IV. RESULTS AND DISCUSSION

The present study aimed at investigating the response of maize plants to four levels of N fertilizer (0, 45, 90 and 135 kg N/fed), two levels of P fertilizer (0 and 30 kg P_2O_5/fed) and three levels of FYM (0, 20 and 40 ton/fed) under calcareous soil conditions of Nubaria region. The interaction effects of the three experimental factors on the studied traits were considered.

The results included some growth characters, flowering date, yield components, grain yield of maize and NPK contents in leaves and kernels. Also, N uptake in grains, N sue efficiency and apparent N recovery as affected by N and P levels were studied. FYM treatments were excluded from the three latter estimations due to heterogeneity of the nutritive elements in the manure.

1. Plant height

Results for the effect of N, P and FYM levels and their interactions on plant height of maize plants in 1995 and 1996 seasons and their combined average are presented in Table (4).

1.1. Effect of N

The results showed that N application had a significant effect on plant height at harvest time. Increasing N level from 0 to 45, 90 and 135 kg/fed significantly increased maize plant height by 42.19, 46.86 and 48.00% in 1995 season, respectively. The corresponding increases in 1996 season were 25.05, 31.49 and 38.06% for the respective N levels. The increases in plant height over the two seasons average were 32.77, 38.54 and 42.60%, respectively.

It is quite evident from the present results that N has a prominent role on maize growth expressed in terms of plant height. The vital role of N and its necessity for protoplasm formation, photosynthesis activity, cell division and merestimatic activity in plant organs is clearly illustrated.

Similar results were also reported by **Shafshak *et al.* (1981), Gouda (1982), Younis *et al.* (1990), Shafshak *et al.* (1994a), Younis *et al.* (1994), Soliman *et al.* (1995)** and **Faisal *et al.* (1997)**, who found that increasing N level significantly increased maize plant height.

1.2. Effect of P

The results in Table (4) indicated that P application of 30 kg P_2O_5/fed significantly increased maize plant height in 1996 season whereas the effect of P was not significant in 1995 season.

Applying 30 kg P_2O_5/fed increased maize plant height by 0.30 and 7.11% in 1995 and 1996 seasons, respectively. Also, the combined analysis of both seasons showed a significant response of maize plant height to P application where an increase of 3.75% was recorded.

It could be concluded that P application induced an increase in maize growth showing the important role of P for maize plant to grown in calcareous soils.

The results reported by **Shafshak (1962), Khalifa (1970),** and **Attia *et al.* (1979)** indicated that P application had no significant effect on maize plant height. On the other hand, **Okalebo *et al.* (1994)** found that maize plant height significantly responded to P application.

1.3. Effects of FYM

Results in Table (4) indicated a significant effect for FYM on maize plant height at harvest in both seasons as well as in the combined average of 1995 and 1996 seasons.

Applying 20 and 40 ton FYM increased plant height by 4.33, and 9.73% in 1995, respectively, corresponding to 6.26 and 4.82% in 1996. The same levels of FYM increased maize plant height by 5.28 and 7.13% over the check treatment in the combined analysis of the two seasons. Most of the increases in plant height due to FYM application reached the level of significance. The results indicated clearly the effect of manure on maize growth due to its contents if nutritive elements and its effects on soil characters.

The present results are in general agreement with those reported by **Mourad** ***et al.*** **(1986), Khalil (1992)** and **Faisal and Shalaby (1998)**, who reported that the application of FYM significantly increased maize plant height.

1.4. Interaction effects

All the effect of the interactions between the experimental factors were not significant on plant height in both seasons as well as in the combined average with one exception for the interaction between N and FYM which showed significant effect in the combined analysis of 1995 and 1996 seasons. It is evident from Table (4) that the effect of FYM on plant height was more clear where no N fertilizer was applied. The maximum plant height was 197.0 cm which was recorded by combing 135 kg N + 40 ton FYM/fed in the combined data.

Table 4: Effect of N, P and FYM levels and their interactions on **plant height (cm)** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	106.3	123.3	137.0	122.2	117.0	148.5	152.8	139.4	111.7	135.9	144.9	130.8
	45	168.3	178.0	184.3	176.9	166.8	185.0	177.5	176.4	167.6	181.5	180.9	176.7
	90	185.8	179.3	180.5	181.9	193.8	190.5	178.0	187.4	189.8	184.9	179.3	184.7
	135	187.0	185.0	182.8	184.9	178.0	203.0	201.5	194.2	182.5	194.0	192.2	189.6
	Mean	161.9	166.4	171.2	166.5	163.9	181.8	177.5	174.4	162.9	174.1	174.4	170.5
30	0	111.3	122.0	145.3	126.2	147.5	160.3	150.8	152.9	129.4	141.2	148.1	139.6
	45	161.8	178.5	188.5	176.3	187.8	189.5	187.8	188.4	174.8	184.0	188.2	182.3
	90	176.5	183.8	188.5	182.9	199.3	191.0	200.0	196.8	187.9	187.4	194.3	189.9
	135	177.0	179.5	191.3	182.6	202.8	212.5	212.0	209.1	189.9	196.0	201.7	195.9
	Mean	156.7	166.0	178.4	167.0	184.4	188.3	187.7	186.8	170.6	177.2	183.1	176.9
N x FYM	0	108.8	122.7	141.2	124.2	132.3	154.4	151.8	146.1	120.6	138.6	146.5	135.2
	45	165.1	178.3	186.4	176.6	177.3	187.3	182.7	182.4	171.2	182.8	184.6	179.5
	90	181.2	181.6	184.5	182.4	196.6	190.8	189.0	192.1	188.9	186.2	186.8	187.3
	135	182.0	182.3	187.1	183.8	190.4	207.8	206.8	201.7	186.2	195.1	197.0	192.8
	Mean	159.3	166.2	174.8	166.8	174.2	185.1	182.6	180.6	166.8	175.6	178.7	173.7

L.S.D. at 5% for	1995	1996	Combined
N	11.1	8.8	6.2
P	NS	6.2	4.4
FYM	9.7	7.6	5.4
N x P	NS	NS	NS
N x FYM	NS	NS	10.7
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

2. Ear height

The effects of N, P and FYM levels and their interactions on topmost ear height at harvest in 1995 and 1996 seasons and their combined average are given in Table (5).

2.1. Effect of N

The results showed clearly that the increase in N level significantly increased ear height in both seasons as well as in the data of the combined average.

The greatest increase was that obtained by comparing the control treatment with any other N level, whereas the increases in ear height due to raising N level for 45 to 90 and 135 kg N/fed were not great and were almost not significant.

The results showed that the application of 45, 90 and 135 kg N/fed increased ear height over the check treatment by 59.58, 63.80 and 64.81%, respectively in 1995, corresponding to 33.76, 43.85 and 57.06% in 1996 season. The same N levels significantly increased ear height by 47.33, 54.39 and 60.4%, respectively compared with the control treatment in the two seasons combined average.

The effect of N on ear height is similar to its effect on plant height and is mainly due to the role of N as an essential nutritive element for plant growth.

Similar results were also reported by **El-Sharkawy** ***et al.*** **(1976), Shafshak** ***et al.*** **(1981), Gouda (1982), Younis** ***et al.*** **(1990), Shafshak** ***et al.*** **(1994a), Younis** ***et al.*** **(1995)** and **Faisal** ***et al.*** **(1997)**, who found that N application significantly increased ear height of maize plants.

2.2. Effect of P

The effect of P application was not significant on ear height in both seasons as well as in the combined average over 1995 and 1996 seasons as shown in Table (5).

The results showed a slight increase in topmost ear height, particularly in the second season, due to P application at 30 kg P_2O_5/fed. The results indicated that applying P_2O_5 at 30 kg/fed increased ear height by 0.33, 3.21 and 1.60% compared with check treatment in 1995, 1996 and the combined average, respectively. However, these slight increases were far below the level of significance.

It could be concluded that P had no apparent effect on ear height under the conditions of the experiment.

The results reported by **Shafshak (1962)**, **Khalifa (1970)**, **Attia *et al.* (1979)** and **Samia Amer (1995)** showed that P application did not significantly influence maize growth characters. On the other hand, **Okalebo *et al.* (1994)** reported that plant height of maize plant at tasseling responded to the applied P.

2.3. Effect of FYM

The results in Table (5) indicated that application of FYM increased markedly ear height at harvest. The increase was significant in 1995 season as well as in the combined average of both seasons, whereas this increase was not significant in 1996 season.

Applying FYM at 20 and 40 ton/fed increased topmost ear height over the check treatment by 10.05, 18.16% in 1995; 4.34 and 1.82% in 1996 and 7.26 and 10.38% in the combined average, respectively.

Table 5: Effect of N, P and FYM levels and their interactions on **ear height (cm)** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	48.5	59.3	70.0	59.3	58.3	51.3	52.5	54.0	53.4	55.3	61.3	56.7
	45	89.8	101.3	106.5	99.2	65.8	72.0	74.3	70.7	77.7	86.7	90.4	85.0
	90	96.8	102.8	102.5	100.7	82.5	80.5	69.8	77.6	89.7	91.7	86.2	89.2
	135	98.5	105.0	101.3	101.6	75.8	88.5	88.9	84.4	87.2	96.8	95.1	93.1
	Mean	83.4	92.1	95.1	90.2	70.6	73.1	71.4	71.7	77.0	82.6	83.3	81.0
30	0	52.8	61.2	77.3	63.8	53.3	58.8	52.8	55.0	53.1	60.0	65.1	59.4
	45	85.3	98.7	108.0	97.3	70.3	81.0	73.8	75.0	77.8	89.9	90.9	86.2
	90	97.3	99.5	106.3	101.0	83.0	70.8	83.3	79.0	90.2	85.2	94.8	90.1
	135	91.8	98.8	108.5	99.7	82.3	92.5	85.5	86.8	87.1	95.7	97.0	93.3
	Mean	81.8	89.6	100.0	90.5	72.2	75.8	73.9	74.0	77.1	82.7	87.0	82.3
N x FYM	0	50.7	60.3	73.7	61.6	55.8	55.1	52.7	54.5	53.3	57.7	63.2	58.1
	45	87.6	100.0	107.3	98.3	68.1	76.5	74.1	72.9	77.8	88.3	90.7	85.6
	90	97.1	101.2	104.4	100.9	82.8	75.7	76.6	78.4	90.0	88.5	90.5	89.7
	135	95.2	101.9	104.9	100.7	79.1	90.5	87.2	85.6	87.2	96.3	96.1	93.2
	Mean	82.6	90.9	97.6	90.4	71.4	74.5	72.7	72.9	77.1	82.7	85.1	81.6

L.S.D. at 5% for	1995	1996	Combined
N	7.1	5.3	4.0
P	NS	NS	NS
FYM	6.1	NS	3.4
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

It is worth mentioning that differences in ear height between the two applied FYM levels (20 and 40 ton/fed) were not significant in both seasons and far below the differences between the check treatment and the FYM levels.

The effect of FYM in increasing ear height is mainly due to the nutritive content of the manure particularly N.

Similar results were also obtained by **Mourad *et al.* (1986)** and **Faisal and Shalaby (1998)**, who found that the application of FYM significantly increased ear height of maize plants.

2.4. Interaction effects

The results in Table (5) indicated that all the effects of the interactions between the three experimental factors as well as the second order interaction on ear height in 1995 and 1996 seasons and in the two seasons average were not significant.

These results indicated that each experimental factor acted independently in affecting this character.

In general, it was observed that the maximum ear height was 108.5 and 97.0 cm in 1995 and the two seasons average, respectively which was recorded by applying 135 kg N + 30 kg P_2O_5 + 40 ton FYM/fed. On the other hand, the highest value of ear height in 1996 was 92.5 cm which was recorded by combining 135 kg N + 30 P_2O_5 + 20 ton FYM/fed.

3. Area of topmost ear leaf

Results presented in Table (6) show the response of area of the topmost ear leaf to N, P and FYM levels and their interactions in 1995 and 1996 seasons as well as their combined average.

3.1. Effect of N

The results revealed that N application significantly increased leaf area of the topmost ear at harvest in 1995 and 1996 seasons as well as their combined average.

It is worth mentioning that no marked differences were observed among 45, 90 and 135 kg N/fed levels and the only significant differences were those recorded between the check treatment (zero N level) and each of 45, 90 and 135 kg N levels.

The results showed that applying 45, 90 and 135 kg N/fed significantly increased area of the topmost ear leaf over the check treatment by 78.96, 80.54 and 87.53%, respectively in 1995, being 26.39, 23.31 and 21.45% in 1996 season. The corresponding increases in the combined average of both seasons were 49.87, 48.88 and 50.96%, respectively.

It could be concluded that the application of N had positive effect on area of topmost ear leaf of maize plant which indicates the vital role of N in plant growth. The encouraging effect of N on the vegetative growth of maize plant is clearly illustrated. The results are also good manifestation of the role of N as an essential element for all plants in general and cereals in particular.

Similar results were also obtained by **Yakout (1977)**, **Abdul-Galil *et al.* (1979)**, **Shafshak *et al.* (1981)**, **Abdel-Gawad *et al.* (1983)**, **Faisal (1983)**, **Khedr (1986)**, **Shafshak *et al.* (1994a)** and **Faisal *et al.* (1997)**, who found that N application significantly increased leaf area of the topmost ear.

3.2. Effect of P

The results in Table (6) showed that P application had significant effect on leaf area of topmost ear only in 1996 season, but in 1995 season the effect of P was not significant.

Applying P at 30 kg P_2O_5 significantly increased area of topmost ear leaf by 8.05% in 1996 season.

Combining data of both seasons showed also a positive effect for P application where a significant increase of 3.36% was recorded by applying 30 kg P_2O_5/fed in the leaf area of the topmost ear compared with the check treatment.

It could be concluded that the P application favorably affected maize growth particularly in the second season. It is well known that P is classified as a major nutrient element. It is a constituent of nucleic acid, phytin, and phospholipids. A good supply of P increases root growth and hastens plant maturity.

The results reported by **Shafshak (1962 and 1970)** and **Attia *et al.* (1979)** showed that P application to maize had no effect on maize growth.

3.3. Effect of FYM

The results in Table (6) showed that application of FYM increased leaf area of the topmost ear. The increase reached the level of significance in the second season as well as in the combined data.

The results showed that the application of 20 and 40 ton/fed of FYM increased area of the topmost ear by 2.28 and 6.77% in 1995 season, respectively, corresponding to 6.09 and 9.65% in 1996 season. The increase of topmost leaf area in the combined average reached 4.06 and 8.11%, respectively for the 20 and 40 ton/fed levels.

It is worthy to note that the significant differences in topmost ear leaf area were only observed between the check treatment and the higher FYM level (40 ton/fed) in the second season and the combined average.

It could be concluded that FYM positively affected leaf area of the topmost ear, but this effect was much smaller when compared with the mineral N levels, probably due to the slow release of its N in an available form that could be used by plants during the course of the experiment.

The present results did not agree with those reported by **Khalil (1992)** who found that leaf area of the topmost ear was not significantly affected by FYM application in two successive seasons.

3.4. Interaction effects

The results revealed that the interaction between N and FYM levels as well as the second order interaction (N x P x FYM) significantly affected leaf area of the topmost ear in 1996 season. The other interactions were not significant.

