4. RESULTS AND DISCUSSIONS

4.1 Peanut growth as affected by seed inoculation and application of N and Ca:

4.1.1 Main effects on peanut growth:

4.1.1.1 Peanut growth as affected by seed inoculation (Inc.):

Results in Table (2) and illustrated in Fig (1, 2 and 3) reveal that seed inoculation (Inc.) significantly decreased the dry weight of peanut plant shoots at 50 days after sowing (DAS) while significant increase in this characteristic was recorded at 95 DAS. The increasing effect was significant for plant roots only at the 1st sample (50 DAS). As for plant height and No. of branches per plant recorded after 95 days from sowing, the obtained increase was insignificant for the 1st characteristic (plant height) but was significant with the No. of branches per plant.

The promotive effect due to seed inoculation on growth parameters of peanut was reported by many investigators, such as, Singh and Ahuja (1985), Lee (1990) and Shaheen and Rahmatulah (1994) who concluded that both peanut growth and nitrogen fixation were significantly increased by inoculation.

4.1.1.2 Peanut growth as affected by Ca application:

With respect to Ca treatments, the foliar application of Ca chelate combined with the low rate of gypsum (500 kg $Fed.^{-1}$), failed to lead to further significant improvement in any of the tested growth parameters (Table 2) and Figs. (1,2 and 3). Moreover, the foliar Ca chelate application significantly reduced the growth yield parameters; weight of

Table (2): Effect of seed inoculation and application of N and Ca on peanut growth.

Treatments	Sampling date					
	* 50 D.A.S		95 D.A.S			
	Root dry weight (g/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant)	Shoot dry weight (g/plant)	Plant height (cm)	No of branches/ plant
Non-inoculation	1.160	17.870	3.071	40.930	33.951	29.746
Inoculation	1.460	17.163	3.117	46.636	34.007	32.831
L.S.D	**0.025**	**0.494**	**N.S**	**2.532**	**N.S**	**0.934**
Calcium application:						
Ca1	1.009	18.863	3.045	50.855	35.500	32.653
Ca1 + F	—	—	3.263	41.397	32.764	31.186
Ca2	1.094	16.975	3.107	44.060	36.486	30.633
Ca2 + F	—	—	2.960	38.821	31.167	30.681
L.S.D	**0.035**	**0.695**	**0.198**	**3.581**	**1.371**	**1.321**
N fertilization:						
15 kg N $Fed.^{-1}$	1.016	16.329	3.114	44.704	33.104	30.754
30 kg N $Fed.^{-1}$	1.051	17.450	3.031	46.139	34.344	29.938
45 kg N $Fed.^{-1}$	1.025	18.770	3.137	40.507	34.490	33.173
L.S.D	**N.S**	**0.602**	**N.S**	**3.101**	**1.187**	**1.144**

Ca 1 : 500 Kg gypsum $Fed.^{-1}$, Ca 2 : 750 Kg gypsum $Fed.^{-1}$, F : Foliar Ca, * DAS: Days after sowing.

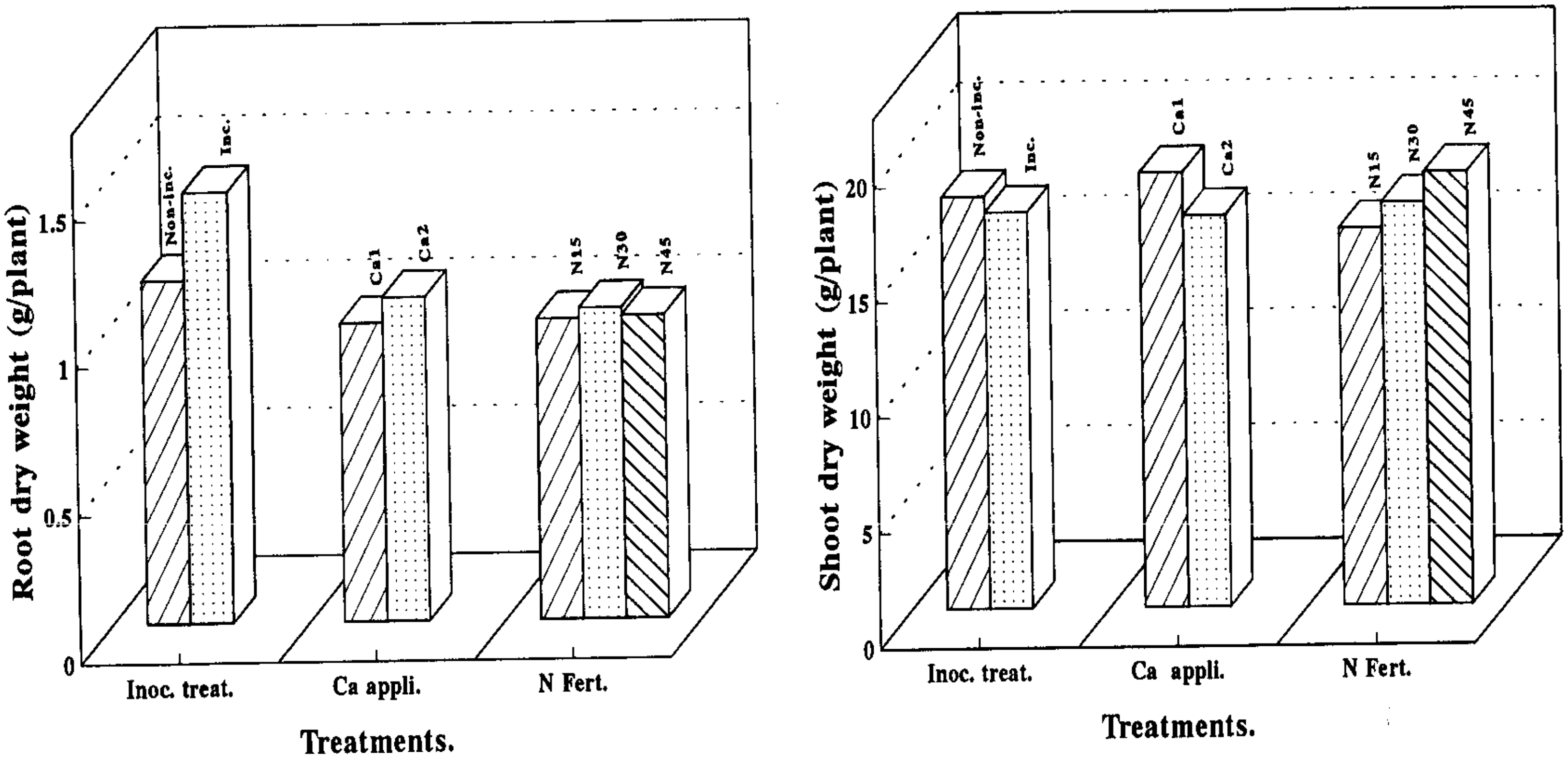


Fig.(1) : Effect of seed inoculation and application of N and Ca on root dry weight (g/plant) & shoot dry weight (g/plant) at 50 days after sowing.

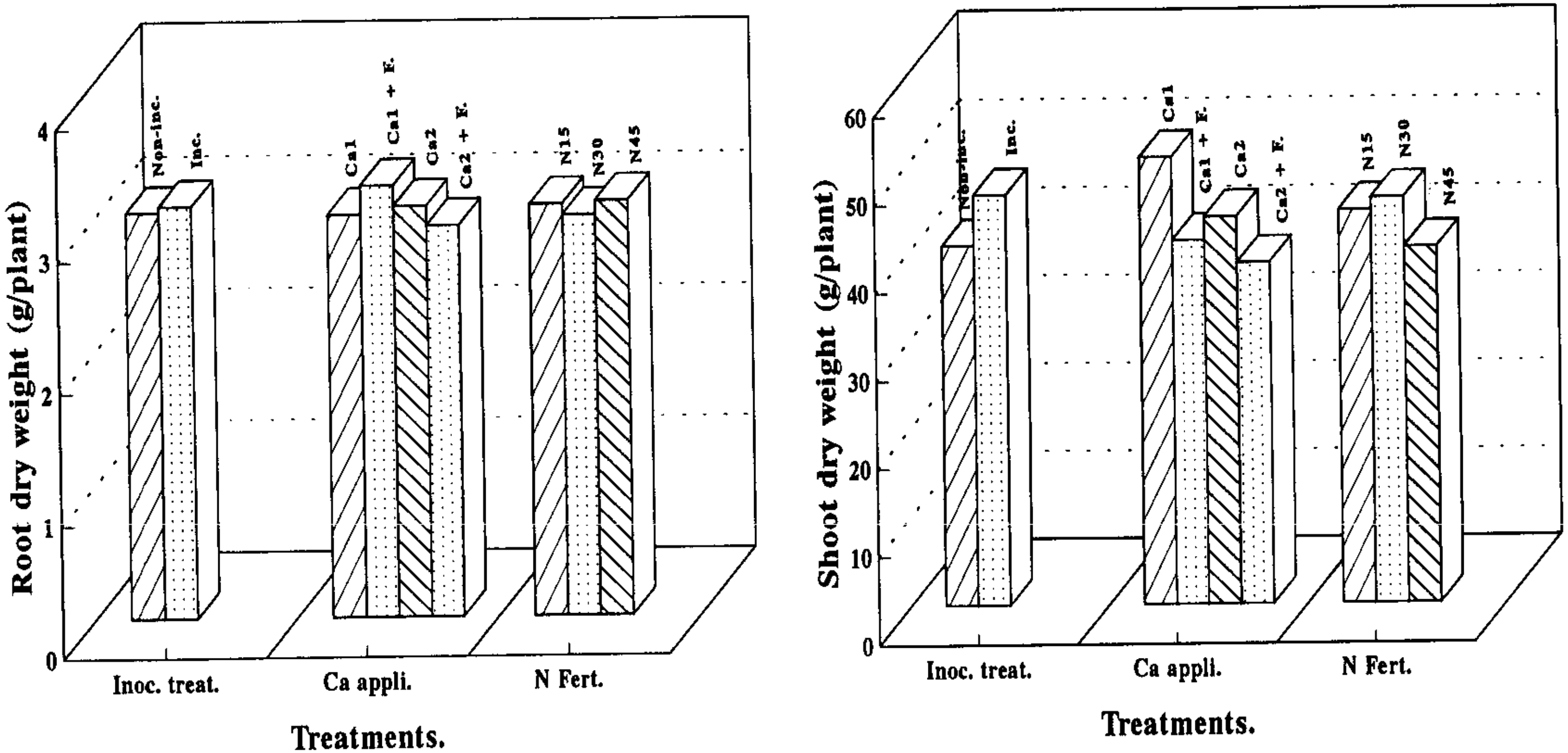


Fig.(2) : Effect of seed inoculation and application of N and Ca on root dry weight (g/plant) & shoot dry weight (g/plant) at 95 days after sowing.

