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Effect of gypsum and CaMS super application on yield and yield attributes of groundnut

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Abstract
Groundnut (*Arachis hypogea* L.) is the most important oil seed crop in India. The cultivated area in Telangana state under groundnut is around 0.79 lakh ha with a production of 3.73 lakh tonnes in *rabi* 2022-23. Enough Ca and S content in the soil around the peanut pods leads to increased yield, seed oil and protein contents. Gypsum and CaMS super (Ca, Mg, S) are the soluble sources of essential plant nutrients like calcium and sulphur to groundnut which can improve overall plant growth. A field experiment was conducted in a Randomized block design under *rabi* 2020-21, at Farmers' fields in Narwa mandal of Telangana state. Experimental data revealed that, application of 100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage recorded highest dry matter production of 7783 kg ha^{-1}. Gypsum is applied at flowering stage shown one day earlier than it was applied in split doses of gypsum application. The highest number of developed pods per plant (15) was observed T_6 (100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) treatment which was at par with T_4 (100% RDF + Gypsum @ 500 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) and T_8 (100% RDF +Gypsum @ 750 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) treatment with 14 pods per plant. SSP, Gypsum and CaMS Super application levels exerted non-significant influence on number of seeds per pod. Application of 100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) resulted maximum pod weight of 69.30 g which was at par with CaMS Super applied treatment. Similarly the above said T_6 treatment got highest pod yield (2737 kg ha^{-1}) and Haulm yield (5046 kg ha^{-1}), Harvest Index (0.35) and shelling percentage (77.43%) which was significantly higher than other treatments.

Keywords: Gypsum, CaMS super, yield and yield attributes and groundnut

Introduction
Groundnut (*Arachis hypogea* L.) is the important oil seed crop in India. The Groundnut cultivated area in India in *rabi* 2022 was around 4.34 lakh ha. Among the states Karnataka stood first with groundnut cultivated area around 1.64 lakh ha followed by Telangana state with Groundnut cultivated area of 0.79 lakh ha with a production of 3.73 lakh tonnes. Among the districts, Nagarkurnool stood first in groundnut sown area with (0.40 lakh ha) followed by Wanaparthy (0.09 lakh ha), Vikarabad (0.08 lakh ha), Mahabubnagar (0.04 lakh ha), Gadwal (0.04 lakh ha) (Groundnut outlook - PJTSAU, 2023) [7].

Imbalanced and inadequate use of nutrients is the major reason for minimum yields in groundnut. Optimization of mineral fertilization is a key to improve the productivity of groundnut. Being a leguminous crop, groundnut can fix up to 40-80 kg of nitrogen per hectare through Biological Nitrogen Fixation (BNF) which accounts for 86-92 percent of the nitrogen taken up by the groundnut (Dart *et al.*, 1983) [4]. Even though legumes can fix nitrogen on their own, they often require phosphorus, calcium, and other nutrients for proper seed formation (Asiedu *et al*., 2000) [2]. The most apparent influence of P is on the root system of plants. P is needed in higher amounts in nodulating legumes than in non-nodulating crops because it is essential for nodule formation and nitrogen fixation (Brady and Weil, 2004) [3]. Apart from primary nutrients, secondary nutrients like calcium (Ca) and sulphur (S) also play a vital role in enhancing production as well as productivity of groundnut.

Gypsum is an excellent source of calcium and sulphur for groundnut all over the world. It contains about 18.6 percent Sulphur and 23 percent Calcium and also provide magnesium. Apart from providing calcium and sulphur, gypsum also plays a significant role in the reclamation of alkaline soils and improves the water movement and allow to crop grow well

and improves soil structure which favours effective pegging in groundnut. Godavari CaMS super was released by Coromandel international limited in 2016. It acts both as a soil conditioner and Fertilizer, containing Ca 15%, Mg 3% and S 8%. Farmers use this product in groundnut crop @ 250 kg ha^{-1} to get good yields. Keeping in view, all these facts, the present project was proposed to study the effect of gypsum and CaMS super (Ca, Mg, S) requirement on productivity of *rab*i groundnut.