The results in Table (6) indicated that in 1996 season, the application of FYM did not show any positive effect on leaf area of topmost ear under the highest N level (135 kg N/fed), even a reduction in this area followed the application of FYM, whereas under the check treatment of N levels (zero kg N/fed) the effect of FYM was quite evident.

The results showed also a significant effect of N x P x FYM levels on this trait in 1996 season. The highest leaf area was 679.5 cm^2 which was recorded by combining 45 kg N + zero kg P2O5 + 40 ton FYM/fed and the lowest value was 356.8 cm^2 which was recorded by the check treatment of the three factors.

Table 6: Effect of N, P and FYM levels and their interactions on **leaf area (cm^2)** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	336.0	366.4	404.9	369.1	356.8	408.2	509.9	425.0	346.4	387.3	457.4	397.1
	45	732.0	654.5	693.0	693.2	419.4	655.4	679.5	584.8	575.7	655.0	686.3	639.0
	90	679.4	715.3	708.0	700.9	550.1	537.8	593.2	560.4	614.8	626.6	650.6	630.5
	135	715.3	718.2	785.5	739.7	631.1	551.8	587.3	590.1	673.2	635.0	686.4	664.9
	Mean	615.7	613.6	647.9	625.7	489.4	538.3	592.5	540.1	552.6	576.0	620.2	582.9
30	0	330.6	436.8	437.0	401.8	510.0	517.6	559.1	528.9	420.3	477.2	498.5	465.4
	45	649.6	698.5	711.5	686.5	610.4	649.1	603.1	620.9	630.0	673.8	657.3	653.7
	90	681.4	682.8	709.0	691.1	623.6	635.8	588.2	615.9	652.5	659.3	648.6	653.5
	135	717.4	680.3	720.5	706.1	568.8	574.7	562.0	568.5	643.1	627.5	641.3	637.3
	Mean	594.8	624.6	644.7	621.4	578.2	594.3	578.1	583.6	586.5	609.5	611.4	602.5
N x FYM	0	333.3	401.6	421.4	385.5	433.4	462.9	534.5	477.0	303.4	432.3	478.0	431.3
	45	690.8	676.5	702.3	689.9	514.9	652.3	641.3	602.9	602.9	664.4	671.8	646.4
	90	680.4	699.1	708.5	696.0	586.9	586.8	590.7	588.2	633.7	643.0	649.6	642.1
	135	716.4	699.3	753.0	722.9	600.0	563.3	574.7	579.3	658.2	631.3	663.9	651.1
	Mean	605.3	619.1	646.3	623.6	533.8	566.3	585.3	561.9	569.6	592.7	615.8	592.7

L.S.D. at 5% for		1995	1996	Combined
	N	55.8	39.1	30.3
	P	NS	27.6	21.4
	FYM	NS	33.8	26.2
	N x P	NS	NS	NS
	N x FYM	NS	67.7	NS
	P x FYM	NS	NS	NS
	N x P x FYM	NS	95.7	NS

4. Tasseling date

The results in Table (7) indicated the effects of N, P and FYM levels and their interactions on tasseling date of maize plants in 1995 and 1996 seasons as well as their combined average. Tasseling date was recorded as the number of days from planting to 50% tasseling.

4.1. Effect of N

The results in Table (7) showed that N application significantly affected tasseling date in maize in both seasons as well as in the combined average.

It is worth mentioning that the marked differences in tasseling date were those between the check treatment (zero level) and the other N levels, whereas the differences among the three applied levels (45, 90 and 135 kg N/fed) were very slight and almost not significant.

The results indicated that in 1995 season applying N at 45, 90 and 135 kg N/fed induced an earlier tasseling by 8.6, 9.8 and 11.8 days compared with the check treatment, respectively. The corresponding values in 1996 season were 1.9, 2.2 and 3.0 days, respectively.

Similarly, the combined average indicated that N at 45, 90 and 135 kg/fed induced an earlier tasseling by 5.3, 6.0 and 7.4 days, respectively compared with the control treatment.

It could be concluded that N induced earlier tasseling in maize. The results indicated the role of N in the formation of sexual organs and in enhancing an early flowering through an increase in the meristematic activity in plants.

Similar results were also reported by **Salem (1973)**, **Ainer (1976)**, **Abdul-Galil** ***et al.*** **(1979)**, **Khedr (1986)**, **Mourad** ***et al.*** **(1986)**, **Shafshak** ***et al.*** **(1994a)**, **Younis** ***et al.*** **(1994)**, **Basha** ***et al.*** **(1995)**, **Younis** ***et al.*** **(1995)** and **Faisal** ***et al.*** **(1977)**, who found that N significantly reduced number of days from planting to 50% tasseling. On the other hand, **Awad** ***et al.*** **(1988)** and **Shalaby** ***et al.*** **(1990)** found that flowering date in maize was not significantly affected by N fertilizer level.

4.2. Effect of P

The results presented in Table (7) showed that applying P at 30 kg P_2O_5/fed induced an earlier tasseling in both seasons as well as their combined average. The effect of P on tasseling date was significant in 1996 season, whereas in 1995 season and the combined average the effect of P was insignificant.

The results revealed that applying P at 30 kg P2O5/fed reduced number of days from planting to 50% tasseling by 0.9, 1.2 and 1.0 days in 1995, 1996 and the combined average, respectively, compared with the check treatment. The only significant difference was that recorded in the second season. The encouraging effect of P on flowering may be due to its role in hastening maturity of plants.

The results reported by **Shafshak (1962)** indicated that P application to maize plants either as soil or foliar application had no significant effect on tasselling date. On the other hand, **Barry and Miller (1992)** reported that flowering date was reduced by increasing P fertilizer level.

4.3. Effect of FYM

The results in Table (7) showed that the application of FYM had no significant effect on tasseling date in 1995 and 1996 seasons as well as their combined average.

The results indicated a very slight reduction in number of days to 50% tasseling when FYM was applied at 40 ton/fed compared with the control. The results showed that adding 40 ton/fed FYM reduced tasseling date by 1.9, 0.3 and 1.1 days in 1995, 1996 and the combined average, respectively. However, these differences were below the level of significance.

The slight effect of FYM on tasseling date is mainly due to the slow release of its N in an available form that could be used by plants during the course of the experiment.

The results reported by **Ponsica *et al.* (1983)** showed that application of animal manure accelerated tasseling in maize. The results obtained by **Abd El-Hameed (1997)** indicated that applying 25 m^3/fed FYM to maize insignificantly affected tasseling date.

4.4. Interaction effects

The results showed that the only significant interaction effect was that between N and P levels in 1996 season (Table 7).

It is evident that the effect of N on tasseling date was more evident where no P was applied. Similarly, under the check N treatment (zero level) the effect of P was evident. The results in Table (7) showed that P application induced an earlier tasseling by 3.0 days where no N was applied, whereas under 135 N level no clear effect was detected for P

Table 7: Effect of N, P and FYM levels and their interactions on **days to 50% tassling** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	71.5	72.0	70.0	71.2	68.3	68.3	68.1	68.2	69.9	70.2	69.1	69.7
	45	64.8	63.5	60.5	62.9	66.0	65.0	65.0	65.3	65.4	64.3	62.8	64.2
	90	61.5	60.8	59.7	60.7	65.0	65.0	64.5	64.8	63.3	62.9	62.1	62.8
	135	59.8	59.3	57.3	58.8	63.8	63.8	64.0	63.9	61.8	61.2	60.7	61.2
	Mean	64.4	63.9	61.9	63.4	65.8	65.5	65.4	65.6	65.1	64.7	63.7	64.5
30	0	70.3	70.0	69.2	69.8	65.8	65.0	64.8	65.2	68.1	67.5	61.6	63.4
	45	61.8	62.0	58.8	60.9	64.3	64.5	64.3	64.4	63.1	63.3	61.6	62.7
	90	60.3	63.5	58.5	60.8	64.3	64.5	64.3	64.4	62.3	64.0	61.4	62.6
	135	58.5	58.0	59.3	58.6	63.5	63.8	63.8	63.7	61.0	60.9	61.6	61.2
	Mean	62.7	63.4	61.5	62.5	64.5	64.5	64.3	64.4	63.6	64.0	62.9	63.5
N x FYM	0	70.9	71.0	69.6	70.5	67.1	66.7	66.5	66.8	69.0	68.9	68.1	68.7
	45	63.3	62.8	59.7	61.9	65.2	64.8	64.7	64.9	64.3	63.8	62.2	63.4
	90	60.9	62.2	59.1	60.7	64.7	64.8	64.4	64.6	62.8	63.5	61.8	62.7
	135	59.2	58.7	58.3	58.7	63.7	63.8	63.9	63.8	61.5	61.3	61.1	61.3
	Mean	63.6	63.7	61.7	63.0	65.2	65.0	64.9	65.0	64.4	64.4	63.3	64.0

L.S.D. at 5% for		1995	1996	Combined
	N	3.2	1.3	1.3
	P	NS	0.94	NS
	FYM	NS	NS	1.1
	N x P	NS	1.9	NS
	N x FYM	NS	NS	NS
	P x FYM	NS	NS	NS
	N x P x FYM	NS	NS	NS

application and the earliness in tasseling has been diminished to 0.2 day only.

However, the earliest tasseling date in 1996 season was achieved by applying the highest N and P levels (135 kg N + 30 kg P_2O_5/fed), being 63.7 days.

5. Silking date

The results of the effects of N, P and FYM levels and their interactions on number of days from planting to 50% silking in 1995 and 1996 seasons as well as their combined average are presented in Table (8).

5.1. Effect of N

The results presented in Table (8) show that application of N significantly induced earlier silking in both seasons as well as in the combined average.

It is worthy to note that the silking date followed the same pattern of response to N level as that observed with tasseling date.

In 1995 season, applying N at 45, 90 and 135 kg/fed significantly reduced silking date by 9.5, 10.8 and 13.3 days, respectively compared with the check treatment. The corresponding reductions in silking dates in 1996 season for the same N levels were 1.9, 3.7 and 4.5 days, respectively, being 4.7, 7.2 and 8.7 days in the two seasons average. All these differences for the earliness in silking date were significant.

It could be concluded that N enhanced silking in maize. This result is a clear illustration for the role of N in building sexual organs in maize plants. It is clear that N application encouraged the meristematic activity and increased the vegetative growth which pushed maize plants towards earlier silking.

Similar results were also obtained by **Salem (1973)**, **Ainer (1976)**, **Rather** *et al.* **(1976)**, **Khedr (1986)**, **Mourad** *et al.* **(1986)**, **Younis** *et al.* **(1990)**, **Gouda** *et al.* **(1992)**, **Shafshak** *et al.* **(1994a)**, **Younis** *et al.* **(1994)**, **Younis** *et al.* **(1995)**, **Abd El-Hameed** *et al.* **(1997)** and **Faisal** *et al.* **(1997)**, who found that N application enhanced silking of maize plants. On the other hand, **Awad** *et al.* **(1988)**, and **Shalaby** *et al.* **(1990)** showed that silking date was not significantly influenced by the application of N fertilizer.

5.2. Effect of P

The results in Table (8) showed that P application reduced silking date in maize. The effect of P on silking date was only significant in 1996 season, whereas in 1995 season and the combined average, the reduction in silking date due to P application was very slightly and far below the level of significance.

Applying P at 30 kg P_2O_5/fed reduced silking date compared with the control by 0.3, 1.1 and 0.7 day in 1995, 1996 and their combined average, respectively. The only significant difference was that in 1996.

It could be concluded that P slightly affected silking date due to its role as an essential nutritive element.

The results reported by **Shafshak (1962)** indicated that applying P as soil application in the form of calcium superphosphate or as a foliar spry by spraying maize plants with sodium monophosphate did not induce any significant effect on silking date. On the other hand, **Barry and Miller**

(1992) reported that time to 50% silking was reduced by increasing P fertilizer level.

5.3. Effect of FYM

The results in Table (8) showed that FYM at the higher level (40 ton/fed) induced a reduction in silking date in the combined analysis of the two experimental seasons. The analysis of variance of the data of 1995 and 1996 season showed no significant effect for FYM.

The results cleared that applying 40 t/fed FYM reduced silking date by 2.1, 1.0 and 1.5 days, respectively in 1995, 1996 and the two seasons average compared with the check treatment. The only significant effect was that of the combined average.

The effect of FYM on silking date was not so clear as that recorded by the mineral N application. This result is mainly due to the slow release of the organic N to an available form that needs long time and extends to be utilized by the succeeding crops following maize.

It is worth mentioning that silking date occurred after about 70 days from planting and this period is too short to allow the growing plants to utilize the nutritive elements contained in the manure. Consequently, the response of silking date to FYM is very limited.

The results obtained by **Abdel-Hameed (1997)** showed that the application of 25 m^3 of FYM to maize insignificantly affected silking date in 1995 and 1996 seasons and their combined average. He recorded a very slight reduction in silking date which was far below the level of significance.

Table 8: Effect of N, P and FYM levels and their interactions on **days to 50% silking** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	74.3	74.3	72.8	73.8	72.0	71.5	69.5	71.0	73.2	72.9	71.2	72.4
	45	66.5	65.8	62.8	65.0	68.3	68.0	69.3	68.5	67.4	66.9	66.1	66.8
	90	63.8	63.0	61.8	62.9	66.9	65.8	65.3	66.0	65.4	64.4	63.6	64.5
	135	61.8	61.3	59.3	60.8	65.8	65.3	65.0	65.4	63.8	63.3	62.2	63.1
	Mean	66.6	66.1	64.2	65.6	68.2	67.7	67.3	67.7	67.4	67.9	66.8	66.7
30	0	74.8	74.0	73.3	74.0	69.0	68.3	68.0	68.4	68.9	71.2	71.7	70.2
	45	64.3	65.8	61.0	63.7	67.3	67.1	67.0	67.1	65.8	66.5	64.0	65.4
	90	62.3	66.5	60.8	63.2	66.7	65.9	65.2	65.9	64.5	66.2	63.0	64.6
	135	60.8	60.2	59.9	60.3	65.8	65.2	64.0	65.0	63.3	62.7	62.0	62.7
	Mean	65.6	66.6	63.8	65.3	67.2	66.6	66.1	66.6	66.4	66.6	65.0	66.0
N x FYM	0	74.6	74.2	73.1	73.9	70.5	69.9	68.8	69.7	72.6	72.1	71.0	71.8
	45	65.4	65.8	61.9	64.4	67.8	67.6	68.2	67.8	66.6	66.7	65.1	66.1
	90	63.1	64.8	61.3	63.1	66.8	65.9	65.3	66.0	65.0	65.4	63.3	64.6
	135	61.3	60.8	59.6	60.6	65.8	65.3	64.5	65.2	63.6	63.1	62.1	62.9
	Mean	66.1	66.4	64.0	65.5	67.7	67.2	66.7	67.2	66.9	66.8	65.4	66.4
L.S.D. at 5% for	N		3.3				1.3				1.3		
	P		NS				0.9				NS		
	FYM		NS				NS				1.1		
	N x P		NS				1.9				NS		
	N x FYM		NS				NS				NS		
	P x FYM		NS				NS				NS		
	N x P x FYM		NS				NS				NS		

5.4. Interaction effects

The results reported in Table (8) indicated that all interactions between the experimental factors had no significant effects on silking date, except the interaction between N and P in 1996 season which excreted a significant effect on this trait.