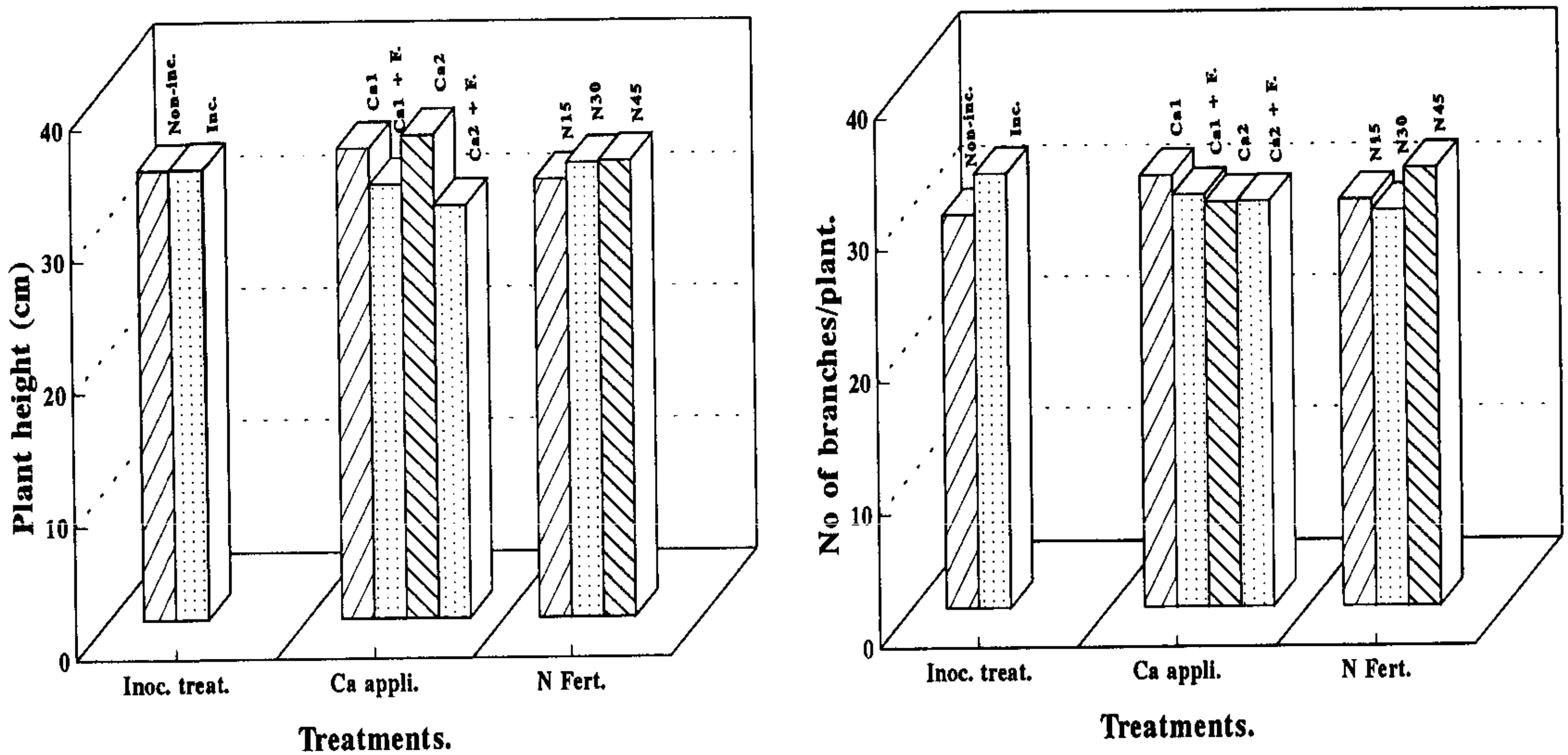


Fig.(3) : Effect of seed inoculation and application of N and Ca on plant height (cm) & number of branches/plant.

shoots, plant height and No. of branches per plant.

Increasing the rate of applied gypsum from 500 kg to 750 kg Fed.$^{-1}$, significantly increased the dry weight of plant root but a significantly decreased the dry weight of peanut shoots and also the No. of branches per plant. In this respect Nour El-Din et al. (1990) and Hassan (1994) reported negative effect on shoot weight of peanut due to calcium. However plant height was not significantly affected. Nour El-Din et al. (1990) reported similar results, while Hassan (1994) reported a negative effect on the plant height due to calcium.

Foliar Ca chelate application (in addition to gypsum soil application at the rate of 750 kg Fed.$^{-1}$) significantly increased only the weight of peanut shoots at the 50 DAS sample but significantly reduced all the other tested growth parameters; weight of shoots and also plant height at both growth periods. However, the No. of branches which was not significantly affected (Table 2).

4.1.1.3 Peanut growth as affected by N application:

Nitrogen fertilization did not affect significantly the dry weight of roots but significantly affected the dry weight of shoots which responded differently through the two tested growth stages as shown in Table (2) and Figs. (1, 2 and 3). Nor El-Din et al. (1990) reported a negative effect on shoot weight at different plant ages.

No significant differences in root weights could be were not obtained by increasing the N rate. However, the weights of plant shoot were significantly and gradually increased by increasing the N rate at 50 DAS, but at 95 DAS the maximum increase was obtained by the N rate of

30 kg N only then declined with the N rates of 45 kg N $Fed.^{-1}$.

Increasing the rate of applied N from 15 to 45 kg N $Fed.^{-1}$ significantly increased the plant height and the number of branches per plant at both tested dates (50 and 95 DAS). However the 30 kg N rate showed intermediate values that did not differ significantly from the highest rate or the lowest one with respect to plant height or No. of branches, respectively. Similar results were reported by Mohsen (1968) and Nour El-Din et al. (1990).

4.1.2 Peanut growth as affected by the interactions of involved treatments:

4.1.2.1 Effects of seed inoculation and Ca application interaction:

Results in Table (3) show a significant adverse effect on dry weight of peanut roots due to inoculation along with gypsum application at the higher rate (750)/kg Fed^{-1}, and foliar Ca application as compared with the other treatments of inoculation combined with Ca application.

Noteworthy observing that the highest dry weight of peanut roots was achieved with the higher level of gypsum (750 kg $Fed.^{-1}$) in absence of inoculation. However, the other treatments which included inoculation except for the 750 kg gypsum Fed^{-1} + F treatment, did not differ significantly from that treatment.

Results of peanut root dry weights at the 95 DAS growth interval did not show any significant interactions.

The dry weight of peanut shoots at both growth stages (50 & 95 DAS) reveal a significant superiority due to gypsum application at the

Table (3): Effect of the interaction between seed inoculation and Ca application on peanut growth parameters.

Treatments		Sampling date					
Inoculation treatment	Ca application	* 50 D.A.S		95 D.A.S			
		Root dry weight (g/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant)	Shoot dry weight (g/plant)	Plant height (cm)	No of branches/ plant
Non-inoculation	Ca 1	0.991	20.871	2.937	58.507	34.694	32.722
	Ca 1 + F	0.946	16.465	3.356	40.189	32.000	29.611
	Ca 2	1.118	16.526	3.059	36.026	36.889	28.150
	Ca 2 + F	1.008	17.619	2.931	33.994	32.222	28.500
Inoculation	Ca 1	1.028	16.856	3.153	43.203	36.306	32.583
	Ca 1 + F	1.078	16.486	3.169	42.606	33.528	34.222
	Ca 2	1.069	17.424	3.155	52.094	36.083	31.656
	Ca 2 + F	1.009	17.884	2.989	43.648	30.111	32.861
L.S.D.		0.050	0.982	N.S	5.064	1.939	1.868

Table (4): Effect of the interaction between seed inoculation and N-fertilization on peanut growth. parameters.

Treatments		Sampling date					
Inoculation treatment	N. levels (Kg Fed.$^{-1}$)	50 D.A.S		95 D.A.S			
		Root dry weight (g/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant)	Shoot dry weight (g/plant)	Plant height (cm)	No of branches/ plant
Non-inoculation	15	0.983	17.052	2.983	43.394	32.313	30.104
	30	0.998	17.458	2.995	46.385	34.542	29.342
	45	1.066	19.100	3.235	36.757	35.000	29.792
Inoculation	15	1.050	15.605	3.244	46.013	33.896	31.404
	30	1.105	17.443	3.067	45.893	34.146	30.533
	45	0.984	18.440	3.039	44.257	33.979	36.554
L.S.D.		0.043	N.S	0.242	4.386	N.S	1.618

Table (5): Effect of the interaction between Ca application and N fertilization on growth parameters.

Treatments		Sampling date					
Ca application	N. levels (Kg Fed.$^{-1}$)	50 D.A.S		95 D.A.S			
		Root dry weight (g/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant)	Shoot dry weight (g/plant)	Plant height (cm)	No of branches/ plant
Ca 1	15	0.868	16.508	3.038	51.414	35.250	30.625
Ca 1	30	1.038	19.384	3.061	69.366	36.750	34.042
Ca 1	45	1.123	20.697	3.037	31.785	34.500	33.292
Ca 1 + F	15	—	—	3.128	46.593	32.500	30.917
Ca 1 + F	30	—	—	3.256	32.877	31.000	28.892
Ca 1 + F	45	—	—	3.404	44.722	34.792	33.750
Ca 2	15	1.103	16.060	3.067	35.933	33.667	29.042
Ca 2	30	1.158	17.355	2.752	48.557	38.250	27.500
Ca 2	45	1.021	17.510	3.503	47.689	37.542	35.358
Ca 2 + F	15	—	—	3.222	44.873	31.000	32.433
Ca 2 + F	30	—	—	3.056	33.758	31.375	29.317
Ca 2 + F	45	—	—	2.603	37.832	31.125	30.292
L.S.D.		0.060	1.702	0.343	6.203	2.375	2.288

Ca 1 : 500 Kg gypsum Fed.$^{-1}$, Ca 2 : 750 Kg gypsum Fed.$^{-1}$, F : Foliar Ca, * DAS: Days after sowing.

lower rate (500 kg Fed.$^{-1}$) in absence of inoculation.

The highest peanut plants were yielded with the higher rate of gypsum (750 kg Fed.$^{-1}$) in absence of inoculation and without foliar Ca application. However both levels of gypsum in case of inoculation and in absence of foliar Ca application did not differ significantly from the above mentioned treatment.

As for the number of branches per plant, it was noticed that in the absence of inoculation, the highest branch number, was achieved with the lower level of gypsum (500 kg Fed.$^{-1}$). Increasing the rate of applied gypsum as well as giving excess doze of foliar Ca, significantly reduced the number of branches per plant.

In the presence of inoculation, all the other treatments showed significantly higher positive effects on number of branches per plant, except to the treatment of gypsum application at the higher level (750 kg Fed.$^{-1}$) that significantly reduced the number of branches per plant,

4.1.2.2 Seed inoculation interaction with N fertilization:

Results in Table (4) reveal that the highest N level (45 kg N Fed.$^{-1}$) without inoculation or the medium N rate (30 kg N Fed.$^{-1}$) in the presence of inoculation produced the highest dry weight of peanut roots at 50 DAS. At the 2nd date of sampling (95 DAS) no significant differences could be detected among all the tested treatments, except the first two levels of N fertilization without inoculation which were significantly less effective on the dry weight of peanut roots. Dry weight of peanut shoots did not show any significant variation at both growth stages except for the 45 kg N level in the absence of inoculation at 95 DAS which showed the least value. While plant height did not responded significantly to the tested treatments, the highest number of branches per plant were achieved with the highest N rate combined with inoculation.

4.1.2.3 Ca application interaction with N fertilization:

Concerning the interaction of Ca application with N levels, the results in Table (5) show that the highest values of dry weight of peanut shoots at 50 DAS were due to Ca soil application at the lower rate (500 kg $Fed.^{-1}$) combined with N fertilization at 30 and 45 kg $Fed.^{-1}$ without Ca foliar application. After 95 days from sowing, the positive effect on shoot dry weight due to the lower treatment of Ca (500 kg gypsum $Fed.^{-1}$) combined with 30 kg N $Fed.^{-1}$ in the absence of foliar Ca application was far higher than all the other tested treatment. Values of peanut plant height positively and responded to the combination of 750 kg gypsum with either 30 or 45 kg N $Fed.^{-1}$ and the combination of 500 kg gypsum with 30 kg N $Fed.^{-1}$, which were more effective than the other treatments.

The number of branches per plant due to this interaction was in the following order of Ca2 + N45 > Ca1 + N30 > Ca1 + FCa + N45 > Ca1 + N45 according to their positive effect.

