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Effect of gypsum and lime on seed yield parameters of groundnut (*Arachis hypogaea*)

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ABSTRACT

An investigation was carried out to study the effects of application of gypsum and lime (lime sludge) to seed crop of groundnut variety TAG-24 on seed yield parameters. The study consisted of 12 treatment combination T_1 as control, T_2 NPK+ Gypsum @ 50 kg ha^{-1} (100% basal), T_3 NPK+ Gypsum @100 kg ha^{-1} (100% basal), T_4 NPK + Gypsum @150 kg ha^{-1} (100% basal), T_5 NPK+ Gypsum @ 50 kg ha^{-1} (50 % basal + 50 % top dressing), T_6 NPK + Gypsum @ 100 kg ha^{-1} (50 % basal + 50 % top dressing), T_7 NPK + Gypsum @ 150kg ha^{-1} (50 % basal + 50 % top dressing), T_8 NPK + Gypsum @ 50 kg ha^{-1} (75% basal + 25 top dressing), T_9 NPK + Gypsum @ 100 kg ha^{-1} (75% basal + 25 % top dressing), T_{10} NPK + Gypsum @ 150 kg ha^{-1} (75% basal + 25 % top dressing), T_{11} NPK + Lime @ 100% LR (basal) and T_{12} NPK + Lime @ 20% LR (basal) + Gypsum 50 kg ha^{-1} (100% top dressing). The crop was evaluated in term of Plant height, Number of branches, Days of first flowering, Harvesting maturity, number of pegs/plant, Number of effective pegs, Number of matured pods, Number of immature pods, pod weight, Shelling percentage, Number of seed/ pod, Weight of 100 seed (g), Pod yield/ plant (g), Pod yield/ha and Number of seed/kg. Result of the investigation revealed that the plant height, number of pods per plants, 100-pod weight, pod yield per plant, shelling percentage and 100-seed weight were significantly increased in T_6 and T_{12} respectively.

Keywords: Groundnut, gypsum, lime yield attributes

Groundnut is grown on nearly 23.95 million ha worldwide with the total production of 36.45 million tons and an average yield of 1520 kg ha^{-1} in 2009 (FAOSTAT 2011). The groundnut area remained the same during 2000-2009 in India (6.5 million ha) and Vietnam (0.24 million ha) (ICRISAT 2012). Seventy percent of the area and seventy five percent of the production has been concentrated in the four states of Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka. Andhra Pradesh, Karnataka, Tamil Nadu and Orissa have irrigated areas primarily during the *Rabi* season. The irrigated areas form about six percent of the groundnut area in India. In fact, balanced fertilizer use is essential not only for increasing the production of groundnut but even for maintaining the present production levels. This is realized when it is evident that an average crop of groundnut removes about 112 kg N, 20 kg Pp and 84 kg ~O from one hectare (Chandra *et al.,* 2006). Gypsum is widely used as a source of Ca for groundnut worldwide. Groundnut response to gypsum, as with any other fertilizer, depends on the fertility status of the soil. The dissolution of gypsum is fairly rapid and therefore readily adds Ca to the podding zone. However, the major disadvantage of gypsum is its vulnerability to leaching especially on light textured soils. Positive responses have been observed on sandy soils with pH less than 5.0 (0.01 M CaCl2). Survey data from the smallholder farming sector has shown that the majority of the farmers do not apply gypsum or any other basal fertilizer to groundnut (Chikowo, 1998). The use of lime instead of gypsum can provide not only Ca for the ground crop but also improves the availability of other plant nutrients. Proper incorporation of lime into the soil ensures the availability of Ca in the podding zone (Cox *et al.,* 1982). The crop following limed groundnut benefits from the residual effect of lime in addition to N contributed through fixation by the legumes. The low solubility of lime makes the Ca and/or Mg less prone to leaching which is one of the most common modes of nutrients loss from sandy soil of the smallholder area. Liming decrease the photo toxic level of Al and reduces nutrient imbalance (Belkacem and nys, 1997). This study was designed to evaluate the effect of application of gypsum and lime on pod yield and seed yield of groundnut.

