.) was less effective.

Adding nitrogen fertilizer alone at the rate of 15 kg/fed. resulted in significant increase in grain weight of spike compared to the control at Atnooh 1991/92, Sidi Barrani 1991/92 and Raffah 1991/92. However, applying nitrogen fertilizer at the rate of 30 kg/fed. resulted in significant increase in grain weight per spike compared to the control at Atnooh 1991/92, Wady El-Washk 1991/91, Sidi Barrani 1991/92 and Raffah 1991/92. Similar results were obtained by **Abd El-Latif and Salamah (1982) and Assey et al. (1990).**

At the same six environments when N and P fertilizers were together in the combination treatments the increase in grain weight per spike was significant compared to the control. Similar results were obtained by **Singh and Misra (1980).**

With regard to varietal effect, data presented in Table 22 show that the differences in grain weight per spike among varieties were significant at Atnooh 1991/92 and El-Mthany 1991/92. The two varieties Giza 124

Table (22): The differential response of 3 varieties of barlay on grain weight per spike at 8 environments in 1989/90, 1990/91 and 1991/92 seasons.(gram)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
variet y	**	151	293.4	-	226	-	101.5	329	-
CC89		1.393	2.289	1.894	1.822	1.896	1.895	2.184	1.639
Giza 123		1.236	1.987	1.659	1.689	1.714	1.746	1.973	1.529
Giza 124		1.409	2.166	1.803	1.768	1.873	1.851	1.997	1.619
Mean		1.346	2.147	1.785	1.759	1.827	1.831	2.051	1.595
LSD	5%	N.S	N.S	0.141	N.S	0.132	N.S	N.S	N.S
	1%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

** Seasonal rainfall in mm.

and CC89 gave heavier grains than Giza 123 variety. The same trend was observed at the other environments eventhough the differences among varieties were not significant. The differences between varieties might be due to the genetical variation in yielding ability and yield components. In this respect **Mahmoud (1992)** stated that the differences in grain weight per spike between varieties Giza 124 and CC89 were not significant.

Data presented in Table 22 show that the heaviest grains/spike were obtained for plants grown at Sidi Barrani 1991/92 and Raffah 1991/92. Considering the total amount and distribution of rainfall by month, these two environments received the highest amount of rainfall and good rainfall distribution which were enough for plants to grow well with less water stress (Table 1). On the contrary, lowest grains/spike were obtained for plants grown at Sidi Barrani 1990/91 for two reasons; the first, late sowing and the second, rainfall distribution was not good because about 28% of total rainfall was received in February -April period this coincided with spike initiation, booting, heading and grain filling stages, therefore less number of grains/spike and fewest grains/spike were obtained compared to other environments.

4- 1000-grain weight

Data presented in Tables 23 and 24 illustrate the effect of N and P fertilizers, varieties and environments on 1000-grain wieght of barley.

Table (23): Means of 1000- grain weight of barley grown under different rainfed conditions at 8 environments as influenced by some fertilization treatments. (gram)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	329	-
N	P								
0	0	37.87	47.41	33.66	44.77	45.48	36.68	45.98	41.33
0	15	40.41	46.01	36.30	42.37	41.71	37.30	45.40	44.33
0	30	39.88	48.35	36.85	44.31	42.92	39.51	49.05	42.40
15	0	38.25	46.64	35.38	42.56	38.28	36.68	47.34	46.04
30	0	38.07	44.27	33.98	40.02	38.46	39.21	44.20	43.36
15	15	39.44	44.43	35.33	41.42	41.01	37.31	45.05	41.44
15	30	39.44	43.06	37.75	46.31	38.37	39.03	43.79	45.23
30	15	37.16	41.31	32.36	38.73	37.90	37.66	45.69	42.83
30	30	38.79	45.72	32.64	42.41	40.25	39.47	43.51	46.30
Mean		38.50	45.24	35.58	42.54	40.48	38.09	45.56	43.69
LSD	5%	N.S	N.S	3.60	N.S	3.29	N.S	N.S	N.S
	1%	N.S	N.S	4.80	N.S	4.38	N.S	N.S	N.S

** Seasonal rainfall in mm

Data presented in Table 23 show that there were significant differences in 1000-grain weight due to fertilization at the two environments, of Atnooh 1991/92 and El-Mthany 1991/92.