According to these results it may be concluded that growth parameters in general tend to respond significantly to the combined treatments of N at the medium rate (N30) and soil Ca application at the 1st rate (500 kg gypsum $Fed.^{-1}$) or (N45) combined with higher Ca rate without foliar Ca application in both cases.

4.1.2.4 Effect of inoculation x Ca application x N fertilization interaction on growth parameters:

The studied growth characteristics of peanut plant was significantly affected by inoculation, Ca application and N fertilization interaction except the plant height at 95 day after sowing (DAS) as shown in Table (6).

4.2 The effect of seed inoculation and application of N and Ca on nutrient uptake by peanut plants:

4.2.1 Main effects on N, P and K uptake:

4.2.1.1 Uptake of N, P and K by peanut plants as influenced by seed inoculation:

Data recorded at the two different stages of growth indicat that the seed inoculation increased the uptake of all the tested nutrients at both sampling dates (50 and 95 DAS). This effect was significant in all cases, except for P uptake at the 95 DAS where this increase was not significant, (Table, 7) and Figs. (4 and 5). Similar results were reported by Abd El-Naim et al. (1976), Moawed et al. (1989), Adu and Misari (1990) and Lee et al. (1990).

4.2.1.2 The uptake of N, P and K by peanut plants as influenced by Ca application:

Data in Table (7) and Fig. (4) showed that increasing the Ca rate increased N uptake significantly at the two stages of growth. On the other direction, increasing Ca rate decreased significantly the P and K

Table (6): Effect of interaction among inoculation, Ca application and N fertilization on growth parameters.

Treatments			Sampling date					
Inoculation treatment	Ca application	N. levels (Kg Fed.$^{-1}$)	* 50 D.A.S		95 D.A.S			
			Root dry weight (g/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant)	Shoot dry weight (g/plant)	Plant height (cm)	No of branches/ plant
Non-inoculation	Ca 1	15	0.820	19.090	2.753	58.537	34.176	31.167
	Ca 1	30	0.917	19.738	2.985	61.875	36.167	33.667
	Ca 1	45	1.235	23.783	3.073	40.128	33.750	33.333
	Ca 1 + F	15	—	—	2.960	28.452	30.500	27.500
	Ca 1 + F	30	—	—	2.307	38.758	30.580	28.000
	Ca 1 + F	45	—	—	3.912	40.867	34.917	33.333
	Ca 2	15	1.045	17.827	3.095	49.286	32.000	31.333
	Ca 2	30	0.812	13.875	3.565	36.205	39.333	26.283
	Ca 2	45	0.980	17.693	3.408	35.075	39.333	26.833
	Ca 2 + F	15	—	—	3.123	37.302	32.583	30.417
	Ca 2 + F	30	—	—	3.123	33.722	32.083	29.417
	Ca 2 + F	45	—	—	2.547	30.958	32.000	25.667
Inoculation	Ca 1	15	0.915	13.927	3.322	44.292	36.333	30.083
	Ca 1	30	1.158	19.030	3.137	76.857	37.333	34.417
	Ca 1	45	1.012	17.612	3.000	23.442	35.250	33.250
	Ca 1 + F	15	—	—	3.173	43.415	34.500	30.583
	Ca 1 + F	30	—	—	3.197	58.355	31.417	27.000
	Ca 1 + F	45	—	—	3.095	54.512	34.667	37.383
	Ca 2	15	1.150	15.780	3.162	43.900	35.333	30.500
	Ca 2	30	0.988	15.880	2.947	29.548	37.167	31.500
	Ca 2	45	1.095	17.798	3.400	54.368	35.750	40.667
	Ca 2 + F	15	—	—	3.320	52.445	29.417	34.450
	Ca 2 + F	30	—	—	2.988	33.795	30.667	29.217
	Ca 2 + F	45	—	—	2.660	44.705	30.250	34.917
L.S.D.			**0.085**	**1.694**	**0.482**	**8.728**	**N.S**	**3.220**

Ca1 : 500 Kg gypsum Fed.$^{-1}$, Ca2 : 750 Kg gypsum Fed.$^{-1}$, F : Foliar Ca, * DAS: Days after sowing.

Table (7): Effect of seed inoculation and application of N and Ca on N, P and K uptake by peanut plants (mg/plant).

Treatments	Sampling date					
	* 50 D.A.S			95 D.A.S		
	N	P	K	N	P	K
Non-inoculation	306	48	269	961	178	869
Inoculation	349	52	290	1178	182	916
L.S.D	**12**	**2**	**3**	**23**	**N.S**	**14**
Calcium application:						
Ca1	310	54	293	969	196	999
Ca1 + F	---	---	---	978	186	931
Ca2	337	46	266	1126	177	839
Ca2 + F	---	---	---	1205	162	753
L.S.D	**17**	**2**	**5**	**32**	**11**	**20**
N fertilization:						
15 kg N $Fed.^{-1}$	315	48	259	1043	172	891
30 kg N $Fed.^{-1}$	313	51	280	1020	184	880
45 kg N $Fed.^{-1}$	355	51	300	1146	184	906
L.S.D	**15**	**2**	**4**	**28**	**10**	**17**

Ca 1 : 500 Kg gypsum $Fed.^{-1}$, Ca 2 : 750 Kg gypsum $Fed.^{-1}$, F : Foliar Ca, * DAS: Days after sowing.

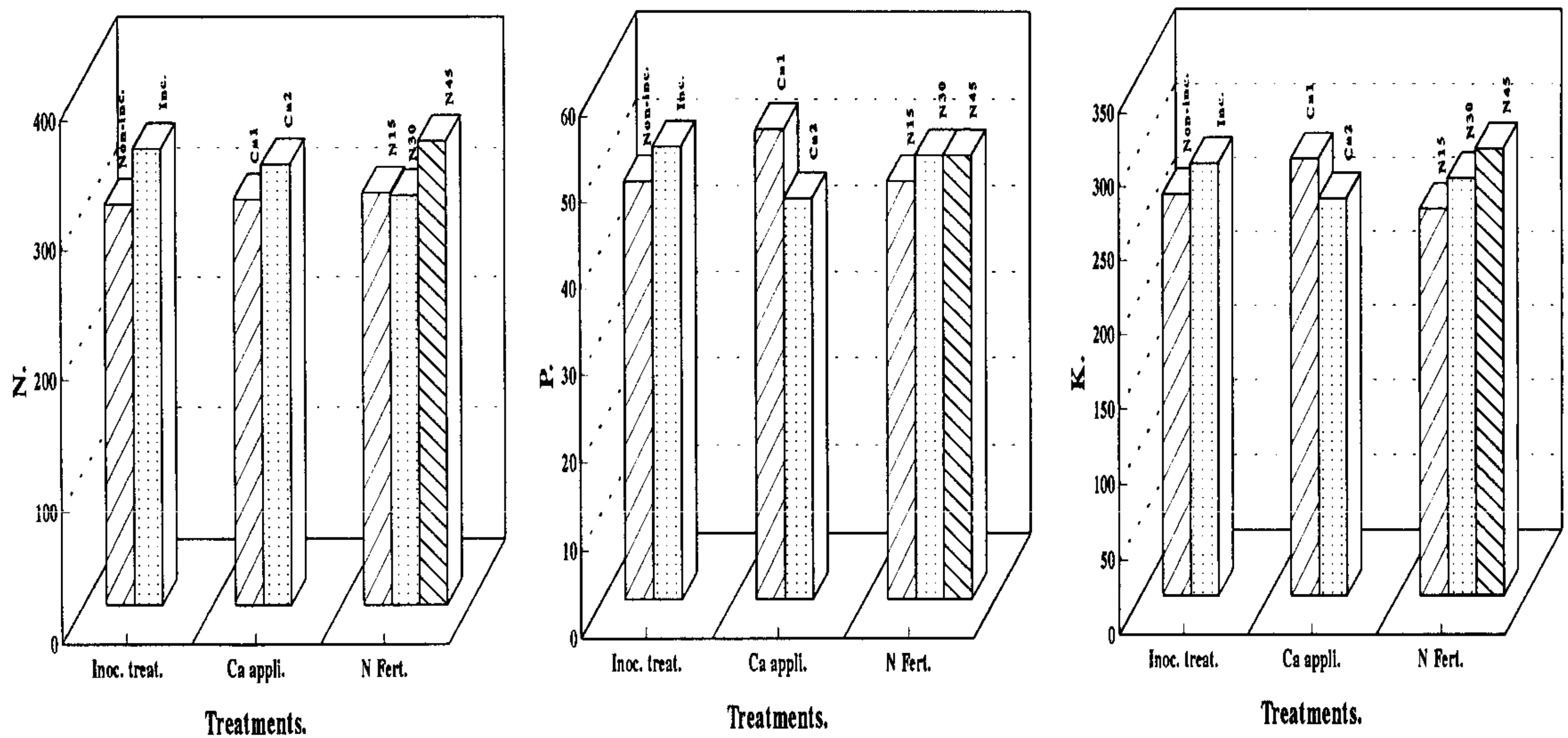


Fig.(4) : Effect of seed inoculation and application of N and Ca on N, P and K uptake (mg/plant) at 50 days after sowing.

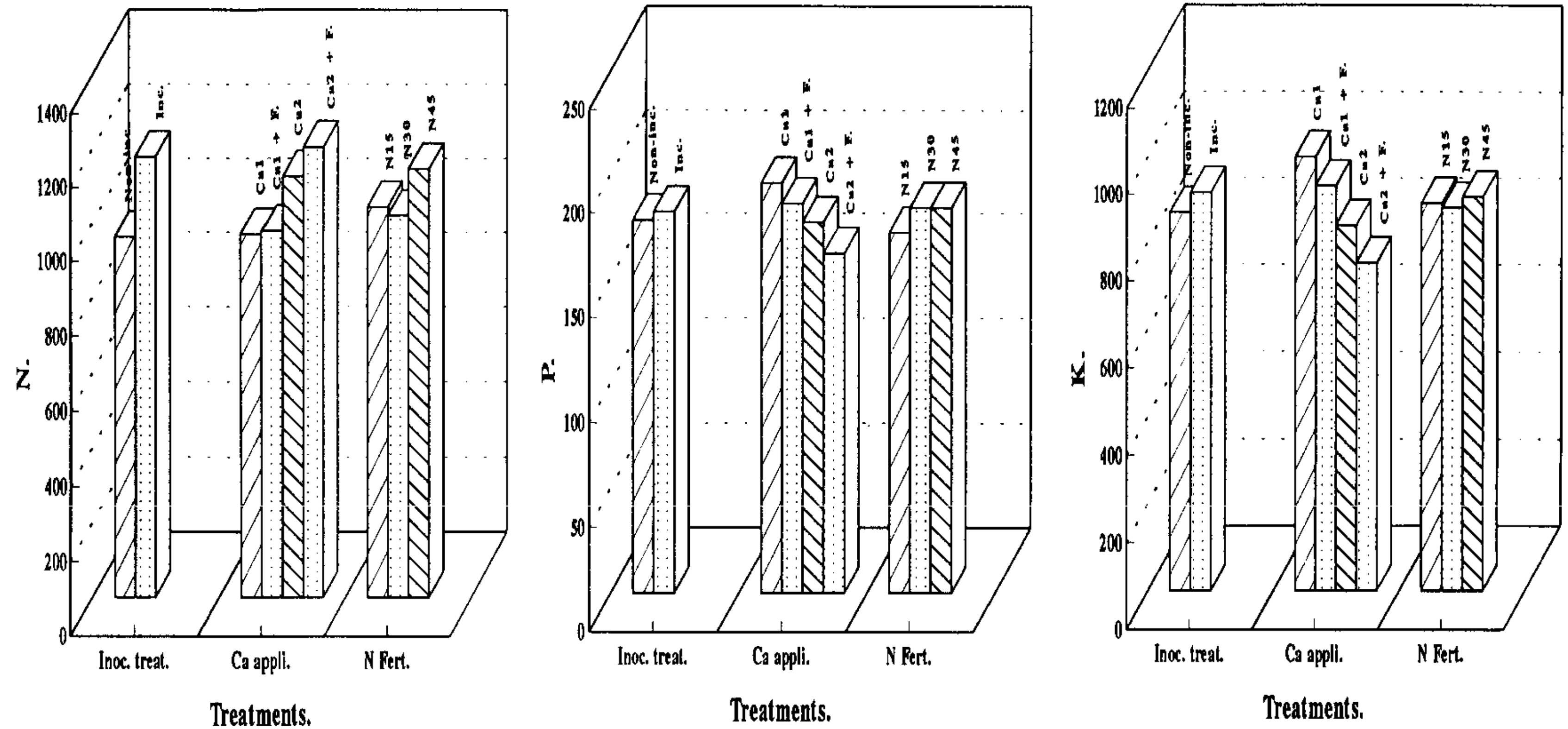


Fig.(5) : Effect of seed inoculation and application of N and Ca on N, P and K uptake (mg/plant) at 95 days after sowing.

uptake. This could be explained on the basis of the antagonism effects of Ca on P and K uptake. These results are in a good line with those reported by Bulasubramanian and Yayock (1981) and Sudhir et al. 91987), however Choi and Ryu (1991) found that gypsum application had no effect on uptake of N, P and K by peanut plants.