MATERIALS AND METHODS

The field experiment was conducted at Central Research Station, Orissa University of Agriculture and Technology, Bhubaneswar in 2009-2010. The experimental site was located at 20.15^{0}N latitudes and 85.53^{0}E longitudes. The experimental plot was located in a patch of medium land and the texture class of soil of the experimental plot was sandy loam. The experimental plot was cunder cultivation of paddy and groundnut in *Kharif* and *Rabi* seasons respectively during the preceding 30 years. The mutant variety TAG-24 was chosen for the study because of its earliness, semi-dwarf

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habit, yield stability, high harvest index, shorter internodes, dark greeen, small leaves and high water use efficiency nature. The experiment was conducted in a plot size 66m x 15m. The main plot was divided into 36 subplots. Since there were 12 treatments with three replications in Randomized Block Design, all the plots were arranged in there strips comprising 12 plots each denoting a single replication. The study consisted of 12 treatment combination T_1 as control, T_2 NPK+ Gypsum @ 50 kg ha^{-1} (100% basal), T_3 NPK+ Gypsum @100 kg ha^{-1} (100% basal), T_4 NPK + Gypsum @150 kg ha^{-1} (100% basal), T_5 NPK+ Gypsum @ 50 kg ha^{-1} (50 % basal + 50 % top dressing), T_6 NPK + Gypsum @ 100 kg ha^{-1} (50 % basal + 50 % top dressing), T_7 NPK + Gypsum @ 150kg ha^{-1} (50 % basal + 50 % top dressing), T_8 NPK + Gypsum @ 50 kg ha^{-1} (75% basal + 25 top dressing), T_9 NPK + Gypsum @ 100 kg ha^{-1} (75% basal + 25 % top dressing), T_{10} NPK + Gypsum @ 150 kg ha^{-1} (75% basal + 25 % top dressing), T_{11} SNPK + Lime @ 100% LR (basal) and T_{12} NPK + Lime @ 20% LR (basal) + Gypsum 50 kg ha^{-1} (100% top dressing). The crop was evaluated in term of Plant height, Number of branches, Days of first flowering, Harvesting maturity, number of pegs plant^{-1}, Number of effective pegs, Number of matured pods, Number of immature pods, pod weight, Shelling percentage, Number of seed pod^{-1}, Weight of 100 seed (g), Pod yield plant^{-1} (g), Pod yield ha^{-1} and Number of seed kg^{-1}. The experiment was subjected to statistical analysis following the principles and procedures outline by Panse and Sukhantme (1978).

RESULTS AND DISCISSION

In order to assess the growth behaviour of the groundnut seed crops raised with application of different doses of gypsum and lime besides normal doses of recommended major nutrients, the plant height was recorded at maturity (Table 1) The change in plant height due to nutrient application were not significant,

Table 1: Effect of soil application of gypsum and lime on seed yield parameters

Treatments	Plant height (cm)	No. of branches	Days to appearance of first flower	Days to harvestable maturity	No. of pegs per plant	No. of effective pegs	No. of mature pods
T_1	25.67	5.32	28	118	14.67	11.32	7.10
T_2	27.13 (105.69)	5.67 (+0.35)	28	118	14.92	11.53	7.79
T_3	26.90 (104.79)	6.14 (+0.82)	29 (+1)	119 (+1)	15.24	11.20	7.82
T_4	26.27 (102.34)	5.42 (+0.10)	29 (+1)	118	14.88	11.12	7.30
T_5	28.23 (109.97)	6.42 (+1.10)	29 (+1)	119 (+1)	15.68	12.48	9.22
T_6	28.03 (109.19)	6.58 (+1.26)	30 (+2)	120 (+2)	16.01	12.99	9.85
T_7	28.05 (109.27)	5.72 (+0.40)	29 (+1)	118	14.89	11.49	8.07
T_8	27.45 (106.93)	6.04 (+0.72)	29 (+1)	119 (+1)	15.04	11.84	8.52
T_9	26.40 (102.84)	5.97 (0.65)	29 (+1)	118	14.97	12.04	8.74
T_{10}	26.67 (103.90)	5.92 (+0.60)	28 ()	119 (+1)	14.98	11.59	7.97
T_{11}	28.04 (109.23)	6.20 (+0.88)	29 (+1)	119 (+1)	15.02	11.59	8.43
T_{12}	28.22 (109.93)	6.72 (+1.40)	30 (+2)	120 (+2)	16.09	13.04	9.96
Mean	**27.26**	**5.51**	**28.92**	**119**	**15.19**	**11.86**	**8.40**
SEm (±)	**0.66**	**0.12**	**0.50**	**0.7**	**0.32**	**0.28**	**0.26**
LSD (0.05)	**NS**	**0.34**	**NS**	**NS**	**NS**	**0.83**	**0.77**

Note : Figures in parentheses indicates percentage to control in respect of plant height and deviation from control in respect of no. of branches, days to flower and days to harvestable maturity.

the increase in height was recorded in all the treated plants which ranged 25.67 to 28.23 (cm). In absolute values, maximum height was recorded in T_5 (28.23) followed by T_{12} (28.22), T_7 (28.05), T_{11} (28.04) and T_6 (28.03) cm. The minimum height among the treatment was recorded in T_4 (26.27) cm. The present findings conforms the previous finding of Mandal *et al*., 2005.