At Atnooh 1991/92, when P was added alone at the rate of 15 kg/ fed. resulted in a significant decrease in 1000-grain weight compared to the control. Adding of nitrogen fertilizer at a rate of 15 or 30 kg /fed. resulted in significant decrease in 1000-grain weight compared to the control. Nevertheless, the difference between the two rates 15 and 30 kg/ fed. was not significant. It could be concluded that, the 1000-grain weight was reduced as a result of the addition of nitrogen. This may be attributed to higher number of grains /spike of plant fertilized in plot than the unfertilized ones, thus a large sink was created and mal distribution of photosythates ensued. These results agree with those obtained by **Orphanos (1991)** who stated that the addition of N decreased the 1000-grain weight.

When N and P were added together, it was evident that the decrease in 1000-grain weight was significant compared to the control. At environment El-Mthany 1991/92, adding nitrogen or phosphorous alone at any used rate gave no significant differences in 1000-grain weight. Similar results were obtained by **Ram and Singh (1978)** who reported no significant differences in 1000-grain weight between several the nitrogen rates. No significant differences were detected when N and P were present in the combination treatments with the exception of treatment (15

kg N+ 30 kg P_2O_5/fed.), where the addition of this treatment resulted in significant increase in 1000-grain weight.

At the other six environments, adding nitrogen or phosphorous alone and N and P together were less effective. Similar results were obtained by **Singh and Misra (1980)** and **Adamu (1991).**

Data presented in Table 24 show that there were significant differences in 1000-grain weight among varieties at Atnooh 1991/92, Sidi Barrani 1991/92, Raffah 1991/92 and El-Dabaa 1989/90. CC89 variety produced heavier grains than Giza 123 and Giza 124. The same trend was observed at the other environments eventhough the differences among varieties were not significant. The differences between the varieties might be due to genetical variation between these varieties in yielding ability and yield components. Similar results were obtained by **Hooda and Kalra (1977).**

The heaviest 1000-grain weight were obtained for plants grown at Sidi Barrani 1991/92 and Raffah 1991/92. Data in Table 1 show that these two environments recieved the highest seasonal rainfall as well as a good rainfall distribution. On the contrary, the lowest 1000-grain weight were obtained for plants grown at El-Mthany 1991/92, sidi Barrani 1990/91 and El-Dabaa 1989/90. These results could be attributed to scarcity of seasonal rainfall at the two latter environments compared with the others (Table 1).

5) Grain yield :

Data presented in Tables 25, 26, 27, 28 and 29 illustrate the effects of N and P fertilizers, varieties, environments and the interaction of fertilization x variety on grain yield of barley.

Positive effects of fertilization on grain yield were observed. The increase in grain yield due to fertilization was significant at the six environments of Sidi Barrani 1990/91,Sidi Barrani 1991/92, El-Mthany 1991/92, Wady El-Washk 1991/92, Atnooh 1991/92 and Raffah 1991/92; whereas the increase was not significant at El-Dabaa 1989/90 and Raffah 1989/90. These results could be attributed to the differences in the amount of rainfall as well as to rainfall distribution. Similar results were obtained by **Ivoilov et al. (1989)** who stated that 89% of yield variation was attributed to weather conditions, mainly rainfall and temperature, 7% was attributed to fertilizers and sowing rates and 4% was attributed to other factors. **Lekes and zinisceva (1990) and Mazid and Bailey (1992).**

Adding phosphorous fertilizer alone at the rate of 15kg/fed, resulted in significant increase in grain yield ($P < 0.5$) compared to the control at Raffah 1991/92. This result could be attributed to the low level of $CaCo_3$ in Raffah site compared to the other ones (Table 2). The difference between the two rates of P (15-30kg/fed.) was not significant. Similar result was obtained by **Singh and Parshad (1972) and Abd El-Latif and Salamah (1982).** On the contray, at the other 7 environments applying P fertilizer using (15 or 30 kg/fed.) showed less effect. Similar

Table (25): Means of grain yield of barley grown under different rainfed conditions at 8 environments as influenced by some fertilization treatments. (kg/ fed.)