4.2.1.3 The effect of N application on uptake of N, P and K by peanut plants:

Regarding the effect of N fertilization, results indicate that uptake of N and K increased with the increasing of N rate at all growth stages, while P uptake was increased by increasing N rate up to 30 kg only at both growth stages (Table 7) and Figs. (4 and 5). Similar results were obtained by Ramesh et al. (1984), Angadi et al. (1989), Bhatol et al. (1994) and Yakadri and Satyanarayana (1995).

4.2.2 The N, P and K uptake by peanut plants as affected by interactions of involved treatments:

4.2.2.1 Effects of seed inoculation and Ca application interaction:

Data in Table (8) indicate that seed inoculation along with 750 kg gypsum $Fed.^{-1}$ + foliar Ca, recorded the highest N uptake after 50 days from sowing, while the inoculated seeds under 750 kg gypsum $Fed.^{-1}$ without foliar Ca gave the highest N uptake at 95 DAS.

Concerning the P uptake by peanut plants, it could be generally observed that seed inoculation under the different Ca treatments, increased P uptake at 50 DAS and addition of foliar Ca with the two

Table (8): Effect of the interaction between seed inoculation and Ca application on uptake of N, P and K by peanut plants.

Treatments		Sampling date					
Inoculation treatment	Ca application	* 50 D.A.S			95 D.A.S		
		N (mg/plant)	P (mg/plant)	K (mg/plant)	N (mg/plant)	P (mg/plant)	K (mg/plant)
Non-inoculation	Ca 1	383	46	307	759	210	1158
	Ca 1 + F	---	---	---	917	176	787
	Ca 2	366	42	256	857	172	888
	Ca 2 + F	---	---	---	1322	154	642
Inoculation	Ca 1	337	52	280	1183	181	839
	Ca 1 + F	---	---	---	1046	178	1074
	Ca 2	307	49	276	1390	200	791
	Ca 2 + F	---	---	---	1088	170	960
L.S.D.		**24**	**3**	**6**	**46**	**16**	**28**

Table (9): Effect of the interaction between seed inoculation and N fertilization on N, P and K uptake by peanut plants.

Treatments		Sampling date					
Inoculation treatment	N. levels (Kg Fed.$^{-1}$)	50 D.A.S			95 D.A.S		
		N (mg/plant)	P (mg/plant)	K (mg/plant)	N (mg/plant)	P (mg/plant)	K (mg/plant)
Non-inoculation	15	283	42	347	902	174	838
	30	307	50	365	953	176	891
	45	329	50	398	1029	185	878
Inoculation	15	347	53	275	1183	172	944
	30	318	51	195	1087	193	870
	45	382	51	202	1263	183	935
L.S.D.		**21.0**	**3.0**	**6.0**	**39.7**	**13.8**	**24.2**

Table (10): Effect of the interaction between Ca application and N fertilization on N, P and K uptake by peanut plants.

Treatments		Sampling date					
Ca application	N. levels (Kg Fed.$^{-1}$)	50 D.A.S			95 D.A.S		
		N (mg/plant)	P (mg/plant)	K (mg/plant)	N (mg/plant)	P (mg/plant)	K (mg/plant)
Ca 1	15	274	48	253	865	177	951
Ca 1	30	327	59	304	864	214	1237
Ca 1	45	329	55	323	1179	196	808
Ca 1 + F	15	—	---	---	924	187	928
Ca 1 + F	30	—	---	---	928	154	912
Ca 1 + F	45	—	—	---	1082	190	952
Ca 2	15	309	43	244	933	198	881
Ca 2	30	337	48	271	1218	171	667
Ca 2	45	364	45	282	1225	189	971
Ca 2 + F	15	—	—	—	1163	174	802
Ca 2 + F	30	—	—	---	1354	151	706
Ca 2 + F	45	—	---	—	1098	161	895
L.S.D.		**30**	**4**	**8**	**56**	**19**	**34**

Ca1: 500 Kg gypsum Fed.$^{-1}$. Ca2 : 750 Kg gypsum Fed.$^{-1}$. F : Foliar Ca, * DAS: Days after sowing.

gypsum rates recorded the highest P uptake. The same inoculation of seeds along with 500 kg gypsum $Fed.^{-1}$ reduced significantly the P uptake compared to the 500 kg gypsum $Fed.^{-1}$ in absence of inoculation at 95 DAS.

Potassium uptake by peanut plants at 50 DAS was also significantly and positively affected by seed inoculation under Ca application at the 1st level, especially with foliar Ca application at this growth stage. The highest values of potassium uptake were recorded with inoculation combined with gypsum (500 kg $Fed.^{-1}$) + F followed by gypsum in absence of inoculation and foliar Ca application. Meanwhile, foliar Ca showed significant positive effects on K uptake under seed inoculation at 95 DAS, the reverse was true in absence of inoculation.

4.2.2.2 The N, P and K uptake as affected by the interaction of seed inoculation and N-fertilization:

The results show that the N uptake of peanut samples at both growth stages (50 and 95 DAS), significantly increased by inoculation under the different N levels where the highest value of N uptake was achieved by seed inoculation combined with addition of 45 kg N $Fed.^{-1}$ (Table 9).

P uptake by peanut plants did not significantly respond to the interaction between inoculation and N-fertilization for except the treatments of inoculation combined with 15 kg N $Fed.^{-1}$ at 50 DAS or with 30 kg N after 95 day from sowing which gave significant increases in P uptake as compared with the non-inoculation treatments.

K uptake was also significantly and adversely affected by the interaction between inoculation and N-fertilization at 50 DAS where the maximum reduction occurred with the treatment of inoculation combined with 45 kg N. At 95 DAS almost opposite trend occurred where K uptake values were significantly increased due to combination of inoculation and N rates of 15 and 45 kg Fed.$^{-1}$, meanwhile, no significant difference could be detected with the N rate of 30 kg Fed.$^{-1}$.

4.2.2.3 The N, P and K uptake as affected by interaction between Ca and N:

It could be observed that the highest uptake of N was gained when peanut plants were supplied with the higher rate of Ca (750 kg gypsum Fed.$^{-1}$ + foliar Ca) under the highest rate of N (45 kg Fed.$^{-1}$) at the growth stage of 50 DAS and 30 kg N Fed.$^{-1}$ at 95 DAS (Table 10).

The Ca x N interaction also affected P uptake by peanut plants. The highest P uptake was recorded by application of 30 kg N and soil applied gypsum at the rate of 500 kg Fed.$^{-1}$ at both 50 and 95 DAS. It could be also generally noticed that both soil and foliar application of Ca tended to decrease P uptake by peanut plants under each level of applied N except for the lowest one (15 kg Fed.$^{-1}$) at the growth stage of 95 DAS.

The results showed that the highest uptake of K was obtained by applying the highest N rate (45 kg) under the lower rate of gypsum rate (500 kg Fed.$^{-1}$) either alone or combined with foliar Ca at 50 DAS. However this could be observed with the N rate of 30 kg Fed.$^{-1}$ under the lower gypsum rate (500 kg) in absence of foliar Ca application at 95 DAS.

4.2.2.4 The effect of inoculation, Ca application and N fertilization on N, P and K uptake by peanut plants:

The results in Table (11) show that the nutrient uptake by peanut plants was significantly effected by this interaction. It was also observed that P and K uptake was generally reduced by the higher gypsum rate under different N levels and the reduction was pronounced in the absence of seed inoculation.

4.3 Yield attributes of peanut:

4.3.1 Main effects on yield attributes of peanut:

4.3.1.1 Yield attributes as affected by seed inoculation:

Data in Table (12) and illustrated in Figs. (6, 7 and 8) reveal that the yield attributes, i.e., No. of branches, and weight of pods per plant were positively responded to inoculation as these parameters were significantly increased with inoculation compared with the control treatment (without inoculation). On the other hand, the other parameters, i.e., seed yield/plant, 100-pods weight and 100-seeds weight did not show significant variation due to the inoculation treatment.

4.3.1.2 Yield attributes as affected by Ca application:

Results in Table (12) and illustrated by Figs. (6, 7 and 8) show that raising gypsum rate from 500 to 750 kg $Fed.^{-1}$ did not yield further increases in the No. of branches and seed yield plant; however weight of 100 pods and weight of 100 seeds positively responded to the increasing rate of gypsum. On the other hand No. of pods and pod yield/plant were

Table (11): The interaction effect of inoculation, Ca application and N fertilization on N, P and K uptake.

Inoculation treatment	Ca application	N. levels (Kg Fed.$^{-1}$)	* 50 D.A.S N (mg/plant)	50 D.A.S P (mg/plant)	50 D.A.S K (mg/plant)	95 D.A.S N (mg/plant)	95 D.A.S P (mg/plant)	95 D.A.S K (mg/plant)
Non-inoculation	Ca 1	15	213	46	268	673	222	1055
	Ca 1	30	318	62	300	798	182	1400
	Ca 1	45	318	59	352	797	227	1018
	Ca 1 + F	15	---	---	---	917	160	810
	Ca 1 + F	30	---	---	---	812	173	767
	Ca 1 + F	45	---	---	---	1003	195	783
	Ca 2	15	320	37	228	808	157	915
	Ca 2	30	403	46	250	888	192	733
	Ca 2	45	375	45	289	873	168	1017
	Ca 2 + F	15	---	---	---	1210	155	570
	Ca 2 + F	30	---	---	---	1313	155	663
	Ca 2 + F	45	---	---	---	1443	152	693
Inoculation	Ca 1	15	335	50	237	1057	207	847
	Ca 1	30	325	55	309	930	172	1073
	Ca 1	45	340	51	292	1562	165	598
	Ca 1 + F	15	---	---	---	932	148	1047
	Ca 1 + F	30	---	---	---	1045	200	1057
	Ca 1 + F	45	---	---	---	1160	185	1120
	Ca 2	15	298	50	261	1628	185	847
	Ca 2	30	271	50	292	978	205	600
	Ca 2	45	353	45	274	1577	210	925
	Ca 2 + F	15	---	---	---	1115	147	1035
	Ca 2 + F	30	---	---	---	1395	193	748
	Ca 2 + F	45	---	---	---	753	170	1097
L.S.D.			41	6	11	79	27	48

Ca 1 : 500 Kg gypsum Fed.$^{-1}$, Ca 2 : 750 Kg gypsum Fed.$^{-1}$, F : Foliar Ca, * DAS: Days after sowing.