The results showed that the earliest silking was achieved by combining 135 kg N + 30 kg P_2O_5/fed in 1996 season, which occurred after 65.0 days. On the other hand the latest silking date was recorded by the check treatment of both N and P, which was reached after 71.0 days from planting.

6. Number of ears per plant

The results presented in Table (9) show the effects of N, P and FYM levels and their interactions on number of ears/plant in 1995 and 1996 seasons as well as their combined average.

6.1. Effect of N

The results in Table (9) showed that N level significantly affected number of ears/plant in both seasons as well as in the combined average.

The results cleared that applying N at 45, 90 and 135 kg/fed increased ears number/plant by 12.94, 15.29 and 24.71% over the check treatment, in 1995 season, respectively. The corresponding increases for the same N levels in 1996 season were 23.17, 26.83 and 39.02%, respectively, being 19.28, 21.69 and 32.53% in the combined average.

It is worth mentioning that all differences among the N levels were significant except those between 45 and 90 Kg N/fed in both seasons as well as the combined average, also the highest N level (135 Kg N/fed) induced a significant increase over the lower level (90 Kg N/fed). The present results indicates clearly that N reduced barreness in maize, which is observed in the check treatment, and also increased number of two-eared plants in maize.

It could be concluded that a good supply of N, in calcareous soils, will certainly increase the prolificacy of maize plants.

Similar results were also reported by **Lashin and Ali (1977)**, **El-Hattab *et al.* (1980)**, **Shafshak *et al.* (1994a)**, **Younis *et al.* (1994)** and **Faisal and Shalaby (1998)**, who found that the increase in N level significantly increased number of ears/plant in maize.

6.2. Effect of P

The results in Table (9) indicated clearly that P application significantly increased number of ears/plant in both seasons as well as their combined average.

Applying P at 30 kg P_2O_5/fed significantly increased ears number/plant by 3.16, 6.19 and 5.21% in 1995, 1996 and the two seasons average, respectively.

This results indicates clearly the role of P as a major nutritive element for maize plants grown in calcareous soil. It is known that P is a constituent of nucleic acid, phytin and phospholipids. An adequate supply of P is essential for seed formation.

The present results are not in agreement with those reported by **Khalifa (1970)** and **Ainer (1976)**, who found that P did not affect this trait probably due to a good supply of the Delta soil with P. On the other hand, **Khalifa *et al.* (1987)** found that a level of P exceeding 30 kg P_2O_5/fed increased number of ears/plant.

6.3. Effect of FYM

The results in Table (9) indicated that applying FYM significantly increased number of ears per plant in 1995 and 1996 seasons and their combined average as well.

Applying 20 and 40 ton/fed FYM increased number of ears/plant by 2.15 and 8.60% in 1995, respectively, being 8.51 and 8.51% in 1996 season for both FYM levels. The corresponding increases in the combined average were 5.32 and 9.57%, respectively.

The present results clearly showed that a good supply of the calcareous soil of Nubaria with FYM is needed to increase the prolificacy of maize plants and to reduce barraness. The positive effect of FYM on this trait is mainly due to its contents of many nutrients and to its role in improving soil properties.

The present results agree with those obtained by **Faisal and Shalaby (1998)**, who found that FYM at 20 m^3/fed increased ears number/plant. On the other hand, **Khalil (1992)** found that application of FYM did not significantly affect this trait.

6.4. Interaction effects

The results in Table (9) showed that none of the interactions between the experimental treatments had a significant effects on number of ears/plant in both seasons as well as in the combined analysis.

The present result indicates that each experimental factors acted independently in affecting this trait.

However, the maximum number of ears/plant in both seasons as well as in their combined analysis was recorded by combing 135 kg N + 30 kg P_2O_5 + 40 ton FYM/fed, being 1.15, 1.21 and 1.18 ears/plant, respectively.

Table 9: Effect of N, P and FYM levels and their interactions on **number of ears per plant** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	0.78	0.82	0.92	0.84	0.71	0.76	0.84	0.77	0.75	0.79	0.88	0.81
	45	0.91	0.94	0.97	0.94	0.91	1.04	1.06	1.00	0.91	0.99	1.02	0.97
	90	0.96	0.97	1.00	0.98	0.99	1.03	1.03	1.02	0.98	1.00	1.02	1.00
	135	0.99	1.03	1.05	1.02	0.97	1.11	1.19	1.09	0.98	1.07	1.12	1.06
	Mean	0.91	0.94	0.99	0.95	0.90	0.99	1.03	0.97	0.91	0.96	1.01	0.96
30	0	0.80	0.82	0.92	0.85	0.69	0.93	0.96	0.86	0.75	0.88	0.94	0.86
	45	0.93	1.00	1.01	0.98	1.00	1.03	1.01	1.01	0.97	1.02	1.01	1.00
	90	0.98	0.96	1.02	0.99	1.01	1.09	1.07	1.06	1.00	1.03	1.05	1.03
	135	1.05	1.07	1.15	1.10	1.20	1.13	1.21	1.18	1.14	1.10	1.18	1.14
	Mean	0.95	0.96	1.03	0.98	0.98	1.05	1.06	1.03	0.97	1.01	1.05	1.01
N x FYM	0	0.79	0.82	0.92	0.85	0.70	0.85	0.90	0.82	0.75	0.84	0.91	0.83
	45	0.92	0.97	0.99	0.96	0.96	1.04	1.04	1.01	0.94	1.01	1.02	0.99
	90	0.97	0.97	1.01	0.98	1.00	1.06	1.05	1.04	0.99	1.02	1.04	1.01
	135	1.04	1.05	1.10	1.06	1.09	1.12	1.20	1.14	1.06	1.09	1.15	1.10
	Mean	0.93	0.95	1.01	0.96	0.94	1.02	1.02	1.00	0.94	0.99	1.03	0.99

L.S.D. at 5% for	1995	1996	Combined
N	0.04	0.06	0.04
P	0.03	0.05	0.03
FYM	0.04	0.06	0.03
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

7. Ear length

Results in Table (10) show the effects of N, P and FYM levels and their interactions on ear length of maize in 1995 and 1996 seasons as well as their combined average.

7.1. Effect of N

The results in Table (10) indicated that the increase in N level significantly increased ear length of maize plants in both seasons and the combined average.

Applying N at 45, 90 and 135 kg/fed increased ear length in 1995 season by 47.06, 60.68 and 65.81% compared with the check treatment, respectively. The corresponding increases in 1996 season were 21.47, 28.83 and 33.74%, respectively. For the combined average, the same N levels excreted increases of 32.62, 41.13 and 46.10% in ear length over the check treatment, respectively.

It is worthy to note that the significant differences in ear length were clear between the check treatment and all other N levels and also between 45 and 135 levels. Other differences, i.e. between 45 and 90 or between 90 and 135 kg N level were significant in 1996 season but not significant in 1995.

It could be concluded that the role of N as an essential element in building maize ears due to its effect on photosynthetic activity in plants and to its positive effects on maize growth.

Similar results were also obtained by **Eraky *et al.* (1980), Abdel-Gawad *et al.* (1983), Faisal (1983), Gouda *et al.* (1992), Shafshak *et al.***

(1994a), Basha *et al.* (1995) and **Abd El-Hameed (1997)** who found that the increase in N level increased ear length of maize.

7.2. Effect of P

The results presented in Table (10) indicated no significant effect for P application on ear length in both seasons. It was observed that very slight increases are observed in ear length due to P application.

Applying 30 kg P_2O_5/fed induced an increase of 1.19, 1.02 and 1.10% in ear length over the check treatment in 1995, 1996 and the combined average, respectively. These very slight increases were far below the level of significance.

It could be concluded that P application did not significantly affect ear length of maize.

Similar results were also obtained by **Shafshak (1962)** who found that application of 32 kg P_2O_5/fed to different maize genotypes did not induce any significant increase in ear length of maize even when P was applied as a spray solution of sodium monophosphate ($NaH_2PO_4.H_2O$). Also **Khalifa (1970)** and **Ainer (1976)** reported similar results.

7.3. Effect of FYM

The results in Table (10) showed that FYM application did not significantly influence ear length of maize in both seasons of experimentation and their combined average.

The results cleared that applying FYM at 20 and 40 ton/fed insignificantly increased ear length over the control by 1.83 and 7.93% in 1995; 2.58 and 2.58% in 1996; and 2.23 and 5.03% in the combined average, respectively. However, all these increases were below the level of significance. The insignificant effect of FYM on this trait is mainly due to the very low content of mineral N in the manure which was estimated as 0.032 and 0.030% in 1995 and 1996 season, respectively. Also, the slow release of organic N contained in the applied FYM led to the very limited effect of animal number on ear length.

The results reported by **Ponsica *et al.* (1983)** and **Khalil (1992)** and **Abd El-Hameed (1997)** indicated that FYM application favorably affected the production of larger ears.

7.4. Interaction effects

The results showed that all effects of the interactions in 1996 season significantly affected ear length. Also, the second order interaction in the combined analysis (Table 10) showed significant effect on this trait.

The results cleared that N x P in 1996 season significantly affected ear length. The results showed that the response to N was more evident where P was applied. Also, the interaction between N x FYM in 1996 season indicated that the response of this trait to the N level was more evident where no FYM was applied while the effect of N level has been reduced where manure was applied.

The second order interaction which was significant in 1996 season and the combined average indicated that the highest ear length was 22.7 cm in 1996 season which was obtained by combining 135 kg N + zero P_2O_5 + 20 FYM/fed. In the combined average the maximum ear length was 21.1 cm which was recorded by the same combination.

Table 10: Effect of N, P and FYM levels and their interactions on **ear length (cm)** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	10.5	11.4	12.0	11.3	15.5	16.9	16.9	16.4	13.0	14.2	14.5	13.9
	45	17.0	16.5	18.3	17.3	18.8	20.6	19.7	19.7	17.9	18.6	19.0	18.5
	90	17.6	19.1	19.5	18.7	21.4	19.5	19.9	20.3	19.5	19.3	19.7	19.5
	135	20.4	19.4	20.0	19.9	21.4	22.7	22.2	22.1	20.9	21.1	21.1	21.0
	Mean	16.4	16.6	17.5	16.8	19.3	19.9	19.7	19.6	17.9	18.3	18.6	18.2
30	0	11.3	11.7	14.3	12.4	15.7	17.1	15.7	16.2	13.5	14.4	15.0	14.3
	45	16.3	17.9	18.7	17.6	19.5	19.0	20.9	19.8	17.9	18.5	19.8	18.7
	90	18.7	18.8	18.9	18.8	21.1	22.0	22.1	21.7	19.9	20.4	20.5	20.3
	135	18.7	18.8	19.3	18.9	21.3	21.6	21.2	21.4	20.0	20.2	20.3	20.2
	Mean	16.3	16.8	17.8	17.0	19.4	19.9	20.0	19.8	17.9	18.4	18.9	18.4
N x FYM	0	10.9	11.6	13.2	11.9	15.6	17.0	16.3	16.3	13.3	14.3	14.8	14.1
	45	16.7	17.2	18.5	17.5	19.2	19.8	20.3	19.8	18.0	18.5	19.4	18.7
	90	18.2	19.0	19.2	18.8	21.3	20.8	21.0	21.0	19.8	19.9	20.1	19.9
	135	19.6	19.1	19.7	19.4	21.4	22.2	21.7	21.8	20.5	20.7	20.7	20.6
	Mean	16.4	16.7	17.7	16.9	19.4	19.9	19.9	19.7	17.9	18.3	18.8	18.3

L.S.D. at 5% for	1995	1996	Combined
N	1.5	0.7	0.8
P	NS	NS	NS
FYM	NS	NS	NS
N x P	NS	0.9	NS
N x FYM	NS	1.2	NS
P x FYM	NS	0.8	NS
N x P x FYM	NS	1.6	1.9

8. Ear diameter

The results in Table (11) show the effects of N, P and FYM levels and their interactions on ear diameter of maize in 1995, 1996 and their combined average.

8.1. Effect of N

The results in Table (11) revealed that the increase in N level significantly affected ear diameter in both seasons as well as in their combined average.

Applying N at 45, 90 and 135 kg/fed significantly increased ear diameter over the check treatment by 17.78, 17.78 and 22.22%, respectively, in 1995, being 9.09, 11.36 and 13.64% in 1996. The corresponding increases in the two seasons average were 13.33, 13.33 and 17.78%, respectively. The increase in ear diameter followed the same pattern as that obtained with ear length. The effect of a good supply of N on ear size is clearly demonstrated. The effect of N on the trait is due to its encouraging effect on the vegetative growth of maize plants.

Similar results were also obtained by **Faisal (1983), Moursi *et al.* (1983), Khedr (1986), Shafshak *et al.* (1994a), Soliman *et al.* (1995)** and **Abd El-Hameed (1997),** who found that the increase in N level increased markedly ear diameter. On the other hand, **Younis *et al.* (1990)** and **Faisal *et al.* (1996)** reported that ear diameter was not significantly affected by the increase in N level.

8.2. Effect of P

The results showed that the effect of P application did not significantly affect ear diameter in both seasons (Table 11). The response of ear diameter to P application was similar to that on ear length.

The present results agree with those obtained by **Shafshak (1962)** and **Ainer (1976)**, who found that ear characters were not influenced by P application to maize.

8.3. Effect of FYM

The results in Table (11) showed that the application of FYM affected ear diameter in one season out of the two experimental seasons.

In 1995 as well as the combined average, applying FYM at 40 t/fed significantly increased ear diameter by 3.92% and 4.81% respectively compared with the check treatment. The lower manure level (20 t/fed) had no significant effect on this trait in that season.

In the second season as well as in the combined average, no any effect for FYM on ear diameter was observed.

The results cleared that the effect of animal manure on yield components of maize is lower than the effect of mineral N fertilizers due to the slow release of organic N to an available form.

The results reported by **Ponsice *et al.* (1983), Khalil (1992) and Abdel-Hameed (1997)** indicated that the application of FYM significantly increased ear diameter of maize.

8.4. Interaction effects

The results presented in Table (11) showed that the interaction between N and FYM significantly affected ear diameter in 1996 season, and the second order interaction (N x P x FYM) significantly affected this trait in the combined analysis of both seasons.