Environment		Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
fert. treatment	**	151	293.4	-	226	-	101.5	329	-
N	P								
0	0	157	374	486	175	225	193	399	313
0	15	191	461	460	176	268	233	524	372
0	30	192	356	488	230	277	265	453	368
15	0	184	669	580	481	306	251	724	288
30	0	198	715	588	497	377	248	849	349
15	15	229	596	704	431	560	268	818	374
15	30	305	700	631	428	507	266	835	339
30	15	271	846	703	509	483	271	1005	367
30	30	349	831	803	603	602	307	1008	394
Mean		231	616	605	393	401	256	735	351
LSD	5%	68	137	111	70	97	N,S.	119	N.S.
	1%	91	183	148	93	129	N.S.	159	N.S.

** Seasonal rainfall in mm.

result was obtained by Singh et al. (1990) who stated that the addition of P only at the rate of 30kg P_2O_5/ha gave the lowest grain yield and no significant difference in grain yield between 30 kgP_2O_5/ha and the control was detected.

Applying nitrogen fertilizer at the rate of 15 kg/fed. resulted in significant increase in grain yield compared to the control at Wady El-Washk 1991/92; Sidi Barrani 1991/92 and Raffah 1991/92.The three latter environments received the highest amounts of seasonal rainfall compared to Sidi Barrani 1990/91 (Table 1), therefore, the responses to N fertilizer with increasing rainfall were observed. Similar results were obtained by **Wahbi et al. (1989)** who stated that the percentage of significant response to N increased with the increase in seasonal rainfall and decrease mineral-N in the soil at planting time. Applying N fertilizer at the rate of 30kg/fed. resulted in significant increase in grain yield at Wady El-Washk 1991/92, Atnooh 1991/92, Sidi Barrani 1991/92 and Raffah 1991/92. The differences between the two rates of N (15-30 Kg /fed.) was significant at Raffah 1991/92 only. These results are in agreement with those obtained by **Cooper et al. (1987)** reported that responses to N are closely related to amounts of rainfall and tend to decrease with decreasing available soil moisture.

Generally, the addition of N tended to improve grain yield of barley per unit area of land.Similar results were obtained by **Hooda and Kalra**

(1977), Verma et al. (1977), Khatua and Samal (1978), Ram and Singh (1978), Sakkal and Sukkar (1983), Solanki et al. (1987), Papstylianou (1989), Lekes and Zinisceva (1990), Bitney et al. (1991), Orphanos (1991) and Torofder and Hossain (1991).

At the same six environments mentioned before, when N and P fertilizers were together in the combination treatments, the increases in grain yield were significant compared to the control. The highest grain yields at Sidi Barrani 1990/91, Atnooh 1991/92, Wady El-Washk 1991/92, El-Mthany 1991/92 and Raffah 1991/92 were achieved when N and P fertilizers were applied at their highest rates (30kg N + 30 kgP_2O_5/fed.) Grain yield of barley plants fertilized with (30kg N + 30 kgP_2O_5/fed.) outyielded those of the control treatment with 122%, 169%, 244%, 65% and 152% at the five environments respectively. On the other side, the highest grain yields of barley plants grown at Sidi Barrani 1991/92 were achieved by adding (30kg N + 15 kgP_2O_5/fed.). Percentage increase due to the last treatment was 126% compared to the control.

The prementioned results show the important role of N and P as essential elements for barley plants under rainfed conditions.

Such findings could be attributed to the promotion effect of nitrogen on vegetative growth which in turn enhances the size of the Source, metabolic processes and increases dry matter accumulation / plant and to the promotion effect of phosphorous on more rapid early growth, greater

leaf area, better root system and better coverage of the soil surface (Cooper 1983). Consequently, the available mositure is used by the crop with the production of dry matter, with less water loss to the atmospher by direct evaporation from the soil under the crop. Thus, the water use efficiency is greatly improved by the application of phosphorous. It was observed that the addition of P increased the rate of development of barly crop resulting in maturity being advanced by up to 11 days (Shepherd et al. 1987). Because of this water use of the crop was very often reduced by P addition in more rapid development and higher yields obtained. This advanced maturity has an important implication on conferring a drought- escape mechanism on the crop as well as resulting in increased yields. Similar results were obtained by Raychaudhuri (1952) and Chandnani (1954) who reported that the efficiency of N is increased when applied in conjunction with P. Singh and Parshad (1972), Singh and Misra (1980), Shepherd et al. (1987), Jones (1989) stated that the response of barley under rainfed conditions to the fertilizer P was strongly dependent on the availability of nitrogen. Nuttall et al. (1989), Tomar (1989) stated that the economic optimum rates of N and P were 62.87 and 28.25 kg/ha, respectively. Wahbi et al. (1989), Singh et al. (1990), Azabi (1991) stated that barley production under rainfed condition can be substantially increased by applying proper levels of balanced fertilizers.