Material and Methods

The present experiment was laid at farmers field's of Raikode village, Narwa mandal of Narayanapet district, which lies in between 16°28'33.78" N latitude and 77°37'58.62" E longitude and 372 m above mean sea level altitude falls under the Southern Telangana Agro-climatic zone of Telangana. Groundnut variety of K-6 was sown on 9th November 2020 with a spacing of 22.5 X 10 cm. The entire dose of phosphorus (40 kg P_2O_5 ha^{-1}) was applied basally. DAP (Diammonium phosphate) was used as the source of phosphorus and nitrogen. Potassium (50 kg K_2O ha^{-1}) was applied in the form of muriate of potash, uniformly in all the plots just before the sowing of the crop. Thinning and weeding operations were done as per the requirement. Ten irrigations were applied to the crop with sprinklers during the crop season depending on the need of the crop. Final irrigation was given one day prior to harvesting to facilitate the easy picking of pods from the soil.

Field research plot was laid in randomized block design with 10 treatments *i.e.,* T_1:Control, T_2:100% RDF(40:40:50 NPK kg ha^{-1}) (P is applied through SSP), T_3:100% RDF + Gypsum @ 500 kg ha^{-1} at flower initiation stage (Farmers practice), T_4: 100% RDF + Gypsum @ 500 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage), T_5:100% RDF + Gypsum @ 625 kg ha^{-1} at flower initiation stage, T_6:100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage), T_7:100% RDF + Gypsum @ 750 kg ha^{-1} at flower initiation stage, T_8:100% RDF +Gypsum @ 750 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage), T_9:100% RDF + CaMS Super @ 250 kg ha^{-1} at flower initiation stage (Farmers practice), T_{10}:100% RDF + CaMS Super @ kg ha^{-1} (50% at flower initiation stage+ 50% at pod development stage) replicated thrice.

The groundnut crop was harvested at 120 DAS at maturity. Net plot area was harvested and crop was left for curing for 4 days. Then the pods were separated from the plants manually and the yield data was recorded. Soil pH, electrical conductivity (EC), available macro nutrients like N, P, K, Ca, Mg and S was analyzed using standard analysis methods. Number of plants per unit area, number of pods per plant, number of developed and undeveloped pods per plant, number of seeds per pod, pod weight (g $plant^{-1}$), test weight (g), shelling percentage, harvest index, pod and haulm yield (kg ha^{-1}) were measured at harvest. Data was analysed statically for test of significance following the Fisher's method of analysis of variance as outlined by Gomez and Gomez (1984) [6].

Results and Discussion

The data pertaining to effect of gypsum and CaMS super application on yield and yield attributes of *rabi* sown groundnut shown in table 1 and 2. Application of 100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) treatment shown significantly higher yield and yield attribute parameters than other treatments. However, it remains at par with T_8 (100% RDF + Gypsum @ 750 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) treatment.

Among the different levels of application of Gypsum and CaMS super at different growth stages of groundnut, Gypsum @ 750 kg ha^{-1} in split doses recorded maximum plants per unit area (43.7) followed by T_2, T_4 and T_5 treatments with 43.3 number of plants per unit area. The highest number (Table 1a.) of pods per plant (31) was observed in treatment T_{10} with (100% RDF + CaMS Super @ 250 kg ha^{-1} (50% at flower initiation stage+ 50% at pod development stage) which was on par treatment T_4 (100% RDF + Gypsum @ 500 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) with 30 pods per plant. Supply of calcium and sulphur in excess amounts through Gypsum and CaMS super stimulated the translocation of metabolites and development of floral primordial from reproductive structures, enhances the formation of pods and kernels in groundnut. These findings were supported by Patel *et al.* (2009) [11] and Pancholi *et al.* (2017) [12].

