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# Sulphur nutrition of rainfed groundnut in red and black soils of Tamil Nadu

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**Abstract**
Field experiment was conducted at Oilseeds Research Station, Tindivanam during Rabi season of 2014 to evaluate the influence of graded levels gypsum (basal, split and top dress) @ 400kg/ha and different times of application as a source of sulphur on soil fertility and yield parameters of groundnut under rainfed condition. Four treatments were allotted in randomized block design with five replications. The treatments consisted of T1 - Control, $T_2$ – 400 kg gypsum as basal, $T_3$ – 400 kg gypsum (50% basal+ 50% top dress during 30-45 days as on when rain received), T4 – 400 kg gypsum as top dress (during 30-45 days as on when rain received). Groundnut TMV13 was used as a test variety. Results indicated that split application of gypsum 200 kg basal + 200 kg at as on when rain received between 30 to 50 days has been found to be most suitable technique for rainfed condition and it is also economically viable to the farmers who practicing rainfed cultivation of groundnut.

**Keywords:** Groundnut, sulphur, gypsum, soil fertility

## Introduction
Peanut or groundnut (*Arachis hypogaea*), is a species in the legume or "bean" family. The peanut was probably first domesticated and cultivated in the valleys of Paraguay. Peanuts are known by many other local names such as earthnuts, ground nuts, goober peas, monkey nuts, pygmy nuts and pig nuts. Despite its name and appearance, the peanut is not a nut, but rather a legume. India, which adopted groundnut as an agricultural crop by the late 19th century, gradually became the major groundnut producing country in the world within a span of 5-6 decades. India shares 22 per cent of the world production (area 4.9 m ha and production 5.8 m tonnes). In Tamil Nadu, it is an important and major oilseed crop, covering an area of 3.38 million hectares with a production of 7.83 million tonnes. Out of which 70% of the area is covered under rainfed crop and the remaining 30% is under irrigated conditions (Madhusudhana, 2013) [4]. In Tamil Nadu, majority of the groundnut area (43%) is covered in North Eastern Zone (comprises of Cuddalore, Villupuram, Tiruvannamalai, Vellore, Kancheepuram, Tiruvallur districts and parts of Ariyalur district). Hence, this agro-climatic zone is considered as a main zone for oilseed production especially groundnut. The crop is also popular in all the remaining zones of Tamil Nadu except in hilly zone and high rainfall zone.
Apart from primary nutrients, calcium (Ca) and sulphur (S) also play an important role in enhancing production and productivity of oilseeds in India. Sulphur is one of the essential plant nutrient required to produce protein, oil and flavoured compounds as well as to ensure quality. It is a master nutrient for oilseed production as each unit of fertilizer sulphur generates 3-5 units of edible oil. The gap between sulphur supply and demand is widen with the targeted higher food production under intensive farming practices covering use of high yielding, highly responsive crop varieties supplied with inadequate organic manure, when fertilized with high grade sulphur free N and P fertilizers. This has resulted in widespread sulphur deficiencies (Patel, 1998; Ramdevputra *et al.*, 2010) [5, 6].
Inadequate availability of sulphur to crop plants not only declines their growth and yield but can also deteriorate nutritional quality of the produce (Schonhof *et al.*, 2007) [7]. However, meagre information under Tamil Nadu condition is available on the response of groundnut to sulphur levels in respect to nutrient uptake pattern and productivity, and hence Attempts have been made through the present investigation to evaluate the influence of graded levels gypsum (basal, split and top dress) @ 400kg/ha and different times of application as a source of sulphur on soil fertility and yield parameters of groundnut under rainfed condition.

