

Effects of Pre-sowing Treatments of Calcium Chloride and Phosphorus Fertilization on the Growth, Yield and Oil Content of Groundnut

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Abstract

A field experiment was conducted to evaluate the effects of pre-sowing treatment of calcium chloride and phosphorus fertilization individually and combinely on the yield, oil content and physico-chemical properties of groundnut. This experiment consists of three pre-sowing treatments of calcium chloride solution (0%, 0.15%, 0.25%, 0.50%) and four doses of phosphorus (0, 30, 45, 60, 75 kg/ha) with control. Pod yield of groundnut found 2.25 t/ha was maximum at 0.50% calcium chloride pre-sowing treatment. The number of pods/plant (26.86) as well as, weight of 100 seeds (88.49) found significantly increased by applying 75 kg P_2O_5 / hectare when compared to the control. From the interaction of pre-sowing and fertilizer treatments, ie, 0.50% pre-sowing of calcium chloride (T_3) with 75 kg P_2O_5 / hectare (P_4) produced significantly increased of pod yield (2.54 t / ha) and oil content (47.25%) of groundnut. Responses of pre-sowing and fertilization treatments on physico-chemical properties of groundnut oil such as refractive index, peroxide value, density remained unchanged throughout this experiment.

Key words : Groundnut, Presowing, Calcium chlorid, Phosphorus, Oil content.

Introduction

Groundnut (*Arachis hypogea*) is one of the important oil and protein producing crop in Bangladesh. After rape and mustard, on the basis of annual production, groundnut is the second most important oil seed crop in our country. Seed contain 44 - 56% high quality edible oil and 22 - 30% highly assumable protein. In addition it is good source of min-

eral, carbohydrates, vitamin E and B (Savage and Keenan 1994). The cost of cultivation of groundnut is lower and it is a good fodder. The average pod yield of groundnut is low in our country than other groundnut producing country of the world (FAO 1988). The progress in groundnut production is slow in our country. Improved production technique and proper management could help in step-

ping up crop productivity. Among the several agro-techniques factors important in enhancing production of yield were the use of proper land preparation, plant spacing (Chavan and Kalra 1983), irrigation (Mishra 1999), application of fertilizer (Sukhiji 1984). In recent years, some encouraging results with pre-sowing treatment on the yield and oil content of groundnut have been reported (Ghosh and Maity 2001). Subbaraman and Selvaraj (1989) reported the positive effect of ground nut seed yield and quality with pre-sowing treatment of calcium chloride in India. Akbari *et al* (1998), and Petel *et al* (1990) observed that application of phosphorus fertilizer increased the pod yield significantly and oil content of groundnut. The information regarding the effect of pre-sowing treatment and phosphorus fertilizer application is merge in our country. Therefore, the investigation was carried out to find out the better crop management for getting maximum pod yield and oil content of groundnut.

Materials and Methods

A field experiment on groundnut was conducted in the field Laboratory of BCSIR, Dhaka during rabi seasons of 2003-2004. The variety of groundnut used for this study was Jhinga badam. The soil of the experimental field was sandy clay loam having pH of 5.8, 1.5 organic matter, 0.04 total nitrogen. The experiment was laid out in a randomized block design with three replications.

The experimental design express in the following way

Block 1 : Pre sowing treatment by calcium chloride

Sub blocks / plots

- a) Control T_0 : 0% $CaCl_2+N_2$ fertilizer (as basal dose)
- b) Treatment T_1 : 0.15% ,, + ,,
- c) Treatment T_2 : 0.25% ,, + ,,
- d) Treatment T_2 : 0.50% ,, + ,,

Block 2 : Fertilizer treatment by triple super phosphate as phosphorus fertilizer Sub blocks / plots

- a) Control P_0 : 0kg/ha+ N_2 fertilizer (as basal dose)
- b) Treatment P_1 : 30kg P / ha + ,,
- c) Treatment P_2 : 45kg P / ha + ,,
- d) Treatment P_3 : 60kg P / ha + ,,
- e) Treatment P_4 : 75kg P / ha + ,,