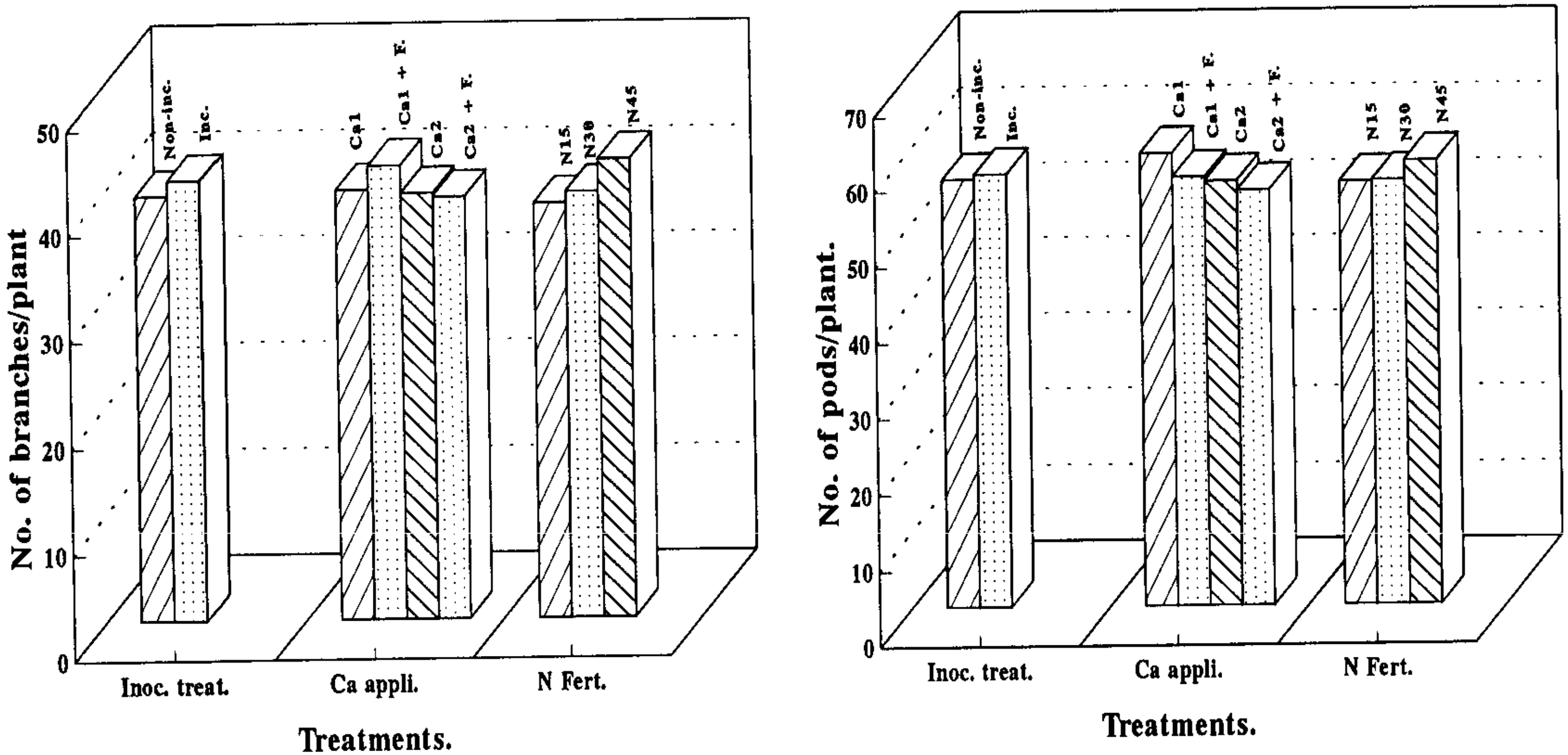


Fig.(6) : Effect of seed inoculation and application of Ca and N on No. of branches/plant & No. of pods/plant.

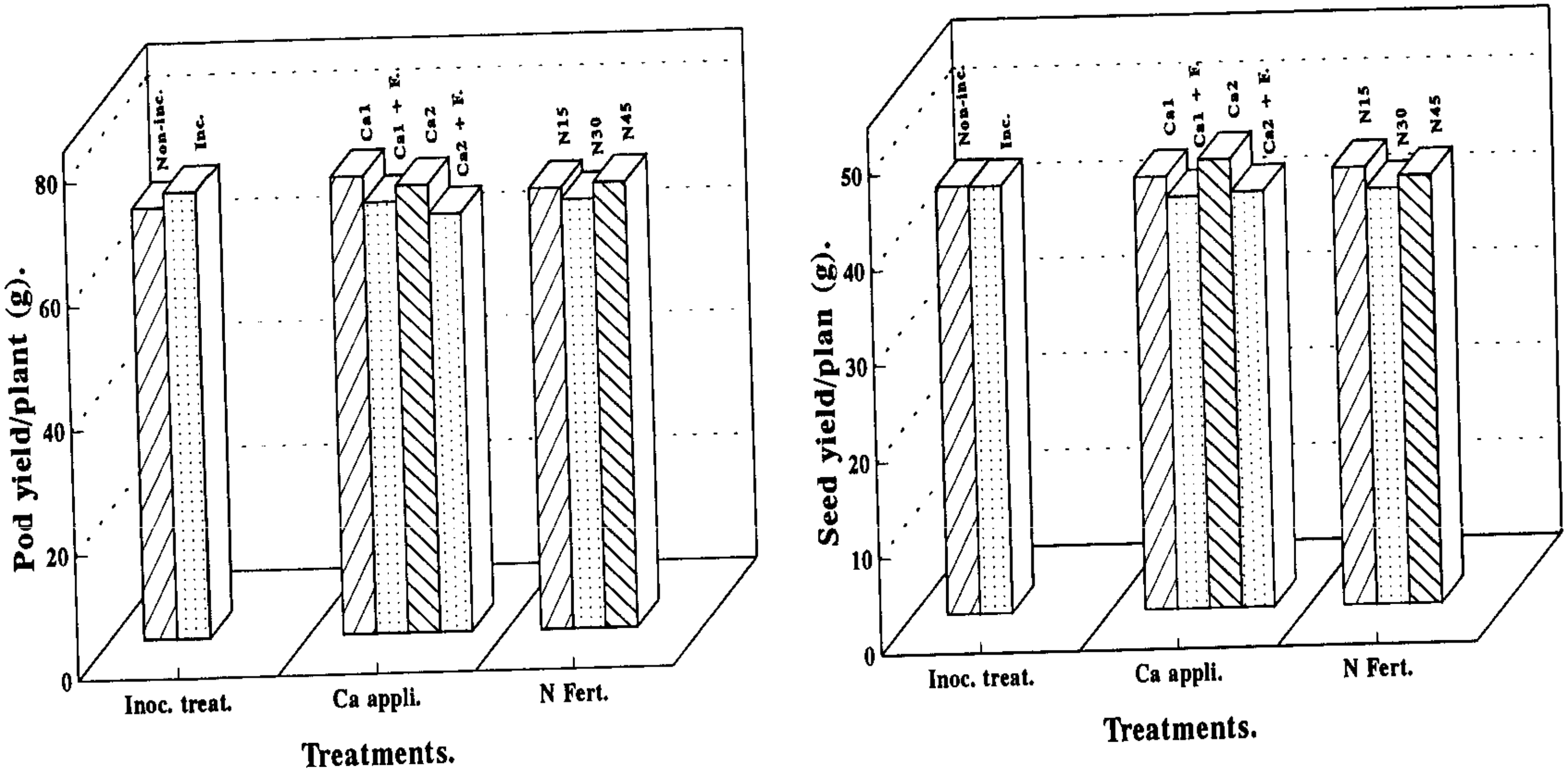


Fig.(7) : Effect of seed inoculation and application of Ca and N on pod yield/plant (g) & seed yield/plant (g).

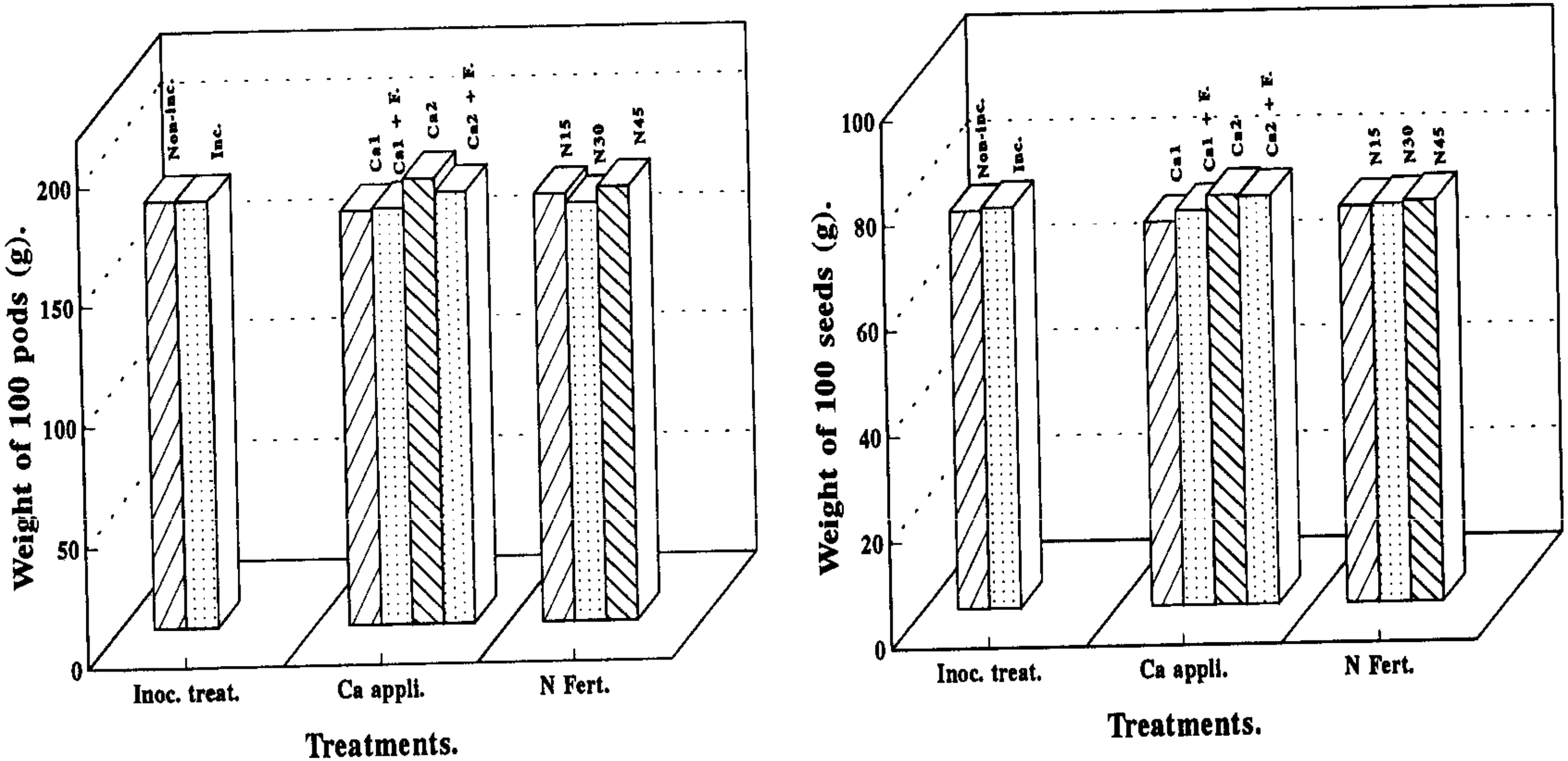


Fig.(8) : Effect of seed inoculation and application of Ca and N on weight of 100 pods (g) & weight of 100 seeds (g).

significantly decreased by increasing gypsum rate.