The interaction effect of gypsum and lime on growth behaviour of groundnut was also reflected in branching pattern (Table 1). The average number of branches per plant was recorded 5.32 while in treated seeds it ranged from 5.42 to 6.72. Application of gypsum increased the branches per plant a range of 0.10 (T_4) to 1.26 (T_6). Where in T_{11} the number of branches was increased by 0.88 but when lime (20% LR) was applied with 50kg ha^{-1} gypsum as top dressing, there was maximum increase of branches (1.40). The result clearly revealed the specific requirement of both Ca and S for normal growth of groundnut as stated by Harris (1968) and Tandon (1991). The importance of branch number for pod yield in ground was emphasized by some workers in the field (Khangura and Sandhu, 1972; Lakshmiah *et al*., 1983).

Different doses of either gypsum or lime were not found statistically significant. When different doses of either gypsum or lime or both applied to groundnut seed crop there was marginal delay in flowering (1or 2 days). Application of lime and gypsum might have helped better nitrogen nutrient of seed crop causing little delay in flowering.

Determination of harvesting maturity stage is crucial for seed quality point of view because over maturity affects the sowing quality of seeds. It achieved when the seed moisture content reduced to safe limits to take up further post-harvest operation (Sahoo and Swain, 1983). In the present study harvestable maturity stage was achieved after 118 days of sowing under recommended doses of NPK (Table1). Whereas, application of gypsum and lime or both did not produce any significant effect on the parameters.

The average number of pegs per plant was 14.67 found in non treated seed (Table 1). There was a increase in the number of pegs within a range of 0.21 (T2) to 1.42 (T12) due to application of gypsum or lime or both. However, the increase in number in peg was not significant. Enyi (1977) reported that seed yield depends on the number of pegs formed. Hence, more pod yield might be expected in treatment having more number of pegs.

The number of effective pegs per plant increased in all the treatments (Table 1). In treated seeds, maximum number of effective pegs was observed in T12 (13.04) followed by T6 (12.99), T5 (12.48) and T9 (12.04). Beside control minimum number of pegs was observed in T2 (11.53). A positive correlation between number of effective pegs and yield was reported (Jaswal and Gupta, 1967; Rahaman and Rahman, 1979).

Application of different doses of gypsum and lime significantly increased the number of matured pods per plant. Maximum number of pods per plant in treated crops was recorded in T_{12} (9.96) followed by T_6 (9.85), T_5 (9.22) and T_9 (8.74). Minimum number of matured pods per plant in treated crops was observed in T_4 (7.30). Similar observations were recorded by Dutta *et al*., (2004) and Mandal *et al*., (2005). The seed receiving gypsum and lime treatment showed reduction in the number of immature pods per plants (Table 2). However, such reduction was not found significant. Minimum number of immature pods per plants was recorded in T_{12} (3.08) followed by T_6 (3.14), T_{11} (3.16) and T_5 (3.26). On the other side maximum number of immature pods were found in T_4 (3.82) followed by T_2 (3.74) and T_{10} (3.62). More number of immature pods per plants might have resulted from late formation of pegs or improper pegging (Pani, 2004).

Hundred pod weight of groundnut was significantly increased within the range of 1.31% and 8.56 % (Table 2). Maximum seed weight was recorded in T_{12} (66.48g) followed by T_6 (66.42 g), T_8 (66.17 g), T_{11} (65.87 g) and T_9 (65.48g). Minimum pod weight was recorded in T_4 (62.04 g). Same result found by (Dosani *et al*., 2003; Dutta *et al.,* 2004; Mandal *et al*., 2005). Positive contribution of pod weight has been observed in some studies (Swain, 1999; Pani, 2004).

Gypsum or lime or combination of both significantly increased the shelling percentage in all the treatments (Table 2). Maximum shelling percentage value was recorded in T_{12} (74.72) followed by T_{10} (74.22), T_6 (74.11), T_8 (73.66), T_7 (73.54) and T_9 (73.52). Minimum shelling percentage value was recorded in T_4 (72.90). Verma *et al*., 1973 reported significant increase in shelling percentage with application of 25 kg ha^{-1}. The present finding confirmed the findings of another study conducted recently by Mandal *et al.*, (2005).