## Materials and Methods
A field experiment was conducted at Oilseeds Research Station, Tindivanam during Rabi season of 2014 in randomized block design with five replications to evaluate the influence of

graded levels gypsum (basal, split and top dress) @ 400kg/ha and different times of application as a source of sulphur on soil fertility and yield parameters of groundnut (TMV13) under rainfed condition. It consist of four treatment *viz.*, T1 - Control, $T_2$ – 400 kg gypsum as basal, $T_3$ – 400 kg gypsum (50% basal+ 50% top dress during 30-45 days as on when rain received), T4 – 400 kg gypsum as top dress (during 30-45 days as on when rain received). The sowing was taken up on 20.10.2014 and the crop was harvested on 27.01.2015. Recommended dose of fertilizer (10:10:45 kg N: P2O5: K2O/ha) were given as common to all the treatments mentioned above. A total of 276 mm of rain was received in 18 rainy days during crop growth period of 2014-15. Three supplementary irrigations (30 mm) were given during 65, 75 and 85 days after sowing. The soil at experimental site was sandy loam in texture, neutral in reaction (pH 6.9) medium in organic carbon (3.1 g $kg^{-1}$), low in available nitrogen (186 kg/ha), medium in phosphorus (20.2 kg/ha) and potassium (198 kg/ha). Observations like plant height, Root length, Root nodules, dry matter production and Pod yield of groundnut were recorded.

**Results and Discussion**

The observations on growth parameters in the present study revealed distinct differences with reference to different graded levels gypsum application. Application of gypsum as split doses as basal and top dress produced tallest plants with a height of 30 cm and followed by basal application of 400 kg gypsum (29.7 cm). There was no significant difference among the gypsum applied treatments. The control produced smallest plants (25.5 cm). The longest roots (12.2 cm) were in basal application of 400kg gypsum and shortest noticed in control as shown in table 1. Root development and growth are primarily soil dependent and it was hindered in surface crusted alfisol. In this context, intervention with gypsum application influenced the root growth by supplying calcium, which facilitated root growth by the action of soil loosening through proper aggregation in the surface crusted alfisol of experimental site. The increase in growth might be attributed to better root formation due to calcium, which in turn stimulated higher absorption of N, P, K and sulphur from soil and improved metabolic activity inside the plant (Kalaiyarasan, *et al.*, 2003) [2].

There is significant influence on root nodules of groundnut by the gypsum application. Sulphur application significantly influenced the nodule formation in groundnut as compared to control. The basal application gypsum @ 400 kg $ha^{-1}$ recorded maximum number of nodules (27.5) followed by 400 kg $ha^{-1}$ split application (table 1). Sulphur addition through gypsum is a main responsible factor for root nodules formation and calcium created congenial soil environment for root growth and nodules development.

Gypsum application significantly influences the DMP. Higher DMP (1874) was recorded in split doses of gypsum@ 400 kg $ha^{-1}$ as compared to basal and top dressing.. The results revealed that application of gypsum @ 400 kg $ha^{-1}$ in two splits boost the yield and DMP as compared to control. More number of matured pods (18.2) was observed in gypsum @ 400 $kgha^{-1}$ as split plots and basal applied plots, which were statistically on par with each other followed by gypsum @400 kg $ha^{-1}$ top dressed plot as shown in table 1.

As regards to pod yield, application of gypsum @400 kg $ha^{-1}$ as split recorded maximum pod yield (1758 kg $ha^{-1}$), which was on par with gypsum @400 kg $ha^{-1}$ basal and top dressed plots. NPK alone received (control) plots registered the lowest yield (1504 kg $ha^{-1}$). The highest pod yield was obtained mainly due to sulphur and calcium nutrients received from gypsum. Calcium from gypsum favoured peg penetration by soil loosening and sulphur regulated the amino acid synthesis and protein formation, which are regulating the plant metabolism and growth of plants. Higher yield with increased application of sulphur also attributed protein and enzyme synthesis as it is a constituent of sulphur containing amino acids namely methionine, cysteine and cysteine and results are in consonance with those earlier reported by Kumar, (Tiwari and Gupta, 2006) [8].