The foliar application treatment of Ca affected the tested yield parameters, quite differently. Foliar Ca application accompanied with soil application of gypsum at a rate of 500 kg $Fed.^{-1}$ yielded significant increase in the No. of branches and 100-seeds weight and reduced the other yield attributes but application of 750 kg gypsum combined with foliar Ca gave less yield attributes than gypsum only.

4.3.1.3 Yield attributes as affected by N-fertilization:

Data presented in Table (12) show that No. of branches and No. of pods/plant increased with increasing N rate. Concerning the influence of N levels on 100-seeds weight, the results were not significant by N levels, while raising N from 15 to 30 kg N $Fed.^{-1}$ decreased weight of pods/plant, weight of seeds/plant and weight of 100 pods. On the other hand the results show that there were no significant differences between 15 kg N $Fed.^{-1}$ and 45 kg N $Fed.^{-1}$.

4.3.2 Yield attributes as affected by interactions of involved treatments:

4.3.2.1 Interaction effects of seed inoculation and Ca application:

Results in Table (13) show that in absence of inoculation, increasing the rate of soil gypsum application from 500 to 750 kg gypsum $Fed.^{-1}$ reduced significantly the No. of branches, No. of pods, weight of pods per plant and weight of seeds per plant but increased significantly the weight of 100 pods. Meanwhile, the weight of 100 seeds was not

Table (13): Effect of the interaction between inoculation and Ca application on yield attributes.

Treatments: Inoculation treatment	Treatments: Ca application	No. of branches/ plant	No. of pods/ plant	Pod yield/plant (g)	Seed yield/plant (g)	Weight of 100 pods (g)	Weight of 100 seeds (g)
Non-inoculation	Ca 1	40.95	61.28	76.81	51.00	176.53	74.63
	Ca 1 + F	41.69	56.00	70.28	43.94	170.65	76.83
	Ca 2	39.28	54.48	69.29	43.85	185.82	73.95
	Ca 2 + F	38.19	54.26	61.28	39.83	177.00	75.82
Inoculation	Ca 1	40.01	58.30	70.54	39.32	168.03	70.72
	Ca 1 + F	43.84	57.25	68.64	42.12	175.65	75.65
	Ca 2	40.95	51.70	74.83	49.86	185.02	78.43
	Ca 2 + F	41.29	55.39	73.44	47.03	181.73	78.79
L.S.D.		1.91	4.36	1.20	1.14	6.11	2.35

Table (14):Effect of the interaction between seed inoculation and N-fertilization on yield attributes.

Treatments: Inoculation treatment	Treatments: N. levels (Kg Fed.$^{-1}$)	No. of branches/ plant	No. of pods/ plant	Pod yield/plant (g)	Seed yield/plant (g)	Weight of 100 pods (g)	Weight of 100 seeds (g)
Non-inoculation	15	35.76	52.26	67.85	43.77	176.29	75.99
	30	39.55	56.76	70.44	44.91	175.26	75.02
	45	41.58	60.49	69.95	45.29	181.43	74.91
Inoculation	15	42.33	59.50	74.19	47.56	179.63	74.31
	30	40.65	55.30	67.86	41.96	173.26	46.12
	45	44.77	56.69	73.54	44.22	179.92	77.26
L.S.D.		1.67	3.74	1.04	0.99	5.29	2.03

Table (15): Effect of the interaction between Ca application and N fertilization on yield attributes.

Treatments: Ca application	Treatments: N. levels (Kg Fed.$^{-1}$)	No. of branches/ plant	No. of pods/ plant	Pod yield/plant (g)	Seed yield/plant (g)	Weight of 100 pods (g)	Weight of 100 seeds (g)
Ca 1	15	40.08	62.78	78.48	48.33	176.23	71.72
Ca 1	30	38.44	60.09	70.05	43.66	170.51	73.02
Ca 1	45	42.91	59.51	72.50	43.48	170.07	73.28
Ca 1 + F	15	41.34	52.91	66.49	43.70	178.94	74.82
Ca 1 + F	30	42.48	54.78	70.76	40.56	167.24	74.97
Ca 1 + F	45	44.48	62.20	71.13	44.82	173.26	74.60
Ca 2	15	37.30	55.32	73.18	47.39	177.84	77.25
Ca 2	30	40.58	56.44	69.46	48.29	179.81	77.10
Ca 2	45	42.46	56.50	73.55	44.88	198.60	78.54
Ca 2 + F	15	37.41	52.51	65.94	43.23	178.84	76.82
Ca 2 + F	30	38.90	52.82	66.33	41.24	179.46	77.18
Ca 2 + F	45	42.85	56.55	69.81	45.83	180.78	77.92
L.S.D.		2.37	5.28	1.45	1.38	7.40	2.85

Ca 1 : 500 Kg gypsum Fed.$^{-1}$, Ca 2 : 750 Kg gypsum Fed.$^{-1}$, F : Foliar Ca.

significantly affected. Almost similar trend was obtained upon addition of foliar Ca along with gypsum as soil application. With seed inoculation, it is interested to observe that either increasing the rate of application Ca as gypsum or its foliar application, significantly increased the growth parameters; pod yield/plant, seed yield/plant and the weight of 100-pod and weight of 100 seeds. Both treatments significantly or insignificantly reduced the No. of branches and the No. of pods per plant.

4.3.2.2 Interaction effect of seed inoculation and N fertilization:

In absence of inoculation, increasing the rate of N applied up to 30 or 45 kg N $Fed.^{-1}$ significantly increased all the tested growth attributes except for the weight of 100 seeds since no significant differences occurred with the different N rates (Table 14).

In presence of inoculation, increasing the rate of applied N significantly increased the No. of branches and the weight of 100 seeds but reduced the seed yield/plant, meanwhile no clear trend could be detected with the other tested parameters.

4.3.2.3 Ca x N interaction effect on yield attributes:

Data in Table (15) showed that application of different N levels under the lower gypsum rate combined with foliar Ca application gave favourable effect only on number of branches compared with other interactions. However, number of pods and pod yield/plant were promoted by N levels used along with the lower gypsum level (500 kg $Fed.^{-1}$) without foliar application of Ca. The other yield components, i.e.

seed yield/plant, 100-pods weight and 100-seeds weight were also improved with the higher gypsum level (750 kg $Fed.^{-1}$) under the same N levels. It is interesting to notice that foliar Ca application had slight effects on the underground characteristics under N levels may be because of its low mobility from shoot to roots of peanut. However soil Ca application along with N application induced positive effects on these underground characteristics, i.e. No. of pods/plant, pod yield/plant, seed yield/plant, 100-pods weight and 100-seeds weight. It could be generally concluded that application of 15 kg N $Fed.^{-1}$ combined with 500 kg gypsum $Fed.^{-1}$ recorded the highest yield attributes per plant as shown in Table (15).

4.3.2.4 The inoculation, Ca application and N fertilization interaction effect on yield attributes:

This interaction showed also significant effects on yield components (Table 16). It could be observed that seed inoculation and application of 15 kg N $Fed.^{-1}$ along with gypsum application at 500-750 kg $Fed.^{-1}$ ameliorate most yield components.

Table (16): Effect of interaction among inoculation, Ca application and N fertilization on yield attributes.

Inoculation treatment	Ca application	N. levels (Kg Fed.$^{-1}$)	No. of branches/ plant	No. of pods/ plant	Pod yield/plant (g)	Seed yield/plant (g)	Weight of 100 pods (g)	Weight of 100 seeds (g)
Non-inoculation	Ca 1	15	36.86	59.08	77.45	52.31	178.89	79.12
	Ca 1	30	39.28	63.58	80.25	52.89	174.98	73.82
	Ca 1	45	39.13	61.19	72.73	47.79	175.71	70.95
	Ca 1 + F	15	37.06	49.31	64.83	41.78	176.50	75.06
	Ca 1 + F	30	42.30	59.47	72.73	41.96	158.30	71.78
	Ca 1 + F	45	43.25	59.23	73.29	48.08	177.15	75.00
	Ca 2	15	34.49	50.71	67.19	38.90	172.53	75.65
	Ca 2	30	38.63	54.60	67.83	48.23	184.01	77.93
	Ca 2	45	40.19	58.11	72.86	44.44	200.91	76.90
	Ca 2 + F	15	34.64	49.95	61.95	42.08	177.26	73.90
	Ca 2 + F	30	37.99	49.40	60.96	36.56	183.74	76.82
	Ca 2 + F	45	43.76	63.44	60.91	40.86	171.96	76.75
Inoculation	Ca 1	15	43.29	66.49	79.50	44.34	173.58	64.33
	Ca 1	30	37.61	56.59	59.85	34.44	166.04	72.23
	Ca 1	45	46.70	51.84	72.28	39.18	164.43	75.61
	Ca 1 + F	15	45.63	56.51	68.15	45.63	181.39	74.85
	Ca 1 + F	30	42.65	50.09	68.80	39.15	176.19	78.15
	Ca 1 + F	45	45.71	65.16	68.96	41.58	169.37	74.21
	Ca 2	15	40.11	59.93	79.16	55.88	183.16	78.60
	Ca 2	30	42.54	58.28	71.10	48.35	175.61	76.54
	Ca 2	45	44.73	54.88	74.24	45.31	196.29	80.15
	Ca 2 + F	15	40.30	55.06	69.94	44.39	180.41	79.75
	Ca 2 + F	30	39.81	56.25	71.69	45.91	175.18	77.54
	Ca 2 + F	45	41.94	54.86	78.70	50.80	189.59	79.08
L.S.D.			3.346	7.546	2.077	1.970	10.580	4.068

Ca 1 : 500 Kg gypsum Fed.$^{-1}$, Ca 2 : 750 Kg gypsum Fed.$^{-1}$, F : Foliar Ca.

4.4 Peanut yield:

4.4.1 Main effect on peanut yield:

4.4.1.1 The effect of inoculation:

Results reveal that seed inoculation significantly increased pod yield, straw yield, oil yield and seed oil percentage, while seed yield was not significantly affected and shelling percentage was reduced significantly (Table 17). Positive effects of seed inoculation were also reported by Albrecht (1943), Alexander (1961), Singh and Ahuja (1985), Chand et al. (1993), Wankhede et al. (1993), Ram et al. (1993) and Pal (1986) on number of nodules and pod yield; Abd-El-Naim (1976) on seed yield and Rahman et al. (1992) and Mowad et al. (1989) on straw yield. In contrast, Lombardi and Lopes (1993) and Kier and Gupta (1993) reported negative effect on the seed yield and Adu and Misari (1990) on shelling percentage.