However, in some environments it could be observed that grain yields fertilized with (15kg N + 15 kgP_2O_5/fed.), (15kg N + 30 kgP_2O_5/ fed.), (30kg N + 15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5/fed.) showed no significant differences, therefore, it is better to recommend the treatment (15kg N + 15 kgP_2O_5 /fed.) to avoid the risk of crop failure due to drought season and to minimize the coasts.

Data in Table 26 and Figure 5 show that differences in grain yield among varieites were significant at Atnooh 1991/92 and Raffah 1991/92. Variety CC89 produced less grain yield than the two varieties Giza 123 and Giza 124. While mean the differences in grain yield between the two varieties Giza 123 and Giza 124 did not reach the level of significance. The same trend was observed at most environments eventhough the differences were not significant. Similar results were obtained by **Hooda and Kalra (1977), Verma et al. (1977), Khatua and Samal (1978), Jha et al. (1981), Jha and Moorthy (1981) and Dahama (1991).**

Data in Table 26 and Figure 6 indicates that this character appeared variable among environments which could be due to the variations that exist among environments, especially, in the amount and distribution of rainfall. Mean yields of barley were slightly affected by soil available P and mineral - N content, mainly because of the dominant effect of rainfall. **Harmsen and Shepherd (1983)** found that grain yields of cereal crops under rainfall conditions at 24 locations in Syria correlated positively with seasonal rainfall.

Table (26): The differential response of 3 varieties of barlay on grain yield at 8 environments in 1989/90, 1990/91 and 1991/92 seasons. (kg/ fed.)

Environment	Sidi Barrani 1990/91	Sidi Barrani 1991/92	El-Mathany 1991/92	Wady El-Washk 1991/92	Atnooh 1991/92	El-Dabaa 1989/90	Raffah 1991/92	Raffah 1989/90
variet y **	151	293.4	-	226	-	101.5	329	-
CC89	243	561	560	354 ,	350	236	656	369
Giza 123	213	624	621	414	435	260	756	345
Giza 124	236	665	633	411	420	273	792	341
Mean	231	616	605	393	401	256	735	351
LSD 5%	N.S	N.S	N.S	N.S	52	N.S	84	N.S
1%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

** Seasonal rainfall in mm.

Grain yield and Seasonal Rainfall Relationship CC 89, Giza 123 and Giza 124 Barley Varieties