For pre-sowing treatment groundnut seeds soaked in calcium chloride solution with different concentration for 32 hours followed by air drying for 10 hours (0%- T_0 , 0.15%- T_1 , 0.25%- T_2 , 0.50%- T_3). The phosphorus fertilizer doses used were 0, 30, 45, 60, 75 kg/ha (0- P_0 , 30 kg- P_1 /ha, 45 kg- P_2 /ha, 60 kg- P_3 /ha and 75 kg- P_4 /ha).The source of phosphorus fertilizer was triple super phosphate collected from BADC, sharebangla office, Dhaka. At the time of land preparation N-fertilizer as urea applied was twice at equal doses. The unit plot size was 2m x 2m. The row to row and plant to plant distance were 25 cm x 20 cm respectively. Three seeds were put in each hill at the specific plant dis-

tance in row and after emergence thinned to single plant. Cultural procedure like weeding, spraying, irrigation were done as and when necessary to ensure the normal growth and development of the plants. At harvest, 10 randomly selected plants from each plot were collected to record different yield parameters from and those on yield were recorded from the whole plot. Oil content in kernel was determined by Soxhlet's extraction apparatus. The physico-chemical characteristics of groundnut oil collected from each treatment were determined according to standard methods (AOAC 1984). All observed data were statistically analyzed following analysis of variances and the mean difference were adjudged by Duncan's New Multiple Range Test (Steel and Torrie 1960) at LSD 5%.

Results and Discussion

Effects of pre-sowing treatment on the growth and yield of groundnut

Effects of pre-sowing treatment are presented in Table I. Pre-sowing treatment T_3 ie. seeds soaked in 0.50% $CaCl_2$ solution for 32 hours significantly (5% level) increased plant height to 43.89 cm per plant, compared to the control (41.50 cm per plant). However the mean value of maximum number of primary branch / plant did not significantly changed through increased to 5.51 cm per plant from T_2 pre-sowing treatment. Number of pods per plant varied from 24.40 to 25.61 and highest pod per plant observed from 0.50% pre-sowing treatment (T_3), through non significant. This finding was in agreement with the result of Sandhy and

Table I. Effects of pre-sowing treatment on growth and yield of groundnut

Pre-sowing treatments	Plant height / plant (cm)	Number of primary branch / plant	Seeds / pod	Pods / plant	Weight of 100 seeds (g)	Pod yield (t / ha)
T_0 (0% $CaCl_2$)	41.50 b*	5.36 a	2.80 a	24.40 ab	86.10 b	1.75 c
T_1 (0.15% $CaCl_2$)	42.10 ab	5.42 a	2.81 a	24.45 ab	87.21 ab	2.01 b
T_2 (0.25% $CaCl_2$)	42.78 ab	5.51 a	2.90 a	24.50 ab	87.41 ab	2.22 a
T_3 (0.50% $CaCl_2$)	43.89 a	5.50 a	2.92 a	25.61 a	87.98 a	2.25 a

Probability (P) LSD 5%. No. of replicate n = 4.

* Means with the same letter are not significantly different from each other at LSD of 5% .

Singh (1994). They found the highest pod per plant at 0.5% pre-sowing treatment in ground nut. The weight of 100 seeds significantly increased (LSD at %) from 86.10g to 87.98g (T₃) steady increase of pod yield of ground nut observed that well explained the superiority of pre-sowing treatment over control treatment like plant height. T₃ treatment showed significantly increase compared to control and therefore, the highest pod yield recorded 2.25 t/ha for T₃. This increase was due to the overall increase in yield components. Similar result were reported by Narayanas and Channurayappa (1996).

Effects of fertilization on the growth and yield of groundnut (Table II).