The results indicated that in 1996 season, the application of FYM induced an increase in ear diameter at lower N levels, whereas at the higher

Table 11: Effect of N, P and FYM levels and their interactions on **ear diameter (cm)** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	4.2	4.3	4.9	4.5	4.2	4.5	4.4	4.4	4.2	4.4	4.7	4.5
	45	5.3	5.3	5.3	5.3	4.5	4.8	5.0	4.8	4.9	5.1	5.2	5.1
	90	5.2	5.4	5.4	5.3	4.9	4.9	4.7	4.8	5.1	5.2	5.1	5.1
	135	5.6	5.4	5.5	5.5	4.8	5.1	4.9	4.9	5.2	5.3	5.2	5.2
	Mean	5.1	5.1	5.3	5.2	4.6	4.8	4.8	4.7	4.9	5.0	5.1	5.0
30	0	4.1	4.9	4.4	4.5	4.4	4.3	4.2	4.3	4.3	4.6	4.3	4.4
	45	5.2	5.3	5.4	5.3	4.6	4.7	5.0	4.8	4.9	5.0	5.2	5.1
	90	5.3	5.3	5.4	5.3	4.9	4.8	5.0	4.9	5.1	5.1	5.2	5.1
	135	5.2	5.5	5.5	5.4	5.0	5.1	5.0	5.0	5.1	5.3	5.3	5.2
	Mean	5.0	5.3	5.2	5.2	4.7	4.7	4.8	4.8	4.9	5.0	5.0	5.0
N x FYM	0	4.2	4.6	4.7	4.5	4.3	4.4	4.3	4.4	4.3	4.5	4.5	4.5
	45	5.3	5.3	5.4	5.3	4.6	4.8	5.0	4.8	5.0	5.1	5.2	5.1
	90	5.3	5.4	5.4	5.3	4.9	4.9	4.9	4.9	5.1	5.2	5.2	5.1
	135	5.4	5.5	5.5	5.5	4.9	5.1	5.0	5.0	5.2	5.3	5.3	5.3
	Mean	5.1	5.2	5.3	5.2	4.7	4.8	4.8	4.8	4.9	5.0	5.1	5.0

L.S.D. at 5% for		1995	1996	Combined
	N	0.2	0.1	0.1
	P	NS	NS	NS
	FYM	0.2	NS	0.1
	N x P	NS	NS	NS
	N x FYM	NS	0.6	NS
	P x FYM	NS	NS	NS
	N x P x FYM	NS	NS	0.3

N levels (90 and 135 kg/fed) no any apparent differences were observed due to application of FYM..

The second order interaction of the two seasons average showed that the highest ear diameter was 5.3 cm which was obtained by combining 135 Kg N + 20 or 40 t FYM + 30 P_2O_5 per fed, and the lowest value was 4.2 cm which was recorded by the check treatment (zero level of the three factors).

9. Ear weight

The results for the effects of N, P and FYM and their interactions on ear weight in 1995 and 1996 seasons as well as their combined average are shown in Table (12).

9.1. Effect of N

The increase in N level significantly increased ear weight in both seasons as well as in their combined average (Table 12). Applying N at 45, 90 and 35 kg/fed significantly increased ear weight by 66.31, 104.49 and 116.98% over the check treatment in 1995 season, respectively. the corresponding increases in 1996 season for the same N levels were 38.22, 66.57 and 73.60%, respectively, being 51.30, 84.19 and 94.18% in the combined average. All increases due the increments in all levels were almost significant.

These results indicate the vital role of N in forming and building up heavy maize ears which in turn is reflected in an increase in maize grain yield.

The present result is quite expected since N markedly increased length and diameter of maize ears and positively affected growth characters of maize plants.

Similar results were also obtained by **Salem *et al.* (1982), Khalifa *et al.* (1983), Gouda (1989), Shafshak *et al.* (1994a)** and **Abdel-Hameed (1997)** who found that the increase in N application level significantly increased ear weight of maize.

9.2. Effect of P

The effect of P application on ear weight was significant where a significant increase in ear weight was obtained in both seasons and their combined average due to P fertilization (Table 12).

The results indicated that applying 30 kg P_2O_5/fed significantly increased ear weight over the check treatment by 16.60, 4.09 and 10.40% in 1995, 1996 and the combined average, respectively.

It could be concluded that P is an essential element for cereal crops and is required for grain formation. The present results are mainly due to the positive effects of P on plant height, leaf area of the topmost ear as shown in the previous results.

The present results are not in agreement with those obtained by **Shafshak (1962), Amer *et al.* (1964), Khalifa (1970), Ainer (1976)** and **Samia *et al.* (1995)** who found that P application did not significantly affect ear weight of maize.

9.3. Effect of FYM

The results in Table 12 showed that FYM significantly affected ear weight in both seasons as well as their combined average. Applying 20 and 40 t/fed FYM increased ear weight over the check treatment by 3.02 and 12.84% in 1995; 7.21 and 8.58% in 1996; and 5.03 and 10.79%, in the combined average, respectively. The increases due to both FYM levels were almost significant.

The present results show the positive effect of FYM on ear weight due to its contents of nutritive elements. The present results are mainly due to the positive effects of FYM on the growth characters as well as on ear size of maize.

It is worth mentioning that the effect of FYM on ear weight could not be compared with the evident effect of mineral N fertilizer which induced marked increases on this trait which is estimated as 5 to 9 folds that of the organic manure in the present study (the mineral fertilizer increased ear weight by 51-94% and the organic manure caused an increase of 5-10% on the two seasons average).

The present results agree with those obtained by **Abd El-Hameed (1997)** who found an increase in ear weight by applying 25 m^3 FYM/fed in one season out of two and in the combined of both seasons. On the other hand, **Khalil (1992)** showed that ear weight was not significantly affected by FYM application.

9.4. Interaction effects

The results showed that significant interactions were observed between N x P in the combined average and N x FYM in 1996 season on ear weight. The other interactions were not significant. The N x P interaction indicated a higher effect of N under P fertilization. The highest ear weight in the combined average was 312.8 gm which was obtained by combining 135 kg N + 30 kg P_2O_5/fed.

Table 12: Effect of N, P and FYM levels and their interactions on **ear weight (gm)** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	98.3	120.6	133.2	117.4	128.9	163.8	181.5	158.1	113.6	142.2	157.4	137.8
	45	232.5	224.6	223.9	227.0	209.4	244.5	233.8	229.0	221.0	234.6	228.5	228.0
	90	277.0	299.4	319.5	298.6	265.1	248.2	266.9	260.1	271.1	273.8	293.2	279.4
	135	306.0	284.2	343.1	311.1	248.2	326.0	298.9	291.0	277.1	305.1	321.0	301.1
	Mean	228.5	232.2	254.9	238.5	212.9	245.6	245.1	234.6	220.7	238.9	250.0	236.6
30	0	134.4	183.6	231.1	183.0	193.8	178.3	148.7	173.6	164.1	181.0	189.9	178.3
	45	256.7	265.3	295.9	272.6	215.3	205.5	263.4	228.1	236.0	235.4	279.7	250.4
	90	311.0	322.8	314.2	316.0	281.2	286.1	302.4	289.9	296.1	304.5	308.3	303.0
	135	346.6	321.4	354.0	340.7	277.0	298.0	280.0	285.0	311.8	309.7	317.0	312.8
	Mean	262.2	273.3	298.8	278.1	241.8	242.0	248.6	244.2	252.0	257.7	273.7	261.2
N x FYM	0	116.4	152.1	182.2	150.2	161.4	171.1	165.1	165.9	138.9	161.6	173.7	158.1
	45	244.6	245.0	259.9	249.8	212.4	225.0	248.2	228.6	228.5	235.0	254.1	239.2
	90	294.0	311.1	316.9	307.3	273.2	267.2	284.7	275.0	283.6	289.2	300.8	291.2
	135	326.3	302.8	348.6	325.9	262.6	312.0	289.5	288.0	294.5	307.4	319.1	307.0
	Mean	245.4	252.8	276.9	258.3	227.4	243.8	246.9	239.4	236.4	248.3	261.9	248.9

L.S.D. at 5% for		1995	1996	Combined
	N	19.4	17.6	12.5
	P	13.7	NS	8.9
	FYM	16.8	15.3	10.8
	N x P	NS	NS	17.7
	N x FYM	NS	30.5	NS
	P x FYM	NS	NS	NS
	N x P x FYM	NS	NS	NS

FYM x N interaction in 1996 season showed that the maximum ear weight was 312.0 gm which was produced by combining 135 gm N + 20 ton FYM/fed.

10. Number of rows/ear

The effect of N, P and FYM levels and their interactions on number of rows/ear in 1995 and 1996 seasons as well as their combined average are given in Table (13).

10.1. Effect of N

The results in Table (13) indicated a significant effect of N application on number of ears/row in the first season as well as in the combined average.

In 1995, applying N at 45, 90 and 135 kg/fed significantly increased number of rows/ear by 3.08, 4.62 and 5.38% compared with the control, respectively. The increases in the combined average for the same N levels were 2.27, 3.0 and 4.55%, respectively and were also significant. Increases in this trait in 1996 were also observed but were far below the level of significance.

It could be concluded that N application favorably affected number of rows/ear due to the role of N in seed formation and plant growth. The results obtained by **Khedr (1986), Shafshak *et al.* (1994a), Soliman *et al.* (1995),** and **Abd El-Hameed (1997)** showed that the increase in N level significantly increased number of rows/ear. On the other hand, **Abdel-Gawad *et al.* (1974), Khalil (1978), Mahgoub (1979), Shafshak *et al.* (1981), Younis *et al.* (1990)** and **Faisal *et al.* (1996)** found that N level did not significantly affect number of rows/ear.

10.2. Effect of P

The results in Table (13) showed that P application had no significant effect on number of ears/row in both seasons as well as in the combined average.

The present result agrees with those obtained by **Shafshak (1962), Khalifa (1970)** and **Amer (1976)** who found that the application of P did not significantly affect ear characters of maize.

10.3. Effect of FYM

The results in Table (13) indicated that the application of FYM at 20 and 40 ton/fed had no significant effect on number of rows/ear in both seasons of experimentation as well as their combined average.

It was observed that slight increases were observed in the second season, being 2.24% in this trait due to applying both FYM levels, but the increases were below the level of significance.

The results showed clearly that the effect of mineral N is more apparent on ear characters compared with the organic N.

The present results agree with those obtained by **Khalil (1992)** who found that FYM application did not significantly affect this trait. On the other hand, **Abd El-Hameed (1997)** and **Faisal and Shalaby (1998)** reported significant increases in number of rows/ear due to application of animal manure.

10.4. Interaction effects

The results presented in Table (13) showed that none of the interactions between the experimental factors had a significant effect on number of rows/ear in both seasons and their combined average.

Table 13: Effect of N, P and FYM levels and their interactions on **number of rows per ear** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	12.4	12.6	13.4	12.8	13.1	13.3	13.3	13.2	12.8	13.1	13.4	13.0
	45	13.9	12.8	13.2	13.3	13.5	13.6	14.1	13.7	13.7	13.2	13.7	13.5
	90	13.9	13.7	13.3	13.6	12.9	14.0	13.7	13.5	13.4	13.9	13.5	13.6
	135	13.8	13.5	14.0	13.7	13.7	14.1	13.5	13.8	13.8	13.8	13.8	13.8
	Mean	13.5	13.2	13.5	13.4	13.3	13.8	13.7	13.6	13.4	13.5	13.6	13.5
30	0	13.1	13.3	13.1	13.2	13.9	12.9	13.4	13.4	13.5	13.1	13.2	13.3
	45	13.7	13.6	12.9	13.4	13.5	13.1	13.6	13.4	13.6	13.4	13.3	13.4
	90	13.8	13.8	13.3	13.6	13.2	14.1	13.9	13.7	13.5	14.0	13.6	13.7
	135	13.8	13.9	13.8	13.7	13.3	14.0	14.0	13.8	13.6	14.0	13.9	13.8
	Mean	13.6	13.7	13.3	13.5	13.5	13.5	13.7	13.6	13.6	13.6	13.5	13.6
N x FYM	0	12.8	13.0	13.3	13.0	13.5	13.1	13.4	13.3	13.2	13.1	13.4	13.2
	45	13.8	13.2	13.1	13.4	13.5	13.4	13.9	13.6	13.7	13.3	13.5	13.5
	90	13.9	13.8	13.3	13.6	13.1	14.1	13.8	13.6	13.5	14.0	13.6	13.6
	135	13.8	13.7	13.9	13.7	13.5	14.1	13.8	13.8	13.7	13.9	13.9	13.8
	Mean	13.6	13.4	13.4	13.5	13.4	13.7	13.7	13.6	13.5	13.6	13.6	13.6

L.S.D. at 5% for	1995	1996	Combined
N	0.4	NS	0.3
P	NS	NS	NS
FYM	NS	NS	NS
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

This result indicates that each experimental factor independently affected this trait.

11. Number of kernels/row

The effects of N, P and FYM levels and their interactions on number of kernels/row in 1995, 1996 and their combined average are given in Table (14).

11.1. Effect of N

The results in Table (14) showed that N application significantly increased number of kernels/row in both seasons as well as in the combined average.

Applying N at 45, 90 and 135 kg/fed significantly increased number of kernels/row in 1995 over the check treatment by 55.06, 61.05 and 63.67%, respectively. The corresponding increases in 1996 season were 26.44, 26.44 and 31.90% for the N levels.

The combined analysis of both season indicated that N at 45, 90 and 135 kg/fed increased this trait by 38.64, 41.33 and 45.45%, over the control level, respectively.

It is worthy to note that the differences among the three applied N levels (45, 90 and 135 kg/fed) were not significant in both seasons.

The present results show the role of N on yield components of maize and are in general agreement with those obtained by **Khedr (1986), Nigem (1989), Soliman *et al.* (1995), Faisal *et al.* (1996), Abd El-Hameed (1997)** and **Faisal *et al.* (1997)**, who found that increasing N level significantly increased number of kernels/row.

11.2. Effect of P

The results presented in Table (14) showed that P application at 30 kg P_2O_5/fed had no effect on number of kernels/row in both season as well as in their combined average.

The present results are in agreement with those obtained by **Shafshak (1962)**, **Khalifa (1970)** and **Ainer (1976)** who found that ear characters of maize were not affected by P application.

11.3. Effect of FYM

The combined analysis of the two seasons average indicated a significant effect of FYM application on number of kernels/row, as shown in Table (14). Applying 20 and 40 ton/fed FYM significantly increased number of kernels/row over the check treatment by 5.10 and 4.85%, respectively in the combined analysis.

This increase indicates a positive effect of animal manure on this trait, but this effect is not comparable to the effect of mineral N which reached about 9 folds that of organic N (45.5% as against 5.1%).

The present results are in agreement with those obtained by **Khalil (1992)**, **Abd El-Hameed (1997)** and **Faisal and Shalaby (1998)** who found that animal manure significantly increased number of grains/row.

11.4. Interaction effects

The results in Table (14) showed that all effects of the first order interactions (N x P, N x FYM and P x FYM) had no significant effects on number of kernels/row in both seasons as well as their combined average. On the other hand, the second order interaction significantly affected this trait in 1996 season as well as in the combined analysis.