The average number of seed per pod was observed to be 1.94 (Table 2) in the lot harvested from the control plot with application of recommended dose of NPK. The increase in seed number per pod due to application of either gypsum or lime or combination of both was not significant. However, the values of the parameter ranged

Table 2: Effect of soil application of gypsum and lime on seed yield parameters

Treatments	No. of immature pods	Pod weight (g)	Shelling %	No. of seeds pod^{-1}	100 seeds weight (g)	Pod yield (g plant^{-1})	Pod yield (q ha^{-1})	No. of seeds kg^{-1}
T_1	4.22	61.24	72.86	1.94	44.62	4.35	14.52	2241
T_2	3.74	63.16 (103.14)	72.92	1.95	46.08 (103.27)	4.92 (113.10)	16.43 (113.15)	2170
T_3	3.38	65.22 (106.50)	73.14	1.95	47.70 (106.90)	5.10 (117.24)	17.04 (117.36)	2096
T_4	3.82	62.04 (101.31)	72.90	1.93	45.23 (101.37)	4.53 (104.14)	15.13 (104.20)	2211
T_5	3.26	65.26 (106.56)	73.42	1.96	47.91 (107.37)	6.02 (138.39)	20.01 (137.81)	2087
T_6	3.14	66.42 (108.46)	74.11	1.98	49.22 (110.31)	6.54 (150.35)	21.82 (150.28)	2032
T_7	3.42	65.28 (106.60)	73.54	1.97	48.01 (107.60)	5.27 (121.15)	17.58 (121.07)	2083
T_8	3.32	66.17 (108.05)	73.66	1.97	48.74 (109.23)	5.64 (129.66)	18.81 (129.55)	2052
T_9	3.30	65.48 (106.92)	73.52	1.97	48.14 (107.89)	5.72 (131.49)	18.84 (129.75)	2077
T_{10}	3.62	65.40 (106.79)	74.22	1.97	48.54 (108.79)	5.21 (119.77)	16.43 (113.15)	2060
T_{11}	3.16	65.87 (107.56)	73.14	1.96	48.18 (107.98)	5.55 (127.59)	18.54 (127.69)	2076
T_{12}	3.08	66.48 (108.56)	74.72	1.98	49.69 (111.36)	6.62 (152.18)	21.83 (150.34)	2012
Mean	**3.42**	**64.84**	**73.54**	**1.96**	**47.67**	**5.37**	**17.51**	**2098**
SEm (±)	**0.24**	**0.33**	**0.35**	**0.34**	**0.26**	**0.29**	**0.26**	**25.4**
LSD (0.05)	**NS**	**0.96**	**1.02**	**NS**	**0.77**	**0.85**	**0.75**	**74.5**

Note : Figures in parentheses indicates percentage of control in respect of pod weight, 100 seed weight, pod yield plant^{-1} and pod yield ha^{-1}.

between 1.95 and 1.98 in different treatment indicating most of the pods to be two seeded.

Hundred seed weight of the groundnut was significantly increased by gypsum or lime or combination of both which ranged from 3.27% to 11.36% (Table 2). Among the treatments T_{12} recorded maximum seed weight followed by T_6 (49.22g), T_8 (48.74g), T_{11} (48.18 g) and T_9 (48.14 g). Minimum seed weight was observed in T_4 (45.23 g). Dutta *et al.,* (2004) observed increased in seed weight due to application of lime. Similar observations were also recorded by Mandal *et al*., 2005 with application of gypsum to groundnut. Beneficial role of lime is also reported in the earlier investigation (Chalk *et al*., 2010; Bekere *et al*., 2013).

Pod yield of the crop was significantly affected by the application of gypsum or lime or combination of both (Table 2). Maximum increase in pod yield per plant was observed in T_{12} (52.18%) followed by T_6 (50.35%), T_5 (38.39%), T_8 (29.66%) and T_{11} (27.59%). Critical examination of the observation data revealed that basal application of lime @ 20 % LR along with top dressing of gypsum @50 kg ha^{-1} (T_{12}) produced maximum positive effect on pod yield. While gypsum @ 150 kg ha^{-1} applied as basal dose (T_4) could not increase the pod yield. Several workers observed increase in pod yield due to application of gypsum and lime (Venkatesh *et al*., 2002; Dosani *et al*., 2003; Maity and Giri, 2003; Dutta *et al*., 2004; Mandal *et al.,* 2005; Vaghasia *et al*., 2007; Benker, 2013).

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