The different doses of phosphorus produced different responses regarding plant height. In fertilizer treatment the maximum plant height was obtained by P₃ treatment. The second highest plant height resulted from P₄ treatment. This was closely followed by P₂ treatment. The smallest plant height obtained control treatment. The maximum number of primary branch with mean value of 5.52 cm per plant obtained from P₃ treatment. Number of pod per plant was found gradually increased from 23.00 to 26.86. P₄ treatment showed the highest number of pod per

Table II. Effects of phosphorus fertilization on growth and yield of groundnut

Fertilizer treatments	Plant height / plant (cm)	Number of primary branch / plant	Seeds / pod	Pods / plant	Weight of 100 seeds (g)	Pod yield (t / ha)
P ₀ (0kg P/ha)	41.25 b*	5.31 a	2.81 a	23.00 c	86.20 b	1.80 c
P ₁ (30kg P/ha)	42.25 ab	5.41 a	2.82 a	24.50 b	87.10 ab	2.20 b
P ₂ (45kg P/ha)	42.30 ab	5.41 a	2.83 a	24.60 b	87.30 ab	2.21 b
P ₃ (60kg P/ha)	43.63 a	5.52 a	2.85 a	25.42 ab	88.27 a	2.21 ab
P ₄ (75kg P/ha)	43.40 a	5.40 a	2.90 a	26.86 a	88.49 a	2.31 a

Probability (P) LSD 5%. No. of replicate n = 5.

* Means with the same letter are not significantly different from each other at LSD of 5% .

plant. The maximum yield of 2.31 t/ha was produced from the plot receiving fertilizer at the rate of 60 kg P₂O₅/ha. The result are in close agreement with the finding of Rao *et al* (2001), Islam and Noor (1982) but the finding are partial disagree with those of Mishra (1999) who found highest pod yield of groundnut at the rate of 80 kg P₂O₅/ha.

Fertilization effect on the oil quality (Table III)

Gradually increase of oil content observed when increasing dose of phosphorus was applied. Higher doses of phosphorus produced higher percentage of oil content per-

cent of groundnut as affected by phosphorus fertilizer treatment varied from 45.01- 47.11. P₄ treatment showed the highest percent of oil content. This value is closely followed by P₃ treatment. The increase in oil content with phosphorus in groundnut have been reported by Sukhija *et al* (1984). Similar trend of groundnut oil also reported by Chavan *et al* (1983) and Bharamba *et al* (2004). The refractive index, peroxide value, density of groundnut oil obtained from fertilizer treatment are more or less same. There are no significant differences observed among the above parameters.

Table III. Effects of phosphorus fertilization on oil content and physico-chemical characteristics of groundnut

Fertilizer treatments	Oil content (%)	Moisture content (%)	Density at the room temp.27°C (gm/cc)	Peroxide value (meq/kg)	Refractive index at 40°C
P ₀ (0kg P/ha)	45.01 b*	6.20 a	0.91128 a	2.04 a	1.4609 a
P ₁ (30kg P/ha)	46.31 ab	6.19 a	0.91128 a	2.05 a	1.4609 a
P ₂ (45kg P/ha)	46.31 ab	6.19 a	0.91127 a	2.06 a	1.4608 a
P ₃ (60kg P/ha)	47.08 a	6.21 a	0.91126 a	2.06 a	1.4608 a
P ₄ (75kg P/ha)	47.11 a	6.21 a	0.91128 a	2.08 a	1.4609 a

Probability (P) LSD 5%. . No. of replicate n = 5.

* Means with the same letter are not significantly different from each other at LSD of 5%.

Effects of pre-sowing treatment on the oil quality (Table IV)

The pre-sowing treatment on oil content and physico-chemical characters of groundnut oil content present in table IV. The oil content of groundnut increased progressively with the increase of pre-sowing treatment. The highest percentage of groundnut oil obtained from T₃ treatment. Control treatment produced less percentage of oil. These results are in close agreement with the finding of Subbaraman and Selvaraj(1989) who found highest percentage of groundnut oil by applying 0.50% pre-sowing treatment of calcium chloride. Refractive index, peroxide value, density of groundnut oil did not show any change during the whole experimental period.