The higher number (15) of developed pods per plant was observed in T_6 (100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage), followed by T_5 (100% RDF + Gypsum @ 625 kg ha^{-1} at flower initiation stage) and T_8 (100% RDF +Gypsum @ 750 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) treatments with (14) developed pods which was at par with T_2 (100% RDF (40:40:50 NPK kg ha^{-1}) (P is applied through SSP), T_4 (100% RDF + Gypsum @ 500 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) and T_7 (100% RDF + Gypsum @ 750 kg ha^{-1}a at flower initiation stage) treatments with 13 number of developed plants per plant (Table 1a.). The highest number (Table 1a.) of undeveloped pods plant (19) was observed in treatment $T_{10}$with (100% RDF + CaMS Super @ 250 kg ha^{-1} (50% at flower initiation stage+ 50% at pod development stage) which was on par treatment T_4(100% RDF + Gypsum @ 500 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) with 17 undeveloped pods per plant. All the treatments showed non-significant effect with respect to number seeds per pod with two kernels per pod. Gypsum and CaMS super application showed significant influence on pod weight. The maximum pod weight of 69.3 g recorded in T_6 which was statistically on par with treatments T_8 (68.4 g), T_5 (64.3 g) and T_7 (60.9 g). Similarly, highest test weight also recorded in treatment receiving 100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) (Table 1b). Availability of calcium and sulphur has been increased with gypsum application in split doses which directly influence on transportation of photosynthetic material to sink from source. Similar findings were observed by Gashti *et al.* (2012) [5].

Highest value (0.37) of HI was obtained with application of 100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) while the lowest was recorded in control treatment (0.26). As groundnut belongs to Leguminosae family, it requires lot of energy and protein compared to carbohydrates which lowers the harvest index. The results were in close conformity with the findings of Naresha *et al.* (2014) [10]. Treatment T_6 recorded maximum

shelling percentage (77.43) followed by T_8 (77.38) and T_5 (76.34) (Table 1b). Gypsum and CaMS Super application as split doses shown non-significant result in shelling percentage. However, an increasing trend was observed with increasing in the gypsum doses. The results were similar with the findings of Jat and Singh (2006) [8].

The greatest pod and haulm yield (2737 and 5046 kg ha^{-1}) was noticed in treatment receiving 100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) which was at par with 100% RDF + Gypsum @ 750 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) and 100% RDF + Gypsum @ 625 kg ha^{-1} at flower initiation stage treatments with 2525 and 2352 kg ha^{-1} of pod yield, 4982 and 4835 kg ha^{-1} of haulm yield, respectively. Gypsum and CaMS Super application increases the availability and solubility of sulphur in the rhizosphere area, absorption of nutrients from the soil and thus increases the kernel yield (Table 2). These results are in close conformity with the findings of Suresh *et al*. (2013) [13] and Kavya *et al*. (2022) [9].

Table 1a: Effect of different levels of Gypsum and CaMS Super application on yield attributes of *rabi* Groundnut

Treatments	Treatment Details	Number of plants per unit area	Total number of pods per plant	Number of developed pods per plant	Number of undeveloped pods per plant	Number of seeds per pod
T_1	Control	43.0	17	10	7	2
T_2	100% RDF (40:40:50 NPK kg ha^{-1}) (P is applied through SSP)	43.0	25	11	14	2
T_3	100% RDF + Gypsum @ 500 kg ha^{-1} at flower initiation stage (Farmers practice)	43.3	23	13	10	2
T_4	100% RDF + Gypsum @ 500 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	43.3	30	13	17	2
T_5	100% RDF + Gypsum @ 625 kg ha^{-1} at flower initiation stage	43.3	26	14	12	2
T_6	100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	43.0	26	15	11	2
T_7	100% RDF + Gypsum @ 750 kg ha^{-1}a at flower initiation stage	43.0	26	13	13	2
T_8	100% RDF +Gypsum @ 750 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	43.7	27	14	13	2
T_9	100% RDF + CaMS Super @ 250 kg ha^{-1} at flower initiation stage (Farmers practice)	43.0	25	11	14	2
T_{10}	100% RDF + CaMS Super @ 250 kg ha^{-1} (50% at flower initiation stage+ 50% at pod development stage)	43.0	31	12	19	2
	SEm±	0.01	0.9	0.5	0.7	-
	CD (p=0.05)	NS	2.7	1.5	2.1	NS