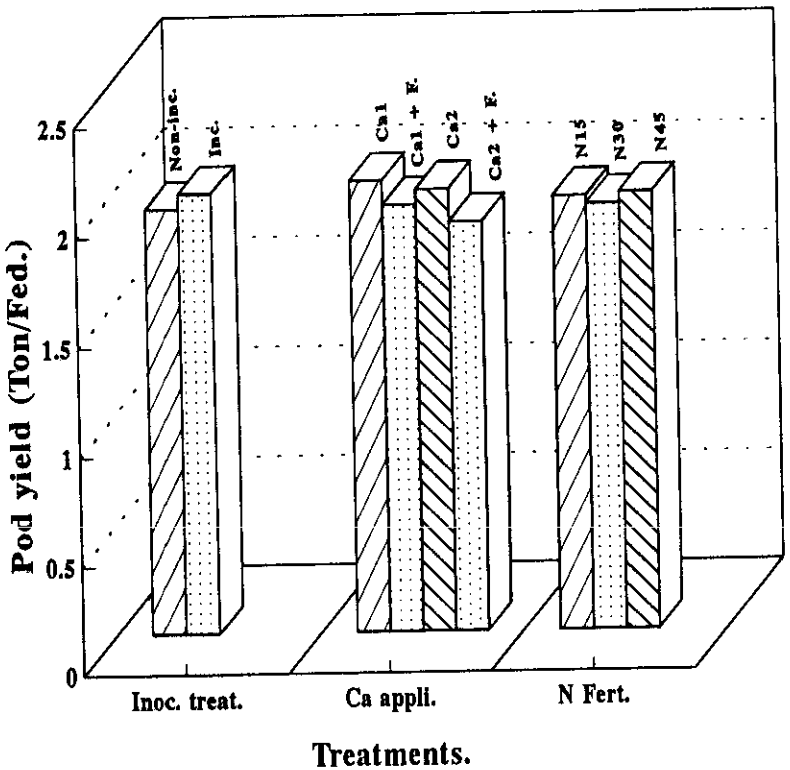
4.4.1.2 Calcium application effect:

Increasing gypsum rate from 500 to 750 kg Fed.$^{-1}$ caused significant increases in seed yield, oil yield and shelling percentage as shown in Table (17). This could be in part due to the key role of Ca in seed filling which in turn increased seed yield and shelling percentage. Meanwhile, increasing gypsum rate had no significant effect on oil percentage while pod yield and straw yield were significantly reducted due to raising gypsum rate. The reduction effect of raising gypsum on pod yield may be attributed to the decrease of shell weight since shilling percentage and seed yield were increased by gypsum application. Positive effects of calcium application were also reported by Shabassy et

Table (17): Effect of seed inoculation and application of Ca and N on peanut yield.

Treatments	Pod yield (Ton Fed.$^{-1}$)	Seed yield (Ton Fed.$^{-1}$)	Straw yield (Ton Fed.$^{-1}$)	Oil yield (Kg Fed.$^{-1}$)	Seed oil (%)	Shelling (%)
Non-inoculation	1.940	1.248	2.855	645.552	51.680	64.430
Inoculation	2.010	1.240	2.939	660.146	52.160	62.170
L.S.D	**0.024**	**N.S.**	**0.066**	**9.440**	**0.380**	**0.780**
Calcium application:						
Ca1	2.059	1.258	3.030	658.354	52.190	61.770
Ca1 + F	1.948	1.201	2.779	636.792	52.270	62.070
Ca2	2.017	1.308	2.887	683.708	52.280	64.790
Ca2 + F	1.868	1.207	2.890	632.542	50.940	64.560
L.S.D	**0.034**	**0.025**	**0.093**	**13.214**	**0.538**	**1.091**
N fertilization:						
15 kg N Fed.$^{-1}$	1.980	1.274	2.917	6.55.406	51.260	64.290
30 kg N Fed.$^{-1}$	1.944	1.212	2.898	633.766	51.820	63.000
45 kg N Fed.$^{-1}$	1.995	1.245	2.875	669.375	52.680	62.600
L.S.D	**0.029**	**0.021**	**N.S.**	**11.443**	**0.466**	**0.945**

Ca 1 : 500 Kg gypsum Fed.$^{-1}$, Ca 2 : 750 Kg gypsum Fed.$^{-1}$, F : Foliar Ca.



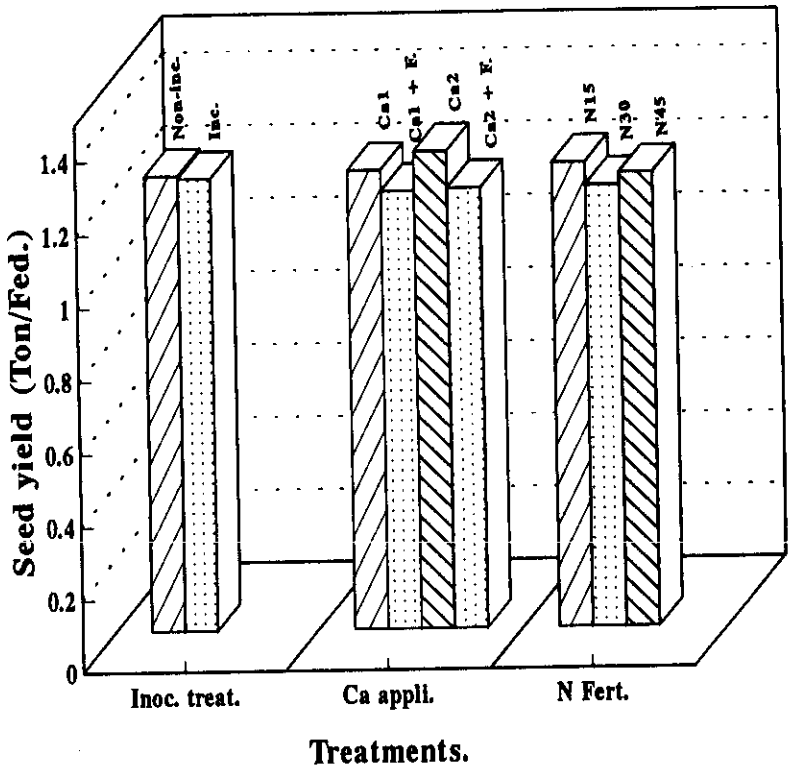


Fig.(9) : Effect of seed inoculation and application of N and Ca on pod yield (Ton/Fed.) & seed yield (Ton/Fed.)

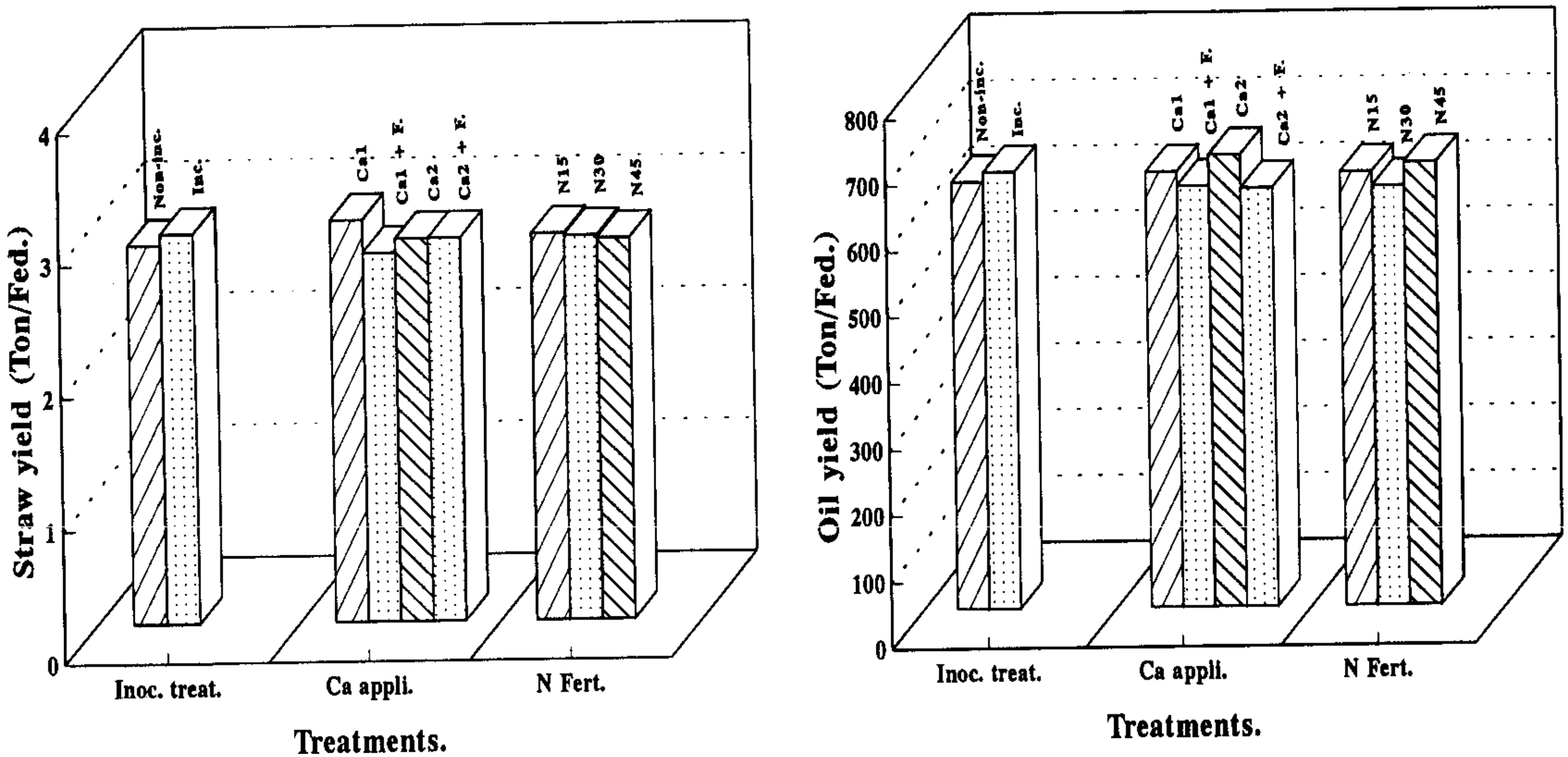


Fig.(10) : Effect of seed inoculation and application of N and Ca on straw yield (Ton/Fed.) & oil yield (Kg/Fed.).

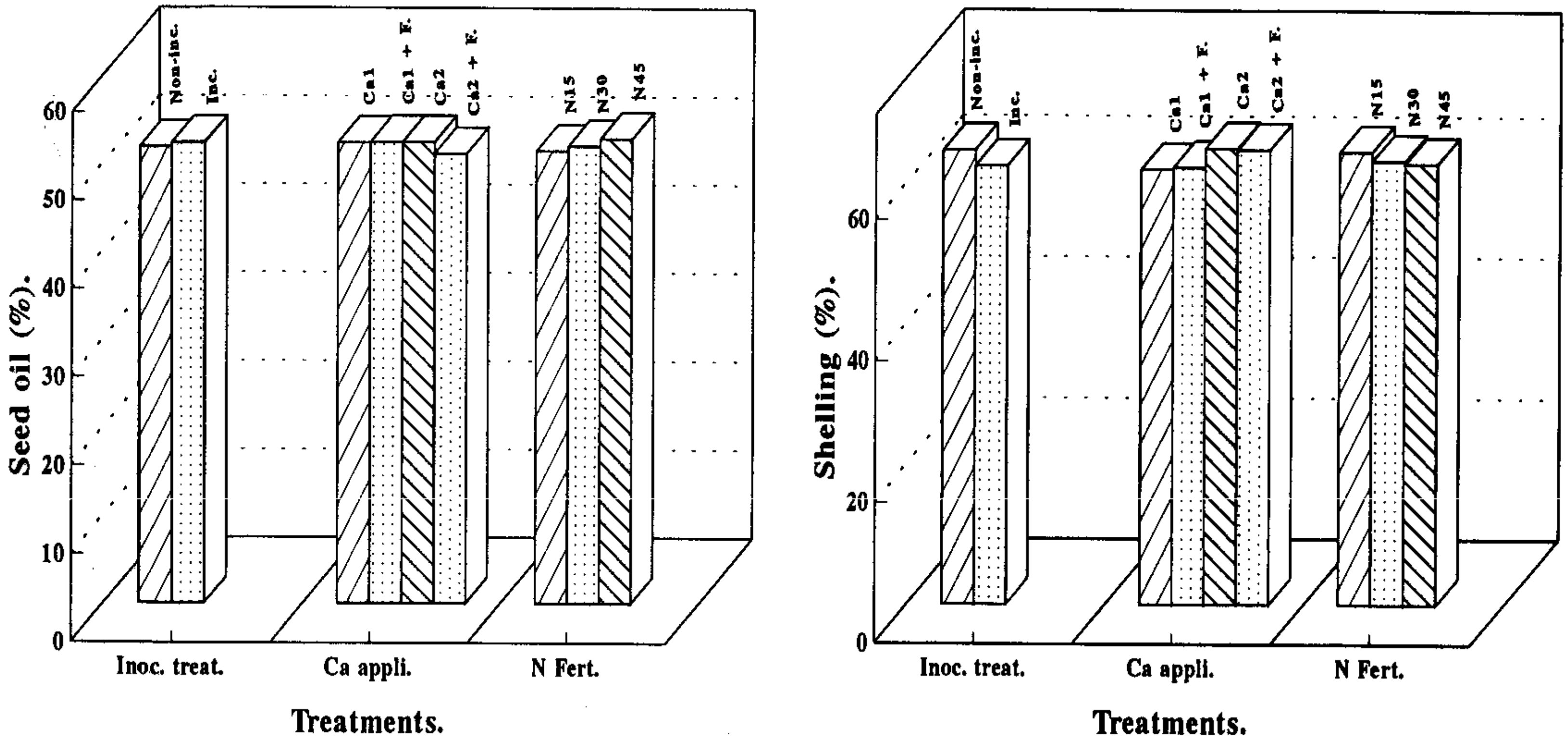


Fig.(11) : Effect of seed inoculation and application of N and Ca on seed oil (%) & shelling (%).