Table 14: Effect of N, P and FYM levels and their interactions on **number of kernels per row** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	22.4	24.2	29.1	25.2	31.1	32.5	36.7	33.4	26.8	28.4	32.9	29.4
	45	40.1	42.7	39.3	40.7	43.5	45.9	42.7	44.0	41.8	44.3	41.0	42.4
	90	38.4	45.3	44.6	42.8	40.9	45.7	43.2	43.3	40.0	45.5	43.9	43.1
	135	45.5	43.1	45.2	44.6	46.3	46.5	47.8	46.9	45.9	44.8	46.5	45.7
	Mean	36.6	38.8	39.6	38.3	40.5	42.7	42.6	41.9	38.6	40.8	41.1	40.2
30	0	25.5	30.9	28.1	28.2	35.5	37.7	35.4	36.2	30.5	34.3	31.8	32.2
	45	42.0	40.9	43.3	42.1	42.8	44.1	44.9	43.9	42.4	42.5	44.1	43.0
	90	42.3	44.0	43.2	43.2	44.3	43.5	46.3	44.7	43.3	43.8	44.8	44.0
	135	41.1	43.6	43.6	42.8	43.9	47.7	43.1	44.9	42.5	45.7	43.4	43.9
	Mean	37.7	39.9	39.6	39.1	41.6	43.3	42.4	42.4	39.7	41.6	41.0	40.8
N x FYM	0	24.0	27.4	28.6	26.7	33.3	35.1	36.1	34.8	28.7	31.3	32.4	30.8
	45	41.1	41.8	41.3	41.4	43.2	45.0	43.8	44.0	42.2	43.4	42.6	42.7
	90	40.4	44.7	43.9	43.0	42.6	44.6	44.8	44.0	41.5	44.7	44.4	43.5
	135	43.3	43.4	44.4	43.7	45.1	47.1	45.5	45.9	44.2	45.3	45.0	44.8
	Mean	37.2	39.3	39.6	38.7	41.1	43.0	42.6	42.2	39.2	41.2	41.1	40.5

L.S.D. at 5% for	1995	1996	Combined
N	3.0	2.0	1.7
P	NS	NS	NS
FYM	NS	NS	1.5
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	4.9	4.3

The results showed that the highest values of number of kernels/row in 1996 and the combined average were recorded by combining 135 kg N + zero P_2O_5 + 40 ton FYM/fed, being 47.8 and 46.5, respectively.

12. Weight of 100-kernels

The effect of N, P and FYM and their interactions on 100-kernel weight in 1995 and 1996 as well as their combined average are presented in Table (15).

12.1. Effect of N

The application of N significantly increased 100-kernel weight in both seasons as well as their combined average (Table 15).

Applying N at 45, 90 and 135 kg/fed increased 100-kernel weight over the control level in 1995 season by 43.63, 42.16 and 45.59%, respectively. The corresponding increases for the same N levels in 1996 season were 2.16, 14.81 and 16.67%, respectively. Also, the combined data indicated increases in 100-kernel weight of 16.29, 25.76 and 28.03% for the three applied N levels over the check treatment.

The results indicate clearly an increase in grain plumbness showing the role of N as a vital element for maize plants. These results are due to the encouraging effect of N on growth characters, ear size and grain formation. Similar results were also reported by **Mahgoub (1979), El-Hattab *et al.* (1980), Eraky *et al.* (1980), Koraiem *et al.* (1980), Abdel-Gawad *et al.* (1983), Khedr (1986), Shafshak *et al.* (1994a), Faisal *et al.* (1996), Abd El-Hameed (1997)** and **Faisal *et al.* (1997)**, who found that 100-kernel weight increased with the increase in N application level.

12.2. Effect of P

The results in Table (15) showed that P application at 30 kg P_2O_5/fed did not significantly affect 100-kernel weight in both seasons as well as in their combined average.

The results showed a very slight increase (averaging 2.61% for the combined data) due to P application, but this increase was small to reach the level of significance.

The present results are in general agreement with those obtained by **Shafshak (1962), Khalifa (1970)** and **Ainer (1976)** who found that P application did not significantly affect ear characters of maize.

12.3. Effect of FYM

The results in Table (15) indicated that FYM favorably affected 100-kernel weight. The effect of FYM on this trait reached the level of significance when it was applied at 40 ton/fed in the first season as well as in the combined data of both seasons. On the other hand, the increase in 100-kernel weight due to applying the lower FYM level (20 ton/fed) was not significant in both seasons.

The results showed that the application of 20 and 40 ton FYM/fed increased 100-kernel weight over the check treatment by 3.89 and 9.73% in 1995; 1.15 and 2.88% in 1996; and 2.32 and 5.96% in the combined average, respectively. These increases of 100-kernel weight due to applying FYM could not be compared with the increase induced by the mineral fertilizer. On the average of both seasons, the highest N level (135 kg

Table 15: Effect of N, P and FYM levels and their interactions on **weight of 100-kernels (gm)** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	16.4	19.2	22.2	19.3	29.9	30.7	32.2	30.9	23.2	25.0	27.2	25.1
	45	27.2	27.9	30.1	28.4	32.0	31.9	34.0	32.6	29.6	29.9	32.1	30.5
	90	28.5	29.0	30.0	29.2	37.5	34.4	35.8	35.9	33.0	31.7	32.9	32.6
	135	29.5	29.6	29.8	29.6	36.1	40.6	39.0	38.6	32.8	35.1	34.4	34.1
	Mean	25.4	26.4	28.0	26.6	33.9	34.4	35.3	34.5	29.7	30.4	31.7	30.6
30	0	18.7	23.0	22.9	21.5	33.0	35.1	33.4	33.8	35.9	29.1	28.2	27.6
	45	27.3	27.5	29.4	28.1	32.7	33.3	34.3	33.4	30.0	30.4	31.9	30.8
	90	28.5	28.0	30.2	28.9	39.5	37.9	38.1	38.5	34.0	33.0	34.2	33.7
	135	29.5	29.2	30.6	29.8	36.4	36.7	38.0	37.0	33.0	33.0	34.3	33.4
	Mean	26.0	26.9	28.3	27.1	35.4	35.8	36.0	35.7	30.7	31.4	32.2	31.4
N x FYM	0	17.6	21.1	22.6	20.4	31.5	32.9	32.8	32.4	24.6	27.0	27.7	26.4
	45	27.3	27.7	29.8	28.3	32.4	32.6	34.2	33.1	29.8	30.2	32.0	30.7
	90	28.5	28.5	30.1	29.0	38.5	36.2	37.0	37.2	33.5	32.4	33.6	33.2
	135	29.5	29.4	30.2	29.7	36.3	38.7	38.5	37.8	32.9	34.1	34.4	33.8
	Mean	25.7	26.7	28.2	26.9	34.7	35.1	35.7	35.1	30.2	30.9	32.0	31.0

L.S.D. at 5% for	1995	1996	Combined
N	1.6	1.5	1.0
P	NS	NS	NS
FYM	1.4	NS	0.9
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

The results indicated that all levels of applied N induced significant increases in shelling %, but no significant differences could be detected among the applied N levels (45, 90 and 135 kg/fed).

The highest shelling percentage was recorded at the highest N level, being 83.7, 82.4 and 83.1% in 1995, 1996 and the combined average, respectively. The corresponding shelling % recorded at the check treatment were 71.8, 79.2 and 75.5%, in the respective seasons.

It could be concluded that N markedly increased shelling % and a good supply of N could increase this trait due to the effect of N on grain formation.

Similar results were also obtained by **El-Hattab *et al.* (1980), Khalifa *et al.* (1983), Abdel-Gawad (1986)** and **Shafshak *et al.* (1994a)**, who found that the increase in N level significantly increased shelling percentage. On the other hand, **Abd El-Hameed (1997)** showed that shelling percentage was not affected by N fertilizer level.

13.2. Effect of P

The results in Table (16) indicated that applying P at 30 kg P_2O_5/fed induced an increase in shelling percentage. This increase was significant in the first season as well as in the combined average, but was far below the level of significance in the second season.

The results indicated that the application of 30 kg P_2O_5/fed produced a shelling % of 81.6, 81.5 and 81.6% in 1995, 1996 and the combined average, respectively. The corresponding values of the check treatment in the respective seasons were 78.6, 81.0 and 79.8%.

It could be concluded that P application positively affected shelling percentage.

The results obtained by **Shafshak (1962)**, **Khalifa (1970)**, **Ainer (1976)** and **Khalifa *et al.* (1987)** indicated that P application had no significant effect on shelling percentage.

The response of this trait to P application in the present study may be due to the experimental soil of Nubaria which contained only 8.30 and 9.68 ppm available P in the first and second season, respectively. Consequently, a response to P is expected.

13.3. Effect of FYM

The results in Table (15) showed that FYM significantly affected shelling percentage in both seasons and the combined average. The highest shelling percentage was recorded at the higher FYM level (40 ton/fed), being 81.8, 82.2 and 82.0% in 1995, 1996 and the combined average, respectively, The corresponding values of the check treatment were 78.7, 80.4 and 79.6%, respectively.

It could be concluded that FYM positively affected shelling percentage due to its contents of the different nutrient elements. The present results are expected since FYM positively affected growth characters and yield components of maize.

The present results agree with those obtained by **Ponsica *et al.* (1983)** who found that application of animal manure favoured production of higher shelling percentage. On the other hand, **Abd El-Hameed (1997)** found that application of 25 m^3 FYM/fed did not significantly affect shelling % in 1995, 1996 seasons and their combined average.

Table 16: Effect of N, P and FYM levels and their interactions on **shelling percentage** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	65.0	66.2	72.6	67.9	76.6	77.2	80.2	78.0	70.8	71.7	76.4	73.0
	45	78.7	81.9	82.8	81.1	80.9	81.3	82.5	81.6	79.8	81.6	82.7	81.4
	90	82.2	82.9	81.9	82.3	80.9	82.5	82.7	82.0	81.6	82.7	82.3	82.2
	135	83.1	82.6	83.8	83.2	81.4	82.2	83.2	82.3	82.3	82.4	83.5	82.7
	Mean	77.3	78.4	80.3	78.6	80.0	80.8	82.2	81.0	78.6	79.6	81.2	79.8
30	0	70.2	75.7	81.0	75.6	79.7	80.1	81.1	80.3	75.0	77.9	81.1	78.0
	45	82.5	84.0	83.9	83.5	79.9	81.7	82.8	81.5	81.2	82.9	83.4	82.5
	90	82.9	83.4	83.7	83.3	81.5	81.5	82.1	81.7	82.2	82.5	82.9	82.5
	135	84.5	83.8	84.6	84.3	81.7	82.7	83.0	82.5	83.1	83.3	83.8	83.4
	Mean	80.0	81.7	83.2	81.6	80.7	81.5	82.3	81.5	80.4	81.7	82.8	81.6
N x FYM	0	67.6	71.0	76.8	71.8	78.2	78.7	80.7	79.2	72.8	74.9	78.8	75.5
	45	80.7	83.0	83.4	82.4	80.4	81.5	82.7	81.5	80.6	82.3	83.1	82.0
	90	82.6	83.2	82.8	82.9	81.2	82.0	82.4	81.9	81.9	82.6	82.6	82.4
	135	83.8	83.2	84.2	83.7	81.6	82.5	83.1	82.4	82.7	82.9	83.7	83.1
	Mean	78.7	80.1	81.8	80.2	80.4	81.2	82.2	81.3	79.6	80.7	82.0	80.8

L.S.D. at 5% for		1995	1996	Combined
	N	1.2	0.9	0.8
	P	0.8	NS	0.5
	FYM	1.0	0.8	0.6
	N x P	1.7	1.6	1.0
	N x FYM	2.0	NS	1.3
	P x FYM	NS	NS	NS
	N x P x FYM	NS	NS	NS

13.4. Interaction effects

The results in Table (16) showed that N x P significantly affected shelling percentage in both seasons as well as in the combined average.

The results showed that the effect of P on this trait was more evident where no N was applied, and this effect was greatly reduced at the higher N levels.

The highest shelling percentage was recorded in both seasons and their combined average by combining 135 kg N + 30 kg P_2O_5/fed, being 84.6, 83.0 and 83.8% in 1995, 1996 and the combined average, respectively. Also, N x FYM significantly affected shelling percentage in 1995 season as well as in the combined average. The results in Table (16) showed that the effect of FYM on this trait was only evident where no N fertilizer was applied whereas under the highest N level the effect of FYM on shelling percentage has been greatly diminished.

The results showed that applying 40 ton FYM/fed raised shelling percentage from 67.6 to 76.8% in 1995; and from 72.8 to 78.8% in the combined average compared with control treatment and at the zero N level. While at the N level of 135 kg/fed the same FYM level increased shelling percentage from 83.8 to 84.2% in 1995 season; and from 82.7 to 83.7% in the combined average.

This result indicates that under the highest N level, the effect of FYM was not significant. All other interactions were not significant with respect to this trait.

14. Grain yield per feddan

Results of the effects of N, P and FYM levels and their interactions on grain yield of maize (kg/fed) in 1995 and 1996 seasons as well as their combined average are presented in Table (17).

14.1. Effect of N

The results indicated a significant effect of N fertilizer level on grain yield in both seasons and their combined average.

It is clear from Table 17 that a significant increase in grain yield was obtained by each increment in N level in both seasons. In 1995 season, applying N at 45, 90 and 135 kg/fed significantly increased grain yield over the control level by 88.30, 100.69 and 161.66%, respectively. The corresponding increases in 1996 season for the same N level were 90.17, 177.06 and 200.01%, respectively. The combined average of both seasons recorded increases in grain yield of 89.16, 139.37 and 170.13%, over the check treatment for the three respective N levels.

These marked increases indicate the evident response of the promising grown cultivar (Single Cross 122) to N application under calcareous soil conditions in Nubaria.

The vital role of N on maize grain yield is clearly demonstrated. The effect of N on maize grain yield is the outcome of its effect on plant height, leaf area, reduction of barreness, increasing each of maize prolificacy, ear size, number of rows/ear, number of kernels/row , weight of 100 kernels, ear weight and shelling percentage.

It could be concluded that N is the most essential nutritive element for maize and growing a single cross supplied with 135 kg N/fed can produce an outstanding grain yield in the calcareous soils of Nubaria.

The present results agree with those obtained by **Ashoub *et al.* (1987), El-Noemani *et al.* (1989), Gouda (1989), Nigem (1989), Younis *et al.* (1990), Bedeer *et al.* (1992), Shafshak *et al.* (1994a), Samia Amer *et al.***

(1995), **Basha *et al.* (1995), Younis *et al.* (1995), Faisal *et al.* (1996), Abd El-Hameed (1997)** and **Faisal *et al.* (1997)** who reported a good and clear response of maize grain yield to high N levels.

14.2. Effect of P

The results in Table (17) showed clearly that P application significantly increased maize grain yield.

Applying 30 kg P_2O_5/fed significantly increased maize grain yield by 26.66, 10.43 and 18.29% over the control treatment in 1995, 1996 and the combined average, respectively.

The present results indicate clearly the effect of P on grain yield under the conditions of Nubaria calcareous soils where the soil has a very low content of available P.

The present results are mainly due to the positive effects of P on plant height, leaf area, number of ears/plant, ear weight and shelling percentage. Consequently, an increase in maize grain yield is expected.

The results reported by **Bakr Ahmed and Raafat (1958), Rana (1980), Juric *et al.* (1986), Miller *et al.* (1987), Okalebio *et al.* (1994)** and **Bordoli and Mallarino (1998)** indicated that P application considerably increased grain yield of maize. On the other hand, **Eid (1959), Kaddah and Abu El-Ela (1960), Shafshak (1962), Ainer (1976), Mikhail and Shalaby (1979),** and **Khalifa *et al.* (1987)** found that P application did not significantly increase maize grain yield.

14.3. Effect of FYM

The results in Table (17) showed that FYM significantly increased maize grain yield in both seasons as well as their combined average. The investigation the level of 135 kg N/fed induced an increase in grain yield which was about 5 folds that of the level of 40 ton FYM per feddan on the average of both seasons.

The efficiency of the mineral N estimated from the combined average showed that under the highest N level one kg N induced an increase in grain yield of 20.7 kg, compared with 20.8 kg obtained by one ton of FYM when applied at the higher level.

