# Nutrient Uptake and Quality Parameters of Groundnut as Influenced by Gypsum and CaMS Super application


## ABSTRACT

A field experiment was laid on sandy loam soils during *rabi* season 2020-21 at farmers field's of Raikode village, Narwa mandal of Narayanapet district and to study the nutrient uptake and quality parameters of groundnut as influenced by effect of gypsum and CaMS super application..The effect of different levels of gypsum and CaMS super on nutrient uptake at harvest was found to be significant. Increase in the gypsum and CaMS levels increases the uptake at harvest. The maximum uptake of nitrogen (98.08 and 114.92 kg $ha^{-1}$), phosphorus (13.69 and 15.41 kg $ha^{-1}$), potassium (24.87 and 63.37 kg $ha^{-1}$), calcium (29.20 and 125.45 kg $ha^{-1}$), magnesium (17.17 and 39.23 kg $ha^{-1}$) and sulphur (14.36 and 18.59 kg $ha^{-1}$) in both pods and haulms at harvest stage was recorded in $_{T6}$ treatment which was at par with $_{T8}$ treatment N, P, K, Ca, Mg and S (90.57 & 109.47 kg $ha^{-1}$; 12.28 & 14.96 kg $ha^{-1}$; 22.18 & 59.92 kg $ha^{-1}$; 29.05 & 120.97 kg $ha^{-1}$; 16.61 & 37.94 kg $ha^{-1}$; 14.11 & 17.98 kg $ha^{-1}$, respectively) while the lower uptake was recorded in control treatment. Whereas quality parameters like aflatoxin content, acid value and iodine value were significantly influenced by application of different levels of gypsum and CaMS super fertilizer. The aflatoxin content varied from 17.95 to 30.50 µg $kg^{-1}$. Increase in the levels of gypsum significantly decreases the aflatoxin content in groundnut oil. Lowest aflatoxin content was noticed in $T_6$ treatment which was at par with treatments $T_7$, $T_6$ and $T_5$ with the aflatoxin content of 18.43, 20.38 and 20.54 µg $kg^{-1}$, respectively. The acid value ranged from 0.80 to 1.72 mg KOH $g^{-1}$. $T_2$ treatment showed significant increase in acid value over other treatments. Similarly, application of phosphorus in the form of single super phosphate significantly influenced the iodine value compared to control. However, highest iodine value (90.1 g 100 $g^{-1}$) was recorded in control treatment, while the lowest iodine value (72.1 g 100 $g^{-1}$) was registered in treatment receiving $T_2$ treatment.



**Key words:** Nutrient uptake, Aflatoxin content, Refractive Index, Acid Value and Iodine Value.


## 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).

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). 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). 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). 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 per cent Sulphur and 23 per cent 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.

**METERIAL AND METHODS:**

A field trial was conduct during *rabi* season 2020-21 at farmers field’s of Raikode village, Narwa mandal of Narayanapet district, which lies in between $16^{o}$28’33.78” N latitude and $77^{o}$37’58.62” E longitude and 372 m above mean sea level altitude falls under the Southern Telangana Agro-climatic zone of Telangana. The experimental field's soil had a sandy loam texture and a pH of 6.54 with available nitrogen (102.5 kg $ha^{-1}$), available phosphorus (13.06 kg $ha^{-1}$), available potassium (135.44 kg $ha^{-1}$), Available Calcium (16.43 mg $kg^{-1}$), Available Magnesium (6.89 mg $kg^{-1}$) and Available Sulphur (16.18mg $kg^{-1}$). Groundnut variety of K-6 was sown on 9$^{th}$ 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.

The experiment was randomized block design. Which was consisted ten treatments *viz.*, $T_1$: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. Recommended dose of potassium (50 kg $K_2O$ $ha^{-1}$) in the form of muriate of potash was applied uniformly in all the plots just before the sowing of the crop. 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. The remaining amount of nitrogen was applied through urea. SSP (Single super phosphate) is applied as basal in treatment $T_2$ as a source of phosphorus. The application of nitrogen, phosphorus, gypsum and CaMS super was done as per the treatments of the experiment. Present experiment was conducted to study nutrient uptake and quality parameters of groundnut as influenced by effect of gypsum and CaMS super application. The observations were recorded nutrient uptake and quality parameters. The data was analyzed using standard statistical techniques.