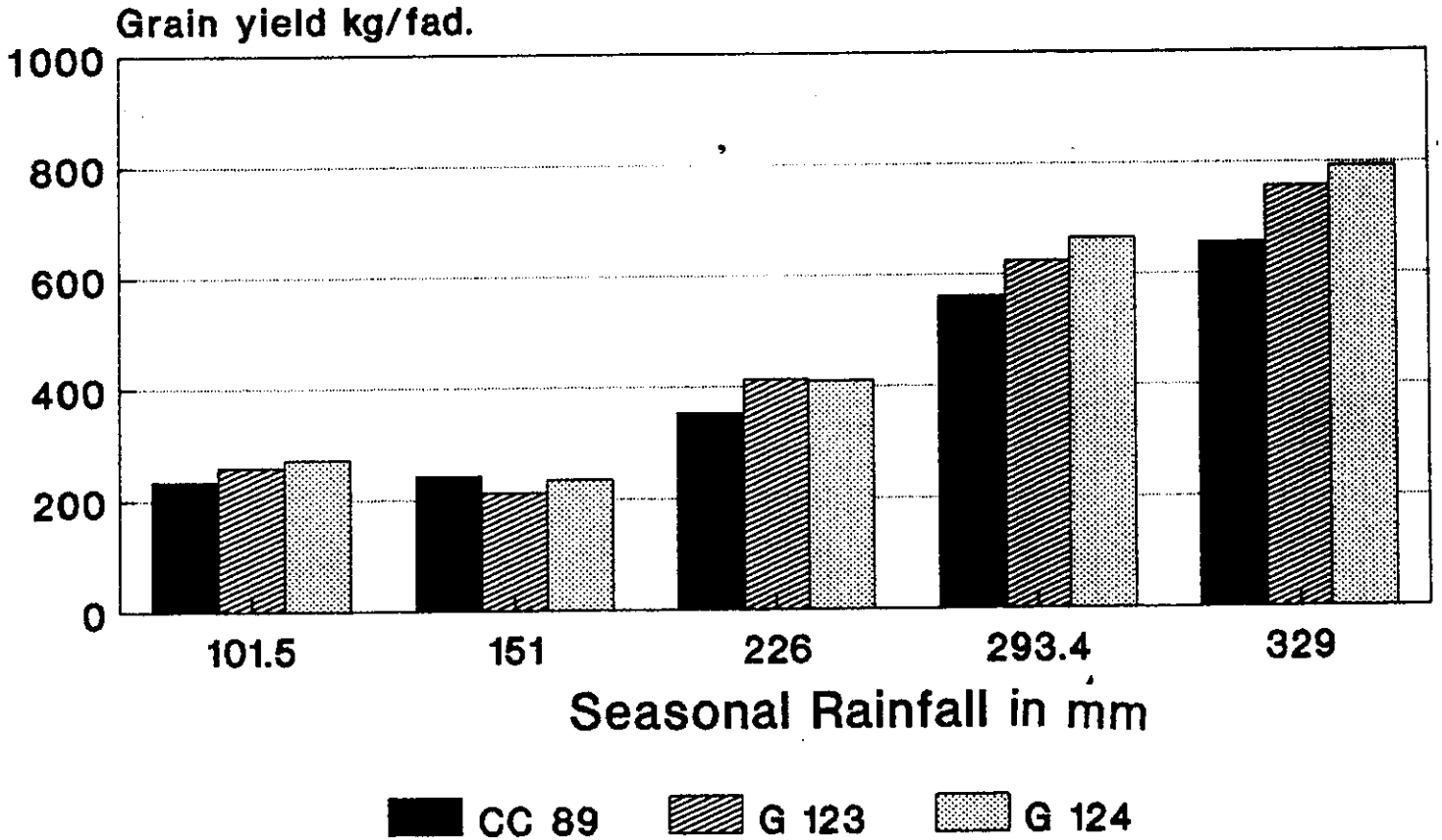

Figure 5

Grain yield and Seasonal Rainfall Relationship

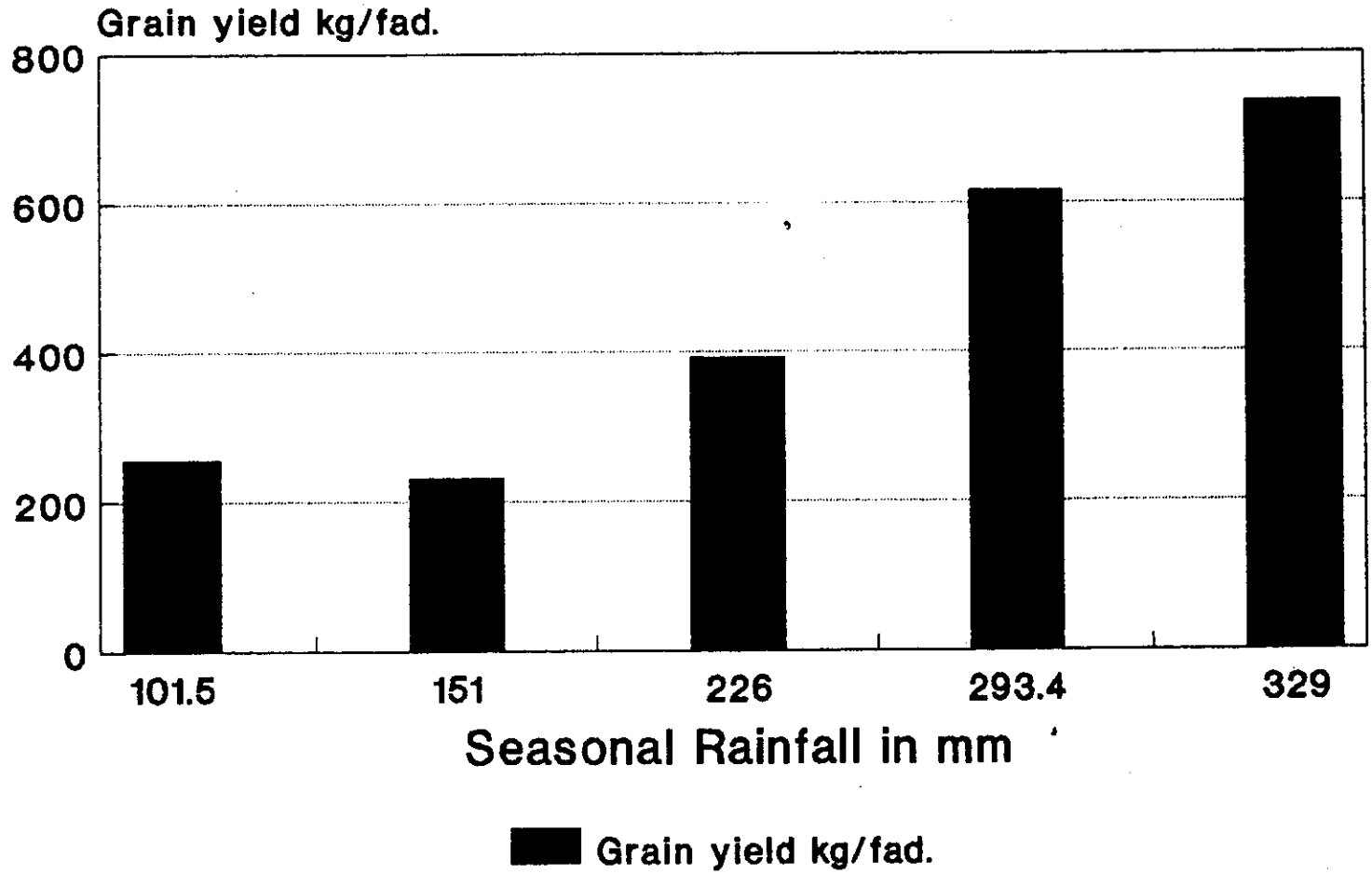

Figure 6

Data presented in Table 1 show that seasonal rainfall (total and distribution) varied widely between the environments. It is well known that water is needed for barley plants at almost every stage of growth. Lack of water at any stage of growth markedly reduced vegetative growth and yield, therefore the advantage of increasing water may be attributed to the ease in the availability of moisture for plant growth, therefore, environments were different in their productivity. The highest grain yields were obtained for Sidi Barrani 1991/92 and Raffah 1991/92, because these two environments received the highest amount of seasonal rainfall as well as better rainfall distribution (Table 1). Previously **Abu-Sharar et al. (1991)** under rainfed conditions, stated that total rainfall was the most predictive variable. On the contrary, drought decreases number and size of cells as well as the internode length, decrease of leaf area which may reduce the photosynthesis which in turn results in decreases dry matter production, reduced amount of metabolites translocated from leaves to grains and affect greatly the amount of photosynthates in grains during grainfilling. Therefore, the lowest grain yields were obtained for El-Dabaa 1989/90 and Sidi Barrani 1990/91 because of poor total rainfall and about 62.6% of total rainfall was received during January at Sidi Barrani 1990/91 whereas at El-Dabaa 1989/90 the amount of rainfall was very low and about 59% of total rainfall was received during January - February period. Similar results were obtained by **Verma et al. (1977), Neate et al. (1982), Papastylianou(1989), Azabi (1991), Ryan et al. (1991).**