al. (1971), Varnel et al. (1977), Choi and Ryu (1991) and Loader et al. (1989) on seed yield; Mohsen (1968), Hassan (1994) and Das and Garnayak (1995) on oil yield; Mohsen (1968), El-Ahemer et al. (1987) and Das and Garnayak (1995) on shelling percentage. In contrast Abdel-Wahab et al. (1986) and Omer (1988) reported negative effect on shelling percentage and straw yield, Golwell et al. (1945) and Abdel-Motaleb (1983) on straw yield and Saad et al. (1989) on seed oil percentage. Sudhir et al. (1988) found that increase in calcium dose (1500 kg/ha) decreased the pod yield.

On the other hand foliar Ca application along with either the lower or higher gypsum level gave significant decreases in pod yield, seed yield, straw yield and oil yield (Table 17), but no clear trend could be detected with seed oil and shelling percentage. The reduction effect of foliar Ca application may be due to the excess Ca concentration in plant shoot caused by foliar Ca spraying which consequently affected negatively some other nutrient uptake especially P and K.

<u>4.4.1.3 Effect of N application:</u>

Pod yield, seed yield and oil percentage were found to be significantly decreased by increasing N rate from 15 to 30 kg $Fed.^{-1}$. This could be in part due to the inhibition of rhizobium activity by excess N.

It is noteworthy to notice that these parameters increased again to different extents by increasing N rate to 45 kg $Fed.^{-1}$. This may be due to the compensation of N which was supplied by rhizobia.

On the other hand, significant effects of N application on straw yield were not detected whereas seed oil percentage was increased significantly by increasing N rate which caused significant reduction in shelling percentage (Table 17).

4.4.2 Peanut yield as influenced by interactions of involved treatments:

4.4.2.1 Effect of inoculation x Ca interaction:

Data in Table (18) showed clearly that peanut seed inoculation had no beneficial effects on peanut yield, since application of 500 kg gypsum Fed.$^{-1}$ without inoculation yielded the highest peanut yield in terms of pod yield, seed yield, straw yield, oil yield and shelling percentage. However, oil percentage was better by seed inoculation under gypsum application particularly at the lower rate. Meanwhile, seed inoculation under the higher gypsum rate gave peanut yield approaching that of the lower gypsum rate without inoculation. This means that Ca may be consumed by the specific rhizobia for building their bodies.

4.4.2.2 Effect of inoculation x N interaction:

Although seed inoculation did not enhance peanut yield under Ca application, it was observed that seed inoculation combined with low N (15 kg Fed.$^{-1}$) application recorded the most favourable effects on peanut yield (Table, 19).

Table (18): Effect of the interaction between inoculation and Ca application on yield.

Treatments		Pod yield (Ton Fed.$^{-1}$)	Seed yield (Ton Fed.$^{-1}$)	Straw yield (Ton Fed.$^{-1}$)	Oil yield (Kg Fed.$^{-1}$)	Seed oil (%)	Shelling (%)
Inoculation treatment	Ca application						
Non-inoculation	Ca 1	2.143	1.417	3.029	734.292	51.750	66.420
	Ca 1 + F	1.975	1.231	2.645	640.625	51.930	62.900
	Ca 2	1.939	1.221	2.874	645.167	52.390	63.180
	Ca 2 + F	1.702	1.116	2.871	562.125	50.640	65.210
Inoculation	Ca 1	1.974	1.100	3.032	582.417	52.630	57.110
	Ca 1 + F	1.921	1.171	2.913	632.958	52.610	61.230
	Ca 2	1.095	1.389	2.900	722.250	52.180	66.400
	Ca 2 + F	2.034	1.299	2.910	702.958	51.240	63.920
L.S.D.		**0.048**	**0.035**	**0.133**	**18.880**	**0.770**	**1.560**

Table (19): Effect of the interaction between inoculation and Ca application on yield.

Treatments		Pod yield (Ton Fed.$^{-1}$)	Seed yield (Ton Fed.$^{-1}$)	Straw yield (Ton Fed.$^{-1}$)	Oil yield (Kg Fed.$^{-1}$)	Seed oil (%)	Shelling (%)
Inoculation treatment	N. levels (Kg Fed.$^{-1}$)						
Non-inoculation	15	1.884	1.226	2.690	606.406	50.000	64.380
	30	1.994	1.258	2.915	663.094	52.610	64.020
	45	1.942	1.260	2.952	667.156	52.420	64.880
Inoculation	15	2.076	1.322	3.136	704.406	52.520	64.210
	30	1.894	1.167	2.881	604.430	51.030	61.980
	45	2.048	1.231	2.799	671.594	52.940	60.310
L.S.D.		**0.042**	**0.031**	**0.115**	**16.348**	**0.660**	**1.350**

Table (20): Effect of the interaction between Ca application and N fertilization on yield.

Treatments		Pod yield (Ton Fed.$^{-1}$)	Seed yield (Ton Fed.$^{-1}$)	Straw yield (Ton Fed.$^{-1}$)	Oil yield (Kg Fed.$^{-1}$)	Seed oil (%)	Shelling (%)
Ca application	N. levels (Kg Fed.$^{-1}$)						
Ca 1	15	2.185	1.352	3.154	695.188	51.510	62.650
Ca 1	30	1.961	1.223	2.977	632.125	51.560	61.940
Ca 1	45	2.030	1.200	2.959	647.750	53.500	60.710
Ca 1 + F	15	1.862	1.212	2.824	618.938	51.530	65.160
Ca 1 + F	30	2.025	1.136	2.716	589.875	52.050	57.750
Ca 1 + F	45	1.957	1.256	2.798	701.563	53.230	63.290
Ca 2	15	2.047	1.336	2.993	683.875	51.530	64.090
Ca 2	30	1.944	1.332	2.853	700.563	52.510	69.710
Ca 2	45	2.059	1.256	2.815	666.688	52.800	60.570
Ca 2 + F	15	1.826	1.198	2.698	623.625	50.480	65.280
Ca 2 + F	30	1.845	1.154	3.044	612.500	51.150	62.610
Ca 2 + F	45	1.934	1.269	2.929	661.500	51.190	65.810
L.S.D.		**0.059**	**0.042**	**0.163**	**23.120**	**0.940**	**1.910**

Ca 1 : 500 Kg gypsum Fed.$^{-1}$. Ca 2 : 750 Kg gypsum Fed.$^{-1}$. F : Foliar Ca.

4.4.2.3 Effect of N fertilization x Ca application interaction:

Application of 500 kg gypsum Fed^{-1} combined with the lower N rate (15 kg N) achieved greater peanut yield in terms of pod yield, seed yield, straw yield and oil yield compared to other Ca x N interactions, while the higher N rate (45 kg N) along with low gypsum rate gave marked increases in seed oil percentage. Meanwhile, shelling percentage was significantly increased by application of the higher gypsum rate (750) along with 30 kg N $Fed.^{-1}$ compared to the other Ca x N interactions (Table, 20).

4.4.2.4 Effect of inoculation x Ca application x N fertilization interaction:

Significant effects of inoculation x Ca x N interaction on peanut yield were detected as shown in Table (21). Seed inoculation combined with 15 kg N $Fed.^{-1}$ under the low gypsum rate (500 kg $Fed.^{-1}$) with foliar Ca gave better peanut yield in terms of pod yield, seed yield, oil yield as well as shelling percentage, while the greatest straw yield was achieved by the same interaction without foliar Ca.

Table (21): Effect of interaction among inoculation, Ca application and N fertilization on peanut yield.

Treatments			Pod yield	Seed yield	Straw yield	Oil yield	Seed oil	Shelling
Inoculation treatment	Ca application	N. levels (Kg Fed.$^{-1}$)	(Ton Fed.$^{-1}$)	(Ton Fed.$^{-1}$)	(Ton Fed.$^{-1}$)	(Kg Fed.$^{-1}$)	(%)	(%)
Non-inoculation	Ca 1	15	2.146	1.465	2.725	735.630	50.720	67.650
	Ca 1	30	2.246	1.481	2.980	768.630	51.700	65.790
	Ca 1	45	2.036	1.304	3.193	698.630	52.840	65.830
	Ca 1 + F	15	1.880	1.087	3.270	551.120	50.460	58.000
	Ca 1 + F	30	1.897	1.350	2.754	723.750	53.550	71.340
	Ca 1 + F	45	2.040	1.245	2.675	660.630	53.160	60.190
	Ca 2	15	1.816	1.171	3.090	567.380	49.440	64.050
	Ca 2	30	2.124	1.175	2.759	625.000	53.400	58.530
	Ca 2	45	1.986	1.346	2.891	7.29.5	52.950	66.140
	Ca 2 + F	15	1.694	1.179	2.795	571.500	49.390	67.810
	Ca 2 + F	30	1.707	1.025	3.030	535.000	51.790	60.430
	Ca 2 + F	45	1.705	1.144	2.904	579.880	50.730	67.390
Inoculation	Ca 1	15	2.224	1.239	3.390	654.750	52.310	57.650
	Ca 1	30	1.675	0.965	2.975	495.630	51.420	58.090
	Ca 1	45	2.024	1.096	2.919	596.880	54.150	55.600
	Ca 1 + F	15	2.214	1.577	2.715	816.630	52.600	70.180
	Ca 1 + F	30	1.991	1.321	2.953	677.380	51.480	68.080
	Ca 1 + F	45	2.079	1.267	2.955	672.750	52.450	60.950
	Ca 2	15	1.908	1.252	2.557	670.500	53.610	66.260
	Ca 2	30	1.926	1.096	2.674	554.750	50.700	56.980
	Ca 2	45	1.929	1.165	2.705	673.630	53.510	60.450
	Ca 2 + F	15	1.957	1.217	2.600	675.750	51.570	62.740
	Ca 2 + F	30	1.982	1.284	3.059	690.000	50.510	64.790
	Ca 2 + F	45	2.162	1.395	2.955	743.130	51.650	64.230
L.S.D.			0.083	0.061	0.230	32.700	1.330	2.700

Ca 1 : 500 Kg gypsum Fed.$^{-1}$, Ca 2 : 750 Kg gypsum Fed.$^{-1}$, F : Foliar Ca.