Interaction of pre-sowing and fertilization on the growth, yield and oil content of groundnut (Table V)

The data on the effect of pre-sowing and phosphorus fertilizer on growth, yield and oil content have been presented in table V. The maximum plant height was recorded from T₃ treatment at the fertilizer rate of 60 kg P₂O₅/ha. It is closely followed by the same T₂ and T₁ treatment with same fertilizer rate. The number of primary branches and seeds per pod range from 5.11- 5.61 and 2.70-3.02 respectively. P₄ fertilizer dose at T₃ pre-sowing treatment produced highest number of pods per plant. The highest pod yield per plot was recorded from 0.05% pre-sowing at the rate fertilization of P₄. The next

Table IV. Effects of pre-sowing treatment on oil content and physico-chemical characteristics of groundnut

Pre-sowing treatments	Oil content (%)	Moisture content (%)	Density at the room temp.27°C (gm/cc)	Peroxide value (meq/kg)	Refractive index at 40°C
T ₀ (0%CaCl ₂)	45.01 b*	6.21 a	0.91127 a	2.05 a	1.4608 a
T ₁ (0.15%CaCl ₂)	45.25 b	6.19 a	0.91126 a	2.06 a	1.4607 a
T ₂ (0.25%CaCl ₂)	46.89 a	6.21 a	0.91127 a	2.05 a	1.4606 a
T ₃ (0.50%CaCl ₂)	46.91 a	6.21 a	0.91122 a	2.04 a	1.4608 a

Probability (P) LSD 5%. No. of replicate n = 4.

* Means with the same letter are not significantly different from each other at LSD of 5% .

Table V. Interaction effects of pre-sowing and fertilization on growth, yield and oil content of groundnut

Fertilization x Pre-sowing treatment		Plant height/ plant (cm)	Number of primary branch / plant	Seeds / pod	Pods / plant	Weight of 100 seed (g)	Pod yield (t/ha)	Oil content (%)
P ₀ (0kg P/ha)	T ₀	43.11c*	5.11 b	2.70 ab	24.21 c	86.53 b	1.75 c	44.51 c
P ₁ (30kg P/ha)	T ₁	44.64 b	5.31 ab	2.79 ab	25.41 bc	86.60 b	1.96 b	45.80 b
	T ₂	44.65 b	5.32 ab	2.81 ab	26.62 b	87.70 ab	2.05 b	45.82 b
	T ₃	44.65 b	5.30 ab	2.72 ab	26.61 b	87.71 ab	2.06 b	45.85 b
P ₂ (45kg P/ha)	T ₁	44.60 b	5.59 a	2.80 ab	26.60 b	87.82 ab	2.08 b	45.89 b
	T ₂	44.60 b	5.59 a	2.80 ab	26.63 b	87.80 ab	2.09 b	45.90 b
	T ₃	44.65 b	5.60 a	2.74 ab	26.65 b	87.82 ab	2.09 b	45.90 b
P ₃ (60kg P/ha)	T ₁	45.34 ab	5.54 ab	2.81 ab	28.50 a	87.82 ab	2.24 ab	46.80 ab
	T ₂	45.34 ab	5.55 ab	2.80 ab	28.54 a	88.51 a	2.26 ab	46.82 ab
	T ₃	45.35 ab	5.55 ab	2.95 a	28.76 a	88.50 a	2.25 ab	46.85 ab
P ₄ (75kg P/ha)	T ₁	45.30 ab	5.32 ab	3.01 a	28.75 a	88.61 a	2.40 a	47.11 a
	T ₂	46.58 a	5.35 ab	3.02 a	28.80 a	88.60 a	2.41 a	47.15 a
	T ₃	46.61 a	5.61 a	3.02 a	28.85 a	88.65 a	2.54 a	47.25 a

* Means with the same letter are not different from each other at the 5% level of significance.

pod yield were found at 0.25% sowing treatment with fertilizer rate of 60 kg P₂O₅/ha. The oil percentage of groundnut found to vary 44.51-47.25%. The highest percentage of oil obtained from T₃ treatment at fertilizer rate of 60 kg P₂O₅. Pre-sowing treatment at lower rate of fertilizer produced lower percentage of groundnut oil.

Conclusion

The findings of the study indicate that the pre-sowing treatment and fertilizer applica-

tion experiment improved the yield contributing character efficiency, leading to higher pod yield and oil content of groundnut. So the further research is needed in this direction with other varieties of groundnut to establish the present finding.

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