## 3.RESULTS AND DISCUSSION

### 3.1 Effect on nutrient uptake:

Data pertained to nutrient uptake is presented in Table .1. The effect of different levels of gypsum and CaMS super on nutrient uptake at harvest was found to be significant. Increase in the gypsum and CaMS levels increases the uptake at harvest. The maximum uptake of nitrogen (98.08 and 114.92 kg $ha^{-1}$), phosphorus (13.69 and 15.41 kg $ha^{-1}$), potassium (24.87 and 63.37 kg $ha^{-1}$), calcium (29.20 and 125.45 kg $ha^{-1}$), magnesium (17.17 and 39.23 kg $ha^{-1}$) and sulphur (14.36 and

18.59 kg ha$^{-1}$) in both pods and haulms at harvest stage was recorded in $T_6$ treatment which was at par with $T_8$ treatment (100% RDF +Gypsum @ 750 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) while the lower uptake was recorded in control treatment. The lower uptake of nitrogen (56.56 and 67.95 kg ha$^{-1}$), phosphorus (6.91 and 8.09 kg ha$^{-1}$), potassium (13.89 and 36.03 kg ha$^{-1}$), calcium (10.15 and 44.89 kg ha$^{-1}$), magnesium (7.40 and 23.30 kg ha$^{-1}$) and sulphur (7.43 and 9.10 kg ha$^{-1}$) in both pods and haulms, respectively (Table 1. at harvest stage was recorded in $T_1$ treatment (Control).

Greater nutrient uptake values of nutrients with respect to application of 100% RDF + Gypsum @ 625 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) is due to synergistic effect of essential nutrients available in sufficient quantities in soil solution which increased overall vegetative growth of groundnut and nutrient uptake. Being a legume crop, groundnut fixes the atmospheric nitrogen and absorbs nitrate nitrogen thereby maintain high nitrogen content in groundnut crop. Root nodules are another important root parameters regulating N fixation in groundnut and root nodules data clearly revealed that application of gypsum as sulphur and calcium source considerably increased number of root nodules over the NPK plot (Kannan *et al*., 2017). Increasing trend was observed with increase in gypsum levels which was attributed to synergistic effect between nitrogen and sulphur as well as phosphorus (Jaggi and Dixit, 1996) and potassium (Ravikumar *et al.*, 2020). while application of sulphur through single super phosphate alone, without any additional source yields very low value which suggests its inadequacy. Similar results were reported by Naresha *et al*. (2018). Higher levels of calcium may favours the soil structure and texture which leads to better absorption of nutrients like phosphorus and potassium.

Calcium requirement is more at pod filling than pegging and pod development stages. Application of gypsum at this stage improves pod filling. The soluble calcium might be increased leading to increased pod yields (Singh, 2009). Since groundnut utilizes most of its sulphur requirements at pegging to pod filling stages (Murant and Kumar, 1990) split application of sulphur source (gypsum) will ensure sufficient quantities of S at times of need which has been proved in the experiment. Increasing trend in sulphur uptake was observed with increase in gypsum levels (Patel and Zinzala, 2018).

**3.2 Effect on quality parameters:**

Application of 100% RDF + Gypsum @ 625 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) has recorded highest oil content of 48.43 per cent followed by $T_8$ (100% RDF +Gypsum @ 750 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), $T_7$ (100% RDF + Gypsum @ 750 kg ha$^{-1}$ at flower initiation stage) with 47.72, 47.68 and 47.43 per cent, respectively (Table.2). Lowest oil content was recorded in control plot (45.77 %). However, increase in the oil content with sulphur application was due to increased availability and solubility of sulphur containing amino acids like cysteine, cystine and methionine and also involved in the formation of glucosides or glucosinolates, which on hydrolysis increase the oil content. Hence, addition of sulphur in almost all the treatments in the form of SSP, Gypsum and CaMS Super creates a favourable environment in the root zone and increased the uptake of nutrients as well as oil synthesis in groundnut. These results are in line with the findings of Kavya *et al*. (2022). Highest oil content might be due to influence of sulphur in rapid conversion of nitrogen to crude protein and finally to oil. The acetic thiolinase, a sulphur-based enzyme in the presence of sulphur converts acetyl Co A to melonyl Co A rapidly resulting in higher oil content (Nagavani *et al.*, 2001).