**Table 1:** Effect of graded level of gypsum on Growth and Yield of Groundnut

| Treatment | Plant height (cm) | Root length (cm) | Root Nodules (Nos) | Dry Matter Production (kg $ha^{-1}$) | Matured Pods (Nos) | Pod yield (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|
| T1- Control -RDF* | 25.5 | 9.7 | 21.3 | 1293 | 15.4 | 1504 |
| T2-400 kg gypsum basal | 29.7 | 12.12 | 27.5 | 1463 | 17.6 | 1711 |
| T3- 400 kg 50% basal +50% top dress | 30.0 | 11.92 | 27.12 | 1689 | 18.2 | 1758 |
| T4- 400 kg top dress | 29.3 | 10.12 | 22.68 | 1598 | 16.5 | 1662 |
| S.Em.± | 0.8 | 0.3 | 0.7 | 52 | 0.5 | 29 |
| C.D.($p \leq 0.05$) | 2.4 | 0.8 | 2.2 | 141 | 2.0 | 95 |

Application of gypsum in different times had significant influence on soil available sulphur and exchangeable calcium. The higher values of soil available S (18.5 kg $ha^{-1}$) and exchangeable Ca (2.8 meq/100g) were observed in gypsum @ 400 kg $ha^{-1}$ top dressed plot and lower value was observed in control. Application of gypsum @ 400 kg $ha^{-1}$ as a basal and split application were statistically comparable with control (table 2). Split application was found to be more beneficial for rainfed groundnut in alfisol and black soil and in this basal dose of calcium meet out the initial requirement of plant and facilitated better root growth and crop establishment in surface crusted red soil and top dressing facilitated peg formation and development, which in-turn enhanced the number of matured pods and groundnut yield. These findings are in line with those earlier reported by of Alva *et al*., 1989 and Kannan *et al*., 2016 [3].

The split application of gypsum@ 400 kg $ha^{-1}$ resulted higher sulphur uptake (18.2 kg $ha^{-1}$) followed by top dressed and basal plots, which were statistically on par with each other. With regard to calcium, maximum uptake (40.6 kg $ha^{-1}$) was noticed in split applied plots which is not significantly comparable with basal and top dressing of gypsum @400 kg $ha^{-1}$. It was mainly due to one-time top dress and moderate rate of crop utilization than other same rate of gypsum application. This result corroborate with the findings of Kannan *et al.*, 2016 [3]. Due to split application of gypsum, S and Ca uptake influences the yield and therefore higher Benefit cost ratio (2.8) was recorded in split applied plots of gypsum@ 400 kg $ha^{-1}$.

**Table 2:** Effect of graded of level gypsum on available S, exchangeable Ca and sulphur and Calcium uptake

| Treatment | Available S (kg/ha) | Exchangeable Ca (meq/100g) | Sulphur uptake(kg/ha) | Calcium uptake(kg/ha) |
|---|---|---|---|---|
| T1- Control -RDF* | 12.3 | 2.1 | 11.8 | 23.6 |
| T2-400 kg gypsum basal | 16.3 | 2.6 | 17.0 | 39.1 |
| T3- 400 kg 50% basal +50% top dress | 18.3 | 2.7 | 18.2 | 40.6 |
| T4- 400 kg top dress | 18.5 | 2.8 | 17.5 | 38.5 |
| S.Em.± | 0.4 | 0.1 | 0.6 | 1.6 |
| C.D.($p \leq 0.05$) | 1.3 | 0.3 | 1.9 | 4.8 |

## Conclusion

From the above results, it could be enlightened that the application of gypsum @ 400 kg $ha^{-1}$ for rainfed red loamy soil of ORS, Tindivanam, as split doses increases the yield along with higher DMP. Split application of gypsum also influences the S availability and also the exchangeable calcium 38 per cent over the control. Therefore split application of gypsum 200 kg basal + 200 kg at as on when rain received between 30 to 50 days has been found to be most suitable technique for rainfed condition and it is also economically viable to the farmers who practicing rainfed cultivation of groundnut in Tamil Nadu.

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