This comparison showed clearly that one kg of pure mineral N equaled in its effect on grain yield one ton of FYM. It is worth noting that the effect of FYM will extend for 2 or 3 years.

It could be concluded that FYM is needed for obtaining higher grain yield of maize grown in calcareous soils.

Similar results were also obtained by **Abdou *et al.* (1969), Omar *et al.* (1970), Biswas *et al.* (1971), Drija and Razakov (1975), Nafadi and Gohar (1975), Mailad *et al.* (1978), Hamissa *et al.* (1979), El-Attar *et al.* (1982), Ikombo (1984), Patel *et al.* (1985), Sharma and Saxena (1985), Abd El-Hameed (1997)** and **Faisal and Shalaby (1998)** who found that animal manure resulted in significant increase in maize grain yield.

14.4. Interaction effects

The results in Table (17) showed that N x P significantly affected grain yield in 1995 season. The results showed that P application markedly increased the response of grain yield to the higher N level. The maximum yield was recorded by combining the highest levels of both elements (135

Table 17: Effect of N, P and FYM levels and their interactions on **grain yield (kg/fed)** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	1112.3	1128.1	1669.4	1303.3	1150.0	1418.8	1559.8	1376.2	1131.2	1273.5	1614.6	1339.8
	45	2692.7	3043.8	3250.9	2995.8	2114.3	2944.7	3096.1	2718.4	2403.5	2994.3	3173.5	2857.1
	90	3104.2	3246.6	3744.0	3364.9	3303.4	4259.1	4580.6	4047.7	3203.8	3752.9	4162.3	3706.3
	135	3841.6	4002.7	4359.5	4067.9	3891.0	3297.5	4763.2	4317.2	3866.3	4150.1	4561.4	4192.6
	Mean	2687.7	2855.3	3256.0	2933.0	2614.7	3230.0	3500.0	3114.9	2651.2	3042.7	3378.0	3024.0
30	0	1514.2	2289.6	3053.8	2285.9	1308.7	1499.9	2132.4	1647.0	1411.5	1894.8	2593.1	1966.5
	45	3228.2	3712.0	4348.3	3762.8	2394.2	2975.4	3722.5	3030.7	2811.2	3343.7	4035.4	3396.8
	90	3761.8	3598.5	4907.9	4089.4	3401.1	4584.0	4999.4	4328.2	3581.5	4091.3	4953.8	4208.8
	135	4289.7	4849.9	5031.8	4723.8	4264.6	4964.5	5029.4	4752.8	4277.2	4907.2	5030.6	4738.5
	Mean	3198.5	3612.5	4335.5	3715.5	2842.2	3506.0	3971.0	3439.7	3020.4	3559.3	4153.3	3577.6
N x FYM	0	1313.3	1708.9	2361.6	1794.6	1229.4	1459.4	1846.1	1511.6	1271.4	1584.2	2103.9	1653.1
	45	2960.5	3377.9	3799.6	3379.3	2254.3	2960.1	3409.3	2874.6	2607.4	3169.0	3604.5	3127.0
	90	3433.0	3422.6	4326.0	3727.2	3352.3	4421.6	4790.1	4188.0	3392.7	3922.1	4558.1	3957.6
	135	4065.7	4426.3	4695.7	4395.9	4077.8	4631.0	4896.3	4535.0	4071.8	4528.7	4796.0	4465.5
	Mean	2943.1	3233.9	3795.7	3324.3	2728.5	3368.0	3735.5	3277.3	2835.8	3301.0	3765.6	3300.8

L.S.D. at 5% for		1995	1996	Combined
	N	158.7	188.2	122.1
	P	112.2	133.1	86.3
	FYM	137.5	163.0	105.7
	N x P	224.5	NS	NS
	N x FYM	NS	325.9	211.6
	P x FYM	192.9	NS	149.3
	N x P x FYM	NS	NS	NS

kg N + 30 kg P_2O_5). Also, N x FYM showed significant effect on grain yield in 1996 season and the combined average. This interaction indicated that the effect of FYM on grain yield was very clear at the zero level of N, and has been diminished with increasing N level. The maximum grain yield was recorded by combining the highest level of both mineral and organic N (135 kg N + 40 ton FYM/fed). The maximum yield reached 4.796 ton/fed in the two seasons average.

The results in Table (17) showed also that P x FYM significantly affected grain yield in 1995 season and the combined average. The data indicated that the effect of FYM on grain yield was more evident under P application. The highest grain yield was recorded by combining P at 30 kg P_2O_5 + FYM at 40 ton/fed in both seasons and the combined data, being 4.335, 3.971 and 4.153 ton/fed in 1995, 1996 and the two season average, respectively.

The results indicated no significant effect of the second order interaction on grain yield in both seasons and their average.

15. Nitrogen content in leaves

The results of N% in leaves at 90 days from planting as affected by N, P and FYM levels and their interactions in 1995 and 1996 seasons as well as their combined average are presented in Table (18).

15.1. Effect of N

The application of N positively affected N% in leaves at 90 days in 1995 season and the combined two seasons average, but the effect of N was not significant in 1996 season.

The combined average showed that N% at the check treatment was 1.54%, which was significantly raised to 1.79, 1.91 and 1.93% when N was applied at 45, 90 and 135 kg/fed, respectively.

The results reported by **Kranz and Chandler (1954), Shafshak *et al.* (1981), Genaidy *et al.* (1987), Mahgoub (1987), Shafshak *et al.* (1994a)** showed that N content in maize leaves was increased markedly due to the increase in N level.

15.2. Effect of P

The results in Table (18) indicated that P significantly increased N% in leaves in the first season only. Applying P at 30 kg P_2O_5 significantly increased N% from 1.81% at the control level to 1.96%.

The effect of P was not clear in the second season as well as in the combined average.

The results reported by **Ahmed *et al.* (1992)** indicated that P application increased the efficiency of various forms of N, and led to relative increase of 72% N recovery. They cleared that this may be due to increasing N effect and its uptake by maize plants in presence of P.

15.3. Effect of FYM

The results in Table (18) showed that FYM significantly increased N% in leaves in 1995 season. Applying 40 ton FYM/fed raised N% from 1.82% in the control treatment to 1.99%.

The effect of FYM in the second season as well as the two seasons average was not significant. The effect of FYM is not that great due to the slow release of P to an available form particularly under calcareous soil conditions.

Table 18: Effect of N, P and FYM levels and their interactions on **nitrogen percentage in leaves at 90 days from planting** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	1.16	1.33	1.62	1.37	1.66	1.80	1.55	1.67	1.41	1.57	1.59	1.52
	45	1.50	1.86	1.69	1.68	2.06	1.84	2.14	2.01	1.78	1.85	1.92	1.85
	90	1.90	1.90	2.34	2.05	1.29	1.81	1.23	1.44	1.60	1.86	1.79	1.75
	135	2.22	2.10	2.12	2.15	1.66	1.47	1.84	1.66	1.94	1.79	1.98	1.91
	Mean	1.70	1.80	1.94	1.81	1.67	1.73	1.69	1.70	1.69	1.77	1.82	1.76
30	0	1.49	1.40	1.45	1.45	1.51	1.78	1.62	1.64	1.50	1.59	1.54	1.55
	45	1.66	1.81	2.02	1.83	1.48	1.73	1.66	1.62	1.57	1.77	1.84	1.73
	90	2.18	2.05	2.28	2.17	2.08	2.10	1.71	1.96	2.13	2.08	2.0	2.07
	135	2.40	2.38	2.42	2.40	1.62	1.64	1.32	1.53	2.01	2.01	1.87	1.97
	Mean	1.93	1.91	2.04	1.96	1.67	1.81	1.58	1.69	1.80	1.86	1.81	1.83
N x FYM	0	1.33	1.37	1.54	1.41	1.59	1.79	1.59	1.66	1.46	1.51	1.57	1.54
	45	1.58	1.84	1.86	1.76	1.77	1.79	1.90	1.82	1.68	1.81	1.88	1.79
	90	2.04	1.98	2.31	2.11	1.69	1.96	1.47	1.71	1.87	1.97	1.90	1.91
	135	2.31	2.24	2.27	2.27	1.64	1.56	1.58	1.59	1.98	1.90	1.93	1.93
	Mean	1.82	1.86	1.99	1.89	1.67	1.78	1.64	1.70	1.75	1.82	1.82	1.80

L.S.D. at 5% for		1995	1996	Combined
	N	0.15	NS	0.13
	P	0.11	NS	NS
	FYM	0.13	NS	NS
	N x P	NS	NS	NS
	N x FYM	NS	NS	NS
	P x FYM	NS	NS	NS
	N x P x FYM	NS	NS	NS

The results reported by **Khalil (1992)** showed that the application of FYM increased N content in ear leaf at flowering.

15.4. Interaction effects

The results in Table (18) showed that all effects of the interactions between the studied factors were not significant which indicates that each factor acted independently in affecting N% in maize leaves at 90 days from planting.

16. Phosphorus content in leaves

The effects of N, P and FYM levels and their interactions on P% in leaves at 90 days from planting in 1995 and 1996 seasons and their combined average are presented in Table (19).

16.1. Effect of N

The results showed that the increase N level markedly increased P% in leaves. The effect of N reached the level of significance in the first season and the combined data. In 1995, applying N at 135 kg/fed significantly increased P% in leaves to reach 0.51% compared with 0.44% at the check treatment. The corresponding increases in the combined data were 0.44 compared with 0.38 at the check treatment. Similarly, increases were also observed in 1996, but these increases were below the level of significance.

The role of N in raising P% in leaves is due to increasing maize growth which increases in turn the uptake of all nutrient elements, particularly the three major nutrients.

The results obtained by **Shafshak *et al.* (1994a)** indicated that the increase in N level slightly increased P% in maize leaves. On the other hand, **Genaidy *et al.* (1987)** showed that there was a significant increase in P% in maize leaves by increasing N level.

16.2. Effect of P

The results indicated clearly that applying P at 30 kg P_2O_5/fed did not significantly affect P% in maize leaves.

The present results are mainly due to the characteristics of calcareous soils which cause a rapid fixation of available P as a result of the high content of calcium carbonate in the soil.

The results obtained by Bakr **Ahmed** ***et al.*** **(1977)** indicated that increasing the rate of P application slightly increased its concentration in maize plants. Also, **Mohamed** ***et al.*** **(1982)** cleared that maize plants responded to P application and P at 60 kg P_2O_5/fed recorded the highest value of P concentration in leaves. Along the same line, **Rouf and Islam (1983)** found that P and N uptake were increased by P fertilization.

16.3. Effect of FYM

The results in Table (19) showed that FYM slightly increased P% in maize leaves, but the increase was not significant in both seasons as well as in the combined average.

The results showed that in spite of the considerable P content in the animal manure and the very low content of available P in the soil, no any response was observed to FYM. This results is mainly due to the high content of calcium carbonate of the soil in addition to the slow release of P to an available form.

The results obtained by **Diab** ***et al.*** **(1992)** showed that chicken manure application combined with P application at 45 kg P_2O_5/fed showed more accumulation of P in maize.

Table 19: Effect of N, P and FYM levels and their interactions on **phosphorus percentage in leaves at 90 days from planting** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	0.43	0.46	0.44	0.44	0.27	0.30	0.32	0.30	0.35	0.38	0.38	0.37
	45	0.44	0.45	0.44	0.44	0.28	0.33	0.31	0.31	0.36	0.39	0.38	0.38
	90	0.44	0.47	0.45	0.45	0.26	0.34	0.35	0.32	0.35	0.41	0.40	0.39
	135	0.45	0.53	0.49	0.49	0.33	0.34	0.40	0.36	0.39	0.44	0.45	0.43
	Mean	0.44	0.48	0.46	0.46	0.29	0.33	0.35	0.32	0.37	0.41	0.41	0.39
30	0	0.44	0.42	0.46	0.44	0.35	0.31	0.31	0.32	0.40	0.37	0.39	0.38
	45	0.43	0.47	0.45	0.45	0.33	0.33	0.34	0.33	0.38	0.40	0.40	0.39
	90	0.44	0.47	0.44	0.45	0.33	0.31	0.36	0.33	0.39	0.39	0.40	0.39
	135	0.53	0.51	0.53	0.52	0.40	0.35	0.32	0.36	0.47	0.43	0.43	0.44
	Mean	0.46	0.47	0.47	0.47	0.35	0.33	0.33	0.34	0.41	0.40	0.41	0.40
N x FYM	0	0.44	0.44	0.45	0.44	0.31	0.31	0.32	0.31	0.38	0.38	0.39	0.38
	45	0.44	0.46	0.45	0.45	0.31	0.33	0.33	0.32	0.38	0.40	0.39	0.39
	90	0.44	0.47	0.45	0.45	0.30	0.33	0.36	0.33	0.37	0.40	0.41	0.39
	135	0.49	0.52	0.51	0.51	0.37	0.35	0.36	0.36	0.43	0.44	0.44	0.44
	Mean	0.45	0.48	0.47	0.47	0.32	0.33	0.34	0.33	0.39	0.41	0.41	0.40

L.S.D. at 5% for	1995	1996	Combined
N	0.02	NS	0.02
P	NS	NS	NS
FYM	NS	NS	NS
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

16.4. Interaction effects

The results presented in Table (19) showed that none of the interactions between the experimental factors significantly affected P% in maize leaves at 90 days from planting either in both seasons or their combined average.

17. Potassium content in leaves

The results presented in Table (20) show the effects of N, P and FYM levels and their interactions on K% in maize leaves in 1995 and 1996 seasons as well as their combined average.

17.1. Effect of N

The results showed that the increase in N level caused an increase in K% in leaves. This increase reached the level of significance in the first season and the combined average. In 1995 season, applying N at 45, 90 and 135 kg/fed recorded K% of 1.32, 1.39 and 1.42%, respectively compared with 1.23% for the control treatment. Similar increase were also observed in K% in the second season and the combined average.

It could be concluded that N application favorably affected K% in leaves probably due to the positive effect of N on maize growth and in building up a well developed root system. Consequently, a high uptake of all nutritive elements is achieved.

The results obtained by **Shafshak *et al.* (1994a)** showed that the increase in N level favorably affected K% in maize leaves in one season out of two. On the other hand, **Genaidy *et al.* (1987)** found that increasing N application level had no effect on K% in maize leaves.

17.2. Effect of P

The results in Table (20) showed no effect for the application of P on K% in maize leaves in both seasons and their combined average.

This result may be due to the presence of available K in the soil in adequate amounts, that any application of plant nutrients will not induce an increase in K% in plant organs.

The results reported by several investigators showed that maize plants did not respond to P application (**Eid, 1959; Kaddah and Abu-El-Ela, 1960; Shafshak, 1962; Khalifa, 1970; Ainer, 1976; Attia *et al.*, 1979** and **Hillal *et al.*, 1981**).

17.3. Effect of FYM

The results in Table (20) showed that the application of FYM had no significant effect on K% in leaves in both seasons as well as their combined average.

This result is mainly due to the high content of available K in the experimental soil which reached 400-425 ppm as shown in Table (2). Also, the slow release of the available nutrients contained in the animal manure reduces its direct effect on the manured crop.

The results reported by **Evans *et al.* (1978)** indicated that all manure treatments increased the N, P and K contents of stover and grains in maize.