Close observation of data regarding protein content from the table 2 reveals non-significant influence of gypsum and CaMS Super on protein content of groundnut Application of 100% RDF + Gypsum @ 625 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) recorded highest protein content (27.43 %) followed by treatment 100% RDF +Gypsum @ 750 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) (23.56 %). Minimum protein content was noticed in control treatment (20.31 %). The maximum protein content was observed with the split application of gypsum as compared to full dose application at flowering time though the difference was non-significant. Similar findings were observed by Patel *et al*. (2009) with the application of gypsum exerted non-significant influence on protein content.

An examination of data (Table 2) revealed that, the higher amount of Aflatoxin content was noticed in control treatment whereas the lowest aflatoxin content was recorded in $T_8$ (100% RDF +Gypsum @ 750 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) treatment with 17.95 µg kg$^{-1}$, which was at par with treatments $T_7$ (100% RDF + Gypsum @ 750 kg ha$^{-1}$a at flower initiation stage), $T_6$ (100% RDF + Gypsum @ 625 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) and $T_5$ (100% RDF + Gypsum @ 625 kg ha$^{-1}$ at flower initiation stage) with the aflatoxin content of 18.43, 20.38 and 20.54 µg kg$^{-1}$ respectively. The highest aflatoxin content was observed in control treatment with 30.50 µg kg$^{-1}$. However, split doses treatments recorded lower content of aflatoxin over full dose application of gypsum and CaMS

Super application at the time of flowering. Aflatoxin content is low in the treatments receiving the sulphur through gypsum rather than CaMS super and SSP. These findings were in line with the Kankam *et al.* (2021).

Refractive index data is given in table 2 and it revealed that, application of 100% RDF (40:40:50 NPK kg ha$^{-1}$) (P is applied through SSP) showed higher refractive index of 1.4682, while the lowest was recorded in control treatment (1.4629). The effect of gypsum and CaMS Super application at different levels and different stages did not show any significant difference among the treatments. The higher measurements of the Refractive index of oils revealed the necessity to purify the oils. Similar finding was reported by Agomuo *et al*. (2017) and these were supported by Zahran and Tawfeuk (2019).

The data regarding effect of gypsum and CaMS Super application at different levels on Acid value is presented in table 2. The effect of gypsum and CaMS Super application at different levels and different stages showed significant difference among the treatments. Treatment receiving 100% RDF (40:40:50 NPK kg ha$^{-1}$) (P is applied through SSP) recorded high acid value of 1.72 mg KOH g$^{-1}$, followed by $T_4$ (100% RDF + Gypsum @ 500 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) and $T_3$ (100% RDF + Gypsum @ 500 kg ha$^{-1}$ at flower initiation stage) with an acid value of 1.70 and 1.66 mg KOH g$^{-1}$, respectively. Application of sulphur in the form of gypsum has exerted single super phosphate which triggers the biochemical reactions and increases the acid value content over other sources like gypsum and CaMS super fertilizers. These findings were supported by Ariraman and Kalaichelvi, 2020.

It is evident from the data (Table 2) that, Iodine value was significantly increased with increase in the gypsum levels. Application of 100% RDF (40:40:50 NPK kg ha$^{-1}$) (P is applied through SSP) has recorded lower iodine content of 72.1 g 100 g$^{-1}$, which was at par with $T_3$ treatment with an iodine content of 74.6 g 100 g$^{-1}$. Higher Iodine content of 90.1 g 100 g$^{-1}$ was noticed in control treatment. Sulphur application through gypsum, CaMS super and SSP showed significant influence over the control. This might be due to conversion of unsaturated fatty acids to saturated fatty acids and synthesis of fatty acids by sulphur which reduces the rancidity of groundnut oil and there by decreases the iodine value of groundnut oil. The iodine number was used to define the degree of unsaturation and stability of peanut oil samples. These results were in conformity with the findings of Ravi *et al*. (2008)