Data in Tables 27,28 and 29 show that the interaction of fertilization x variety was significant for grain yield at Atnooh 1991/92, Wady El-Washk 1991/92 and Raffah 1991/92. At Atnooh 1991/92, it is evident that with the three varieties the highest grain yields were obtained when N and P were added together. CC89 variety gave its highest grain yield with the treatments (15 kg N+ 15 kgP_2O_5/fed.), (15 kg N+ 30 kgP_2O_5/fed.) and (30 kg N+ 30 kgP_2O_5/fed.). Giza 123 variety gave its highest grain yield with the treatments (15kg N + 15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5/fed.). But for Giza 124 variety the highest grain yields were obtained with the treatments (15kg N + 15 kgP_2O_5/fed.) , (15kg N + 30 kgP_2O_5/fed.) , (30kg N + 15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5/fed.). On the other hand, with treatments (30 kgP_2O_5/fed.) Giza 124 variety outyielded its two counterparts in grain yield. With treatment (15 kg N/ fed.) Giza 124 variety yielded the highest grain yield followed by Giza 123 and the lowest was CC89 variety. With treatment (30 kg N/fed.) Giza 123 variety outylielded its two counterparts in grain yield. With treatment (30kg N + 30 kgP_2O_5/fed.) Giza 123 yielded the highest grain yield followed by Giza 124 and the lowest was CC89 variety. At Wady El Washk 1991/92, it is evident that with the three varieties the highest grain yields were obtained when N and P were added together. CC 89 and Giza 123 varietes gave their highest grain yields with treatments (30kg N +15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5/fed.). But Giza 124 variety gave