Table 1b: Effect of different levels of Gypsum and CaMS Super application on yield attributes of *rabi* Groundnut

Treatments	Treatment Details	Pod weight	Test weight	Harvest Index	Shelling percentage
T_1	Control	37.0	32.4	31.1	66.0
	100% RDF (40:40:50 NPK kg ha^{-1}) (P is applied through SSP)	44.7	35.5	31.7	68.7
T_3	100% RDF + Gypsum @ 500 kg ha^{-1} at flower initiation stage (Farmers practice)	49.1	40.3	31.8	73.3
T_4	100% RDF + Gypsum @ 500 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	58.3	36.2	31.5	74.2
T_5	100% RDF + Gypsum @ 625 kg ha^{-1} at flower initiation stage	64.3	40.9	33.0	76.3
T_6	100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	69.3	41.6	35.3	77.4
T_7	100% RDF + Gypsum @ 750 kg ha^{-1}a at flower initiation stage	60.9	39.9	32.8	75.7
T_8	100% RDF +Gypsum @ 750 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	68.4	41.0	33.6	77.3
T_9	100% RDF + CaMS Super @ 250 kg ha^{-1} at flower initiation stage (Farmers practice)	45.9	37.0	34.0	71.5
T_{10}	100% RDF + CaMS Super @ 250 kg ha^{-1} (50% at flower initiation stage+ 50% at pod development stage)	48.5	37.9	34.4	72.6
	SEm±	3.8	2.0	1.5	3.6
	CD (p=0.05)	11.3	5.9	NS	NS

Table 2: Effect of different levels of Gypsum and CaMS Super application on yield of *rabi* Groundnut

Treatments	Treatment Details	Pod yield	Haulm yield
T_1	Control	1742	3863
T_2	100% RDF (40:40:50 NPK kg ha^{-1}) (P is applied through SSP)	1941	4178
T_3	100% RDF + Gypsum @ 500 kg ha^{-1} at flower initiation stage (Farmers practice)	2199	4718
T_4	100% RDF + Gypsum @ 500 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	2212	4803
T_5	100% RDF + Gypsum @ 625 kg ha^{-1} at flower initiation stage	2352	4835
T_6	100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	2737	5046
T_7	100% RDF + Gypsum @ 750 kg ha^{-1}a at flower initiation stage	2351	4825
T_8	100% RDF +Gypsum @ 750 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage)	2525	4982
T_9	100% RDF + CaMS Super @ 250 kg ha^{-1} at flower initiation stage (Farmers practice)	2159	4208
T_{10}	100% RDF + CaMS Super @ 250 kg ha^{-1} (50% at flower initiation stage+ 50% at pod development stage)	2190	4170
	SEm±	111	184
	CD (p=0.05)	330	546

Conclusion

From the experimental data, it was concluded that, Gypsum and CaMS Super applied in split doses at flowering and pod development stage considerably increased the yield and yield attributes of *rabi* harvested groundnut. Application of 100% RDF + Gypsum @ 625 kg ha^{-1} (50% at flower initiation stage + 50% at pod development stage) shown positive effect on yield and yield attributes. This is due to the enrichment of calcium and sulphur through gypsum in plants and soil, enhanced peanut quality under irrigated conditions. Gypsum is essential for a notable improvement in the physico-chemical characteristics of soil and yield of groundnuts. These findings help to validate the varied physical environments under a variety of soils, which serves as a benchmark for the farming community, academics, and other interested parties, ultimately improving the socioeconomic circumstances of the farmers.

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