**CONCLUSION:**

On the basis of the above-mentioned findings, it may be inferred that, Among the different treatments, application of 100% RDF + Gypsum @ 625 kg $ha^{-}$(50% at flower initiation stage + 50% at pod development stage) showed significant influence on growth, yield and quality of groundnut. The highest dry matter production (7783 kg $ha^{-1}$), pod and haulm yields (2737 and 5046 kg $ha^{-1}$), less aflatoxin content (17.09 µg $kg^{-1}$) was recorded in $T_6$ treatment. Among the two CaMS super treatments, $T_{10}$ (100% RDF + CaMS Super @ 250 kg $ha^{-1}$ (50% at flower initiation stage+ 50% at pod development stage) showed higher growth, yield and quality of groundnut.

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**Table 1. Uptake of nutrients (kg ha$^{-1}$) by groundnut as influenced by different levels of Gypsum and CaMS Super application at Harvest**

| Treatment Details | N | | P | | K | | Ca | | Mg | | S | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pods | Haulm | Pods | Haulm | Pods | Haulm | Pods | Haulm | Pods | Haulm | Pods | Haulm |
| $T_1$: Control | 56.56 | 67.95 | 6.91 | 8.09 | 13.89 | 36.03 | 10.15 | 44.89 | 7.40 | 23.30 | 7.43 | 9.10 |
| $T_2$:100% RDF (40:40:50 NPK kg ha$^{-1}$) (P is applied through SSP) | 70.58 | 80.69 | 8.08 | 9.62 | 15.2 | 41.98 | 19.14 | 74.32 | 9.39 | 26.55 | 10.95 | 11.06 |
| $T_3$:100% RDF + Gypsum @ 500 kg ha$^{-1}$ at f lower initiation stage (Farmers practice) | 77.12 | 97.74 | 9.37 | 11.36 | 19.82 | 51.24 | 22.39 | 92.91 | 10.68 | 30.09 | 13.13 | 15.32 |
| $T_4$:100% RDF + Gypsum @ 500 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) | 79.26 | 101.37 | 10.32 | 12.45 | 21.05 | 52.87 | 23.97 | 101.05 | 11.59 | 32.94 | 13.39 | 16.67 |
| $T_5$:100% RDF + Gypsum @ 625 kg ha$^{-1}$ at flower initiation stage | 90.17 | 105.61 | 11.17 | 14.00 | 21.84 | 55.38 | 27.27 | 111.92 | 14.48 | 35.10 | 13.64 | 16.74 |
| $T_6$:100% RDF + Gypsum @ 625 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) | 98.10 | 114.92 | 13.69 | 15.41 | 24.87 | 63.37 | 29.20 | 125.45 | 17.17 | 39.23 | 14.36 | 18.59 |
| $T_7$:100% RDF + Gypsum @ 750 kg ha$^{-1}$a at flower initiation stage | 86.15 | 103.97 | 10.69 | 13.60 | 21.47 | 54.63 | 24.86 | 104.81 | 12.81 | 33.55 | 13.55 | 16.52 |
| $T_8$:100% RDF +Gypsum @ 750 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) | 90.57 | 109.47 | 12.28 | 14.96 | 22.18 | 59.92 | 29.05 | 120.97 | 16.61 | 37.94 | 14.11 | 17.98 |
| $T_9$:100% RDF + CaMS Super @ 250 kg ha$^{-1}$ at flower initiation stage (Farmers practice) | 74.75 | 82.66 | 9.16 | 10.09 | 18.50 | 43.86 | 21.74 | 81.36 | 9.73 | 43.15 | 12.24 | 11.72 |
| $T_{10}$:100% RDF + CaMS Super @ 250 kg ha$^{-1}$ (50% at flower initiation stage+ 50% at pod development stage) | 76.42 | 83.98 | 9.33 | 10.04 | 19.44 | 44.32 | 21.75 | 81.99 | 10.54 | 44.27 | 12.58 | 12.22 |
| **SEm±** | **5.