17.4. Interaction effects

The results indicated that none of the interactions between the experimental factors significantly affected K% in leaves after 90 days from planting.

Table 20: Effect of N, P and FYM levels and their interactions on **potassium percenatge in leaves at 90 days from planting** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	1.20	1.25	1.21	1.22	1.11	1.33	1.29	1.24	1.16	1.29	1.25	1.23
	45	1.28	1.42	1.39	1.36	1.21	1.29	1.32	1.27	1.25	1.36	1.36	1.32
	90	1.32	1.45	1.41	1.39	1.45	1.37	1.32	1.38	1.39	1.41	1.37	1.39
	135	1.40	1.53	1.30	1.41	1.58	1.45	1.37	1.47	1.49	1.49	1.34	1.44
	Mean	1.30	1.41	1.33	1.35	1.34	1.36	1.33	1.34	1.32	1.39	1.33	1.35
30	0	1.24	1.25	1.19	1.23	1.25	1.27	1.20	1.24	1.25	1.26	1.20	1.24
	45	1.30	1.13	1.39	1.27	1.36	1.36	1.12	1.28	1.33	1.25	1.26	1.28
	90	1.37	1.39	1.41	1.39	1.35	1.24	1.29	1.29	1.36	1.32	1.35	1.34
	135	1.44	1.45	1.40	1.43	1.39	1.48	1.37	1.41	1.42	1.47	1.39	1.42
	Mean	1.34	1.31	1.35	1.33	1.34	1.34	1.25	1.31	1.34	1.33	1.30	1.32
N x FYM	0	1.22	1.25	1.20	1.23	1.18	1.30	1.25	1.24	1.20	1.28	1.23	1.24
	45	1.29	1.28	1.39	1.32	1.29	1.33	1.22	1.28	1.29	1.31	1.31	1.30
	90	1.35	1.42	1.41	1.39	1.40	1.31	1.31	1.34	1.38	1.37	1.36	1.37
	135	1.42	1.49	1.35	1.42	1.49	1.47	1.37	1.44	1.46	1.48	1.36	1.43
	Mean	1.32	1.36	1.34	1.34	1.34	1.35	1.29	1.33	1.33	1.36	1.32	1.34

L.S.D. at 5% for	1995	1996	Combined
N	0.13	NS	0.07
P	NS	NS	NS
FYM	NS	NS	NS
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

18. Nitrogen content in kernels

The results of the effects of N, P and FYM levels and their interactions on N% in kernels in 1995 and 1996 seasons as well as their combined average are presented in Table (21).

18.1. Effect of N

The results in Table (21) showed that the increase in N level significantly increased N% in grain in both seasons as well as in the combined average. This increase reached the level of significance when N was applied at 90 and 135 kg/fed, whereas the lower level, i.e. 45 kg N/fed did not induce a significance increase. The highest N level (135 kg/fed) raised N% in grain to 1.81, 1.50 and 1.66% in 1995, 1996 and the combined average, respectively as against 1.62, 1.29 and 1.46% for the check treatment in the respective seasons.

The effect of N on this trait is similar to that observed with N% in leaves at 90 days from planting and is expected since N increased maize growth which in turn increased uptake of the applied N by the well developed root system.

Similar results were also obtained by **Moll (1987), Alfoldi *et al.* (1994)** and **Shafshak *et al.* (1994a)** who found that the increase in N level significantly increased N% in kernels.

18.2. Effect of P

The application of P increased N% in grain over the check treatment, but this increase was only significant in the first season (Table 21). The results showed that applying P at 30 kg P_2O_5/fed recorded N% being 1.73, 1.38 and 1.56% in 1995, 1996 and the combined average, compared with

1.67, 1.38 and 1.53% for the check treatments of the respective seasons. This result indicates, in general, that P encouraged N uptake by maize plants due to the positive effects of P application on growth characters.

The results reported by **Ahmed *et al.*** **(1992)** indicated that P application at 45 kg P_2O_5/fed increased N recovery due to increasing the response to N in presence of P.

18.3. Effect of FYM

FYM increased N% in kernels. This increase was significant in the first season as well as in the combined average, but in the second season no effect was observed. Applying 40 ton FYM/fed recorded N% in grain of 1.78 and 1.63% in the 1995 season and the combined average as against 1.53 and 1.45% for the check treatment, respectively. The role of FYM on N% in grain is not so clear as that of mineral N.

The good effect of manure is due to the nutrients contained in the manure and to the beneficial effects of FYM on soil characters. The results reported by **Liebhardt (1976)**, **Evans *et al.* (1978)**, **Kizyakov and Krotinov (1986)**, **El-Sherbieny *et al.* (1988)** and **Riad *et al.* (1995)** indicated that the application of animal manure markedly increased N content in maize kernels. On the other hand, **Abd El-Hameed (1997)** found that the application of 25 m^3 FYM/fed had no significant effect on crude protein in grain.

18.4. Interaction effects

The results in Table (21) showed that interactions between the three experimental factors had no significant effects on N% in kernels indicating the independence of these factors in affecting this trait.

Table 21: Effect of N, P and FYM levels and their interactions on **N% in kernels** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	1.31	1.65	1.72	1.56	1.30	1.22	1.25	1.26	1.31	1.44	1.49	1.41
	45	1.38	1.78	1.78	1.65	1.22	1.24	1.46	1.31	1.30	1.51	1.62	1.48
	90	1.39	1.76	1.86	1.67	1.40	1.55	1.43	1.46	1.40	1.66	1.65	1.57
	135	1.72	1.82	1.85	1.80	1.53	1.46	1.44	1.48	1.63	1.64	1.65	1.64
	Mean	1.45	1.75	1.80	1.67	1.36	1.37	1.40	1.38	1.41	1.56	1.60	1.53
30	0	1.56	1.70	1.74	1.67	1.18	1.35	1.40	1.31	1.37	1.53	1.57	1.49
	45	1.44	1.73	1.91	1.69	1.24	1.22	1.29	1.25	1.34	1.48	1.60	1.47
	90	1.72	1.77	1.74	1.74	1.51	1.22	1.59	1.44	1.62	1.50	1.67	1.60
	135	1.70	1.87	1.91	1.83	1.48	1.43	1.63	1.51	1.59	1.65	1.77	1.67
	Mean	1.61	1.77	1.83	1.73	1.35	1.31	1.48	1.38	1.48	1.54	1.66	1.56
N x FYM	0	1.44	1.68	1.73	1.62	1.24	1.29	1.33	1.29	1.34	1.49	1.53	1.46
	45	1.41	1.76	1.72	1.68	1.23	1.23	1.38	1.28	1.32	1.50	1.62	1.50
	90	1.56	1.77	1.80	1.66	1.46	1.39	1.51	1.50	1.51	1.58	1.66	1.58
	135	1.71	1.85	1.88	1.81	1.51	1.45	1.54	1.50	1.61	1.65	1.71	1.66
	Mean	1.53	1.77	1.78	1.69	1.36	1.34	1.44	1.38	1.45	1.56	1.63	1.55

L.S.D. at 5% for		1995	1996	Combined
	N	0.14	0.09	0.08
	P	NS	NS	NS
	FYM	0.12	NS	0.07
	N x P	NS	NS	NS
	N x FYM	NS	NS	NS
	P x FYM	NS	NS	NS
	N x P x FYM	NS	NS	NS

19. Phosphorus content in kernels

The effects of N, P and FYM levels and their interactions on P% in kernels in 1995 and 1996 seasons as well as their combined average are shown in Table (22).

19.1. Effect of N

The results in Table (22) showed that the increase in N level had no significant effects on P% kernels in both seasons and their combined average. The results showed slight increases in P% due to increasing N level, but these increases were far below the level of significance.

The present results are not in agreement with those reported by **Kranz (1949)**, **Jordan *et al.* (1950)**, **Kranz and Chandler (1951)**, **Leonce and Miller (1966)**, **Blair *et al.* (1970)**, **Rouf and Islam (1983)**, **El-Koumey (1993)** and **Shafshak *et al.* (1994)** who found that the increase in N level increased P% in maize kernels.

19.2. Effect of P

The results in Table (22) showed that applying P at 30 kg P_2O_5/fed did not induce a significant increase in P% in kernels compared with the check treatment. The very slight increases observed in P% due to applying P fertilizer were far below the level of significance.

The present result may be due to abundance of calcium carbonate in the soil in Nubaria which causes a rapid fixation of P and greatly reduce the availability of this element.

The results obtained by **Hillal *et al.* (1981)**, **Mahmoud *et al.* (1982)**, **Rouf and Islam (1983)** and **Diab *et al.* (1992)** showed that P application

Table 22: Effect of N, P and FYM levels and their interactions on **phosphorus percentage in kernels** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995 FYM levels(tons/fed) 0	20	40	Mean	1996 FYM levels(tons/fed) 0	20	40	Mean	Combined FYM levels(tons/fed) 0	20	40	Mean
0	0	0.49	0.53	0.55	0.52	0.35	0.41	0.38	0.38	0.42	0.47	0.47	0.45
	45	0.50	0.55	0.59	0.55	0.35	0.40	0.42	0.39	0.43	0.48	0.51	0.47
	90	0.52	0.67	0.52	0.57	0.35	0.43	0.41	0.40	0.44	0.55	0.47	0.49
	135	0.53	0.69	0.58	0.60	0.36	0.40	0.44	0.40	0.45	0.55	0.51	0.50
	Mean	0.51	0.61	0.56	0.56	0.35	0.41	0.41	0.39	0.44	0.51	0.49	0.48
30	0	0.57	0.50	0.59	0.55	0.37	0.38	0.45	0.40	0.47	0.44	0.52	0.48
	45	0.56	0.60	0.55	0.57	0.40	0.45	0.39	0.41	0.48	0.53	0.47	0.49
	90	0.53	0.58	0.63	0.58	0.37	0.42	0.46	0.42	0.45	0.50	0.55	0.50
	135	0.57	0.55	0.69	0.60	0.40	0.43	0.43	0.42	0.49	0.49	0.56	0.51
	Mean	0.56	0.56	0.62	0.58	0.39	0.42	0.43	0.41	0.47	0.49	0.53	0.50
N x FYM	0	0.53	0.52	0.57	0.54	0.36	0.40	0.42	0.39	0.45	0.46	0.50	0.47
	45	0.53	0.58	0.57	0.56	0.38	0.43	0.41	0.40	0.46	0.51	0.49	0.48
	90	0.53	0.63	0.58	0.58	0.36	0.43	0.44	0.41	0.45	0.53	0.51	0.50
	135	0.55	0.62	0.64	0.60	0.38	0.42	0.44	0.41	0.47	0.52	0.54	0.51
	Mean	0.54	0.59	0.59	0.57	0.37	0.42	0.42	0.40	0.46	0.50	0.51	0.49

L.S.D. at 5% for	1995	1996	Combined
N	NS	NS	NS
P	NS	NS	NS
FYM	NS	0.03	0.03
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

considerably increased P% in kernels and leaves and increased P uptake by plants.

19.3. Effect of FYM

The results in Table (22) showed that FYM increased P% in kernels and this increase reached the level of significance in the second season as well as in the combined average. It is also observed that both levels of the applied manure (20 and 40 tons/fed) showed about the same effect on P% in grain.

The results showed that applying 40 ton/fed FYM raised P% in grain from 0.54, 0.37 and 0.46% for the check treatment in 1995, 1996 and the combined average to 0.59, 0.42 and 0.51%, respectively. The effect of animal manure was higher than the effect of mineral fertilizer, which is mainly due to the greater content of P in the manure and also to the high content of organic matter in FYM which leads in turn to improve soil pH and reduces soil reaction, a condition which helps in the availability of P in the calcareous soil.

Similar results were also obtained by **Evan *et al.* (1978)** and **Saker (1985)** who found that application of FYM increased P% in grains.

19.4. Interaction effects

The results in Table (22) showed that all interactions between the experimental factors had no significant effects on P% in kernels.

20. Potassium content in kernels

The results of the effects of N, P and FYM levels and their interactions on K% in kernels in 1995 and 1996 seasons as well as their combined average are given in Table (23).

20.1. Effect of N

The increase in N level increased K% in kernels. The effect of N reached the level of significance in 1996 season as well as the combined average. The results showed that the highest N level (135 kg/fed) recorded the highest K% in kernels. Applying 135 kg N/fed recorded K% in kernels of 0.45, 0.58 and 0.50% in 1995, 1996 and the combined data, respectively, as against 0.40, 0.47 and 0.42% at the check treatment in the respective seasons.

It could be concluded that N increased K uptake by maize plants probably due to increasing root growth and enlarging the absorption area of maize plants by building a well developed root system.

The present results are in agreement with those obtained by **Shafshak *et al.* (1994a)**.

20.2. Effect of P

The results showed that applying P at 30 kg P_2O_5/fed had no significant effect on K% in kernels. Very slight increases were observed due to P application but these increases were below the level of significance.

The present results are mainly due to the presence of available K in the soil in quantities that are quite enough to supply the growing plants by their requirements.

Many investigators showed that maize plants did not show apparent response to P fertilization (**Eid, 1959**; **Kaddah and Abu-El-Ela, 1960**; **Shafshak, 1962**; **Amer *et al.*, 1964**; **Ainer, 1976** and **Mickail and Shalaby, 1979**).

Table 23: Effect of N, P and FYM levels and their interactions on **potassium percentage in kernels** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	0.32	0.35	0.36	0.34	0.41	0.50	0.49	0.47	0.37	0.42	0.43	0.41
	45	0.36	0.34	0.36	0.35	0.41	0.51	0.57	0.50	0.39	0.43	0.47	0.43
	90	0.38	0.41	0.41	0.40	0.56	0.51	0.48	0.52	0.47	0.46	0.45	0.46
	135	0.37	0.42	0.43	0.41	0.54	0.64	0.51	0.56	0.46	0.53	0.47	0.49
	Mean	0.36	0.38	0.39	0.38	0.48	0.54	0.51	0.51	0.42	0.46	0.45	0.45
30	0	0.36	0.41	0.43	0.40	0.47	0.48	0.44	0.46	0.42	0.45	0.44	0.43
	45	0.41	0.38	0.40	0.40	0.49	0.49	0.47	0.48	0.45	0.44	0.44	0.44
	90	0.44	0.44	0.43	0.44	0.54	0.54	0.47	0.52	0.49	0.49	0.45	0.48
	135	0.38	0.38	0.47	0.41	0.55	0.60	0.64	0.60	0.47	0.49	0.56	0.51
	Mean	0.40	0.40	0.43	0.41	0.51	0.53	0.51	0.52	0.47	0.47	0.47	0.47
N x FYM	0	0.34	0.38	0.40	0.37	0.44	0.49	0.47	0.47	0.39	0.44	0.44	0.42
	45	0.39	0.36	0.38	0.38	0.45	0.50	0.52	0.49	0.42	0.43	0.45	0.44
	90	0.41	0.43	0.42	0.42	0.55	0.53	0.48	0.52	0.48	0.48	0.45	0.47
	135	0.38	0.40	0.45	0.41	0.55	0.62	0.58	0.58	0.47	0.51	0.52	0.50
	Mean	0.38	0.39	0.41	0.40	0.50	0.54	0.51	0.52	0.44	0.47	0.46	0.46

L.S.D. at 5% for	1995	1996	Combined
N	NS	0.05	0.03
P	NS	NS	NS
FYM	NS	NS	NS
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

20.3. Effect of FYM

The results in Table (23) showed that no significant effect was detected due to applying FYM at 20 or 40 ton/fed in 1995, 1996 and their combined average on K% in kernels.