Table 27 : **Effect of fertilization by variety interaction on grain yield at environment Atnooh 1991/92** (kg/ fed.)

Fert. treatments N	P	Variety CC89	G123	G124
0	0	230	261	209
0	15	258	265	282
0	30	195	223	412
15	0	178	318	422
30	0	289	531	310
15	15	611	579	489
15	30	457	478	587
30	15	417	541	492
30	30	513	716	576
LSD	5%	164		
	1%	N.S.		

Table 28 : **Effect of fertilization by variety interaction on grain yield at environment Wady El-Washk 1991/92** (kg/ fed.)

Fert. treatments N	P	Variety CC89	G123	G124
0	0	136	241	150
0	15	129	270	129
0	30	168	241	282
15	0	450	527	468
30	0	415	597	480
15	15	395	366	531
15	30	412	398	475
30	15	552	482	495
30	30	531	604	688
LSD	5%	129		
	1%	N.S.		

Table 29 :**Effect of fertilization by variety interaction on grain yield at environment Raffah 1991/92** (kg/ fed.)

Fert. treatments N	P	Variety CC89	G123	G124
0	0	355	407	437
0	15	476	633	462
0	30	495	518	346
15	0	668	671	833
30	0	610	956	980
15	15	816	626	1013
15	30	672	925	908
30	15	806	1146	1063
30	30	1012	926	1085
LSD	5%	206		
	1%	284		

its highest grain yield with treatment (30kg N + 30 kgP_2O_5/fed.). Also Giza 123 gave its highest grain yield with treatments (15 kg N/fed.) and (30 kg N/fed.). Also CC89 variety gave its highest grain yield with (15kg N/fed.) .On the other hand, with treatment (15 kgP_2O_5/fed.) Giza 123 outyielded its two counterparts in grain yield. With treatment (30 kg N/ fed.) Giza 123 variety yielded the highest grain yield followed by Giza 124 and the lowest was CC89 variety. With treatment (15kg N + 15 kgP_2O_5/fed.) Giza 124 outyielded its two counterparts in grain yield. With treatment (30kg N + 30 kgP_2O_5/fed.) Giza 124 yielded the highest grain yield followed by Giza 123 and the lowest was CC89 variety. At Raffah 1991/92, it is evident that with the three varieties the highest grain yields were obtained when N and P were added together. CC 89 variety gave its highest grain yields with treatments (15kg N +15 kgP_2O_5/fed.), (30kg N + 15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5/fed.). Giza 123 variety gave its highest grain yield with treatments (30kg N + 30 kgP_2O_5/fed.) Giza 124 variety gave its higher grain yields with treatments (15kg N +15 kgP_2O_5/ fed.), (15kg N + 30kgP_2O_5/fed.), (30kg N + 15 kgP_2O_5/fed.) and (30kg N + 30 kgP_2O_5/fed.). Also Giza 123 and Giza 124 varieties gave their highest grain yield with 30 kg N/fed. On the other hand, with treatments (30 Kg N/fed.), (15kg N + 30kgP_2O_5/fed.), and (30kg N + 15kgP_2O_5/fed.), Giza 123 and Giza 124 varieties outyielded CC89 variety. With treatment (15kg N + 15kgP_2O_5/fed.), Giza 124 variety yielded the highest grain yield followed by CC89 and the lowest was Giza 123 variety.

In conclusion, Giza 123 and Giza 124 varieties highly responded to N and P when added together, while CC89 variety showed slight response. Also, Giza 123 and Giza 124 varieties highly responded to N when added alone, but CC89 variety did not responsed as well.