The results showed increases in K% in kernels due to FYM application. Applying 40 ton/fed FYM recorded K% in kernels of 0.41, 0.51 and 0.46% in 1995, 1996 and the combined average, respectively as against 0.38, 0.40 and 0.44% for the control treatment in the same seasons.

It could be concluded that under the conditions of the experiment, FYM did not apparently affect K% in grains.

The results reported by **Evans *et al.* (1978)** indicated increases in N, P and K contents in stover and grains of maize due to animal manure application,.

20.4. Interaction effects

The results in Table (23) indicated that all effects of the interactions between N, P and FYM levels had no significant effects on K% in maize kernels.

21. Crude protein content in kernels

The results of the effects of N, P and FYM levels and their interactions on protein content in grain in 1995, 1996 seasons as well as their combined average are presented in Table (24).

21.1. Effect of N

The results in Table (24) showed that the increase in N level significantly increased protein content in grains in both seasons and their combined average.

The highest N level produced the highest protein content in both seasons. Applying N at 135 kg/fed produced protein % of 11.33, 9.39 and 10.37% in 1995, 1996 and the combined average, respectively compared with 10.10, 8.103 and 9.06% for the check treatment in the respective seasons.

The present results are mainly due to the effect of N in increasing N% in grains as well as in leaves. Similar results were also obtained by **El-Hattab *et al.* (1980), Ali (1983), Sarhan (1985), El-Kholany and Abdel-Aziz (1986), Gheith *et al.* (1986), Kamel *et al.* (1986), El-Agamy *et al.* (1987), Salem (1987), Gouda (1989), Shafshak *et al.* (1994a)** and **Abd El-Hameed (1997)**.

21.2. Effect of P

The results showed that P application did not significantly affect protein % in grain in both seasons. Slight increases in protein content were observed in the first season but these increases were below the level of significance. Applying P at 30 kg P_2O_5/fed produced protein % of 10.83, 8.63 and 9.73 in 1995, 1996 and the combined average, respectively, as against 10.44, 8.62 and 9.53% for the check treatment in the respective seasons. It could be concluded that P slightly improved protein % in grain.

Results reported by **Rouf and Islam (1983)**, showed that P application increased P and N uptake. Also, **Ahmed *et al.* (1992)** showed that P fertilization increased N recovery in case of FYM application. They concluded that the response of maize plants to N increased in presence of P.

21.3. Effect of FYM

Application of FYM positively affected protein content in grain. The effect of manure reached the level of significance in the first season as well as in the combined average (Table 24).

The increase in protein content was significant by applying both levels of manure (20 and 40 ton/fed), and the highest values were recorded by the higher level.

Applying FYM at 40 ton/fed produced protein content in kernels being 11.35, 9.01 and 10.18% in 1995, 1996 and the combined average, respectively compared with 9.55, 8.49 and 9.02% for the check treatment in the same seasons. The present results are expected since FYM significantly increased N content in grains as shown in Table (21).

The present results are in agreement with those obtained by **Evans *et al.* (1978), El-Kobbia *et al.* (1979), Fouda and Sharaf (1982), El-Sherbiney *et al.* (1988)** and **Khalil (1992)** who found that animal manure application increased N content in grains. Also **Reiad *et al.* (1995)** found that organic manure at a rate of 30 or 40 m^3/fed increased the percentage and amount produced of crude protein. On the other hand, **Abd El-Hameed (1997)** showed that no significant effect was observed on crude protein in maize grains when FYM was applied at 25 m^3/fed in both seasons of the study.

21.4. Interaction effects

The results in Table (24) revealed that all interactions between the three experimental factors did not significantly affect crude protein % in kernels in both seasons and the combined average.

Table 24: Effect of N, P and FYM levels and their interactions on **protein percentage in kernels** in 1995 and 1996 seasons and their combined data.

P levels kg/fed	N levels kg/fed	1995				1996				Combined			
		FYM levels(tons/fed)				FYM levels(tons/fed)				FYM levels(tons/fed)			
		0	20	40	Mean	0	20	40	Mean	0	20	40	Mean
0	0	8.19	10.31	10.75	9.75	8.13	7.63	7.81	7.86	8.16	8.97	9.28	8.81
	45	8.63	11.13	11.13	10.30	7.63	7.75	9.13	8.17	8.13	9.44	10.13	9.23
	90	8.69	11.00	11.63	10.44	8.75	9.69	8.94	9.13	8.72	10.35	10.29	9.79
	135	10.75	11.38	11.56	11.29	9.56	9.13	9.25	9.31	10.16	10.32	10.41	10.30
	Mean	9.07	10.96	11.27	10.44	8.52	8.55	8.78	8.62	8.79	9.77	10.03	9.53
30	0	9.75	10.63	10.88	10.42	7.38	8.44	8.75	8.19	8.57	9.54	9.82	9.31
	45	9.00	10.81	11.94	10.58	7.75	7.63	8.06	7.81	8.38	9.22	10.00	9.20
	90	10.75	11.06	10.88	10.90	9.44	7.63	9.94	9.00	10.10	9.35	10.41	9.95
	135	10.63	11.69	11.94	11.42	9.25	8.94	10.19	9.46	9.94	10.32	11.07	10.44
	Mean	10.03	11.05	11.41	10.83	8.46	8.16	9.24	8.63	9.25	9.61	10.33	9.73
N x FYM	0	8.97	10.47	10.85	10.10	7.76	8.03	8.28	8.03	8.37	9.26	9.55	9.06
	45	8.82	10.97	11.54	10.44	7.69	7.69	8.60	7.99	8.26	9.33	10.07	9.22
	90	9.72	11.03	11.26	10.67	9.10	8.66	9.44	9.07	9.41	9.85	10.35	9.87
	135	10.69	11.54	11.75	11.33	9.41	9.03	9.72	9.39	10.05	10.32	10.74	10.37
	Mean	9.55	11.00	11.35	10.63	8.49	8.35	9.01	8.62	9.02	9.69	10.18	9.63

L.S.D. at 5% for	1995	1996	Combined
N	0.85	0.59	0.47
P	NS	NS	NS
FYM	0.73	NS	0.40
N x P	NS	NS	NS
N x FYM	NS	NS	NS
P x FYM	NS	NS	NS
N x P x FYM	NS	NS	NS

22. Nitrogen uptake in grain

Nitrogen uptake was determined as affected by N and P levels. Data of FYM were excluded here due to the heterogeneity of the manure and the unavailability of most of its nutrient contents as a result of the slow release of the organic N. The results of N uptake in grains as affected by N and P levels in 1995 and 1996 seasons are given in Table (25).

22.1. Effect of N

The increase in N level markedly increased N uptake in both seasons and the combined average.

Applying N at 45, 90 and 135 kg/fed increased N uptake by 22.73, 34.83 and 50.40 kg/fed in 1995 season, respectively compared with the control level. These increases are relatively 119, 182 and 264% of the N uptake of the check treatment.

In 1996 season, the three N levels 45, 90 and 135 kg/fed increased N uptake over the check treatment by 12.54, 33.61 and 46.13 kg/fed, respectively. These increases correspond relative increases of 82.50, 221.12 and 303.49% of the N uptake of the zero N level.

The two seasons average indicated a marked increase in N uptake being 17.64, 34.64 and 48.27 kg N/fed due to applying 45, 90 and 135 kg N/fed compared with the zero N level. These increases are relatively 102.86, 201.98 and 281.46% over the control, respectively. The present results show clearly the need of maize plant to N when grown in a calcareous soil.

Similar results were also obtained by **Hamissa *et al.* (1979)**, **Youssef (1979)**, **Ahmed *et al.* (1992)** and **Shafshak *et al.* (1994b)** who found that N uptake markedly increased with the increase in N level.

Table 25: **Nitrogen uptake in grain (kg/fed)** as affected by N and P application in 1995 and 1996 seasons.

N kg/fed	1995			1996			Combined average		
	P_2O_5 (kg/fed)			P_2O_5 (kg/fed)			P_2O_5 (kg/fed)		
	0	30	Average	0	30	Average	0	30	Average
0	14.57	23.62	19.10	14.95	15.44	15.20	14.76	19.53	17.15
45	37.16	46.49	41.83	25.79	29.69	27.74	31.48	38.09	34.79
90	43.15	64.70	53.93	46.25	51.36	48.81	44.70	58.03	51.37
135	66.08	72.92	69.50	59.53	63.12	61.33	62.81	68.02	65.42
Mean	40.24	51.93	46.08	36.63	39.90	38.27	38.44	45.92	42.18

22.2. Effect of P

The results showed that P application increased N uptake in both seasons (Table 25). Applying P at 30 kg P_2O_5/fed increased N uptake by 29.05, 8.93 and 19.46% over the check treatment in 1995, 1996 and the combined average, respectively. The results indicated clearly that at all N levels from zero to 135 kg/fed, P application led to a considerable increase in N uptake. The present results indicate clearly the important role of P fertilization in calcareous soils at Nubaria.

Similar results were also obtained by **Youssef (1979)** who found that N uptake was significantly increased with N and P application. He stated that the addition of P increased the efficiency of roots to absorb N.

23. Nitrogen use efficiency

Results in Table (26) show the values of N use efficiency as affected by N and P application in 1995 and 1996 seasons.

23.1. Effect of N

The results showed that applying 45 kg N/fed produced the greatest N use efficiency in 1995 season (36.61 kg), while in 1996 season applying 90 kg N/fed recorded the highest efficiency, being 23.60 kg grain per one kg N. On the average of both seasons, 45 kg N/fed recorded the greatest N use efficiency, being 29.70 kg grain per one kg N. Applying the highest N levels, i.e. 135 kg N/fed recorded 20.39, 21.10 and 20.75 kg in 1995, 1996 and the combined average, respectively.

Table 26: **Nitrogen use efficiency (kg grain per one kg N)** as affected by N and P application in 1995 and 1996 seasons.

N kg/fed	1995			1996			Combined average		
	P_2O_5 (kg/fed)			P_2O_5 (kg/fed)			P_2O_5 (kg/fed)		
	0	30	Average	0	30	Average	0	30	Average
0	-	-	-	-	-	-	-	-	-
45	35.12	38.09	36.61	21.43	24.12	22.78	28.28	31.11	29.70
90	22.13	24.97	23.55	23.94	23.25	23.60	23.04	24.11	23.58
135	20.22	20.56	20.39	20.30	21.89	21.10	20.26	21.23	20.75
Mean	25.82	27.87	26.89	21.89	23.09	22.49	23.86	25.48	24.68

The present results indicate a great N use efficiency by applying the highest N level showing the importance of applying a high N level in calcareous soil for producing a high grain yield of maize.

The results obtained by **Moll *et al.* (1982)** showed that N use efficiency in maize ranged between 20 and 32 kg grain per kg soil-N, when applied at 225 kg N/ha. **Anderson *et al.* (1984)** reported that N use efficiency decreased when N fertilizer increased, while **Shafshak *et al.* (1994a)** showed that N use efficiency markedly increased due to the increase in N level.

23.2. Effect of P

The results in Table (26) indicated that P application at 30 kg P_2O_5/fed increased N use efficiency in both seasons. Application of P raised N use efficiency by 7.94, 5.48 and 6.79% in 1995, 1996 and combined average, respectively. The present results indicate the importance of P application in Nubaria calcareous soil.

The results reported by **Ahmed *et al.* (1992)** showed that application of P increased the efficiency of various forms of N and increased N recovery.

24. Nitrogen recovery (NRC)

The results in Table (27) show the effect of N and P levels of N recovery in 1995 and 1996 seasons.

24.1. Effect of N

The results indicated that the highest recovery percentage was recorded by applying 45 kg N/fed in 1995 season, while in 1996 the application of 90 kg N/fed recorded the highest recovery %, being 50.51 and 37.35% in 1995 and 1996, respectively.

Table 27: **Apparent nitrogen recovery (%)** as affected by N and P application in 1995 and 1996 seasons.

N kg/fed	1995			1996			Combined average		
	P_2O_5 (kg/fed)			P_2O_5 (kg/fed)			P_2O_5 (kg/fed)		
	0	30	Average	0	30	Average	0	30	Average
0	-	-	-	-	-	-	-	-	-
45	50.20	50.82	50.51	24.09	31.67	27.88	37.15	41.25	39.20
90	31.76	45.41	38.59	34.78	39.91	37.35	33.27	42.66	37.97
135	38.16	36.52	37.34	33.02	35.32	34.17	35.59	35.92	35.76
Mean	40.04	44.25	42.15	30.63	35.63	33.13	35.34	39.94	37.64

On the average of both seasons, applying 45, 90 and 135 kg N/fed recorded apparent recovery % of 39.20, 37.97 and 35.76%.. This result indicates generally that the recovery % decreased with the increase in N level on the average of both seasons.

The results reported by **Mahgoub (1987)** indicated that N recovery tended to decrease as fertilizer N increased but the differences between N rates were not significant. On the other hand, **Shafshak *et al.* (1994a)** found that N recovery was increased as the N level increased from 80 to 105 and 130 kg/fed. They recorded N recovery % of 16.73, 19.85 and 25.97 for the N levels 80, 105 and 130 kg/fed, respectively on the average of 1991 and 1992 seasons.

24.2. Effect of P

The results in Table (27) showed that P application at 30 kg P_2O_5/fed markedly increased N recovery in both seasons. The increase in N recovery was 10.51, 16.32 and 13.02% in 1995, 1996 and the combined average, respectively.

It could be concluded that P increased N recovery % considerably in calcareous soil at Nubaria.

The present results agree with those obtained by **Ahmed *et al.* (1992)** who found that the application of 45 kg P_2O_5/fed combined with the different forms of N increased N recovery.

V. SUMMARY

Two field experiments were conducted at Nubaria Research Station, Agricultural Research Center, Egypt, during 1995 and 1996 seasons to study the effects of four N levels (0, 35, 90 and 135 kg/fed), two P levels (0 and 30 kg P_2O_5/fed) and three FYM levels (O, 20 and 40 ton/fed)on the growth, grain yield and its components, and chemical contents of leaves and kernels of S.C. 122.

The soil type was calcareous and sandy clay loam in texture with a $CaCO_3$ of about 23%.

A spilt-split plot design with four replications was used, the main plots were devoted for FYM levels, the sub-plot for P levels and the sub-sub-plots for the N levels. Sub-sub-plot area was 21 m² (1/300 fed). Planting was done on 19 and 21 June in 1995 and 1996, respectively. The preceding crop was wheat in both seasons. Harvest was undertaken on 20 October in both seasons. The results of the experiments could be summarized as follows:

I. Effect of N levels

1. The increase in N level from zero to 45, 90 and 135 kg/fed significantly increased plant height, ear height, area of the topmost ear leaf, number of ears/plant, ear length, ear diameter, ear weight, number of rows/ear (in the first season), number of kernels/row, weight of 100 kernels, shelling percentage and grain yield/fed. The highest value of these traits were generally recorded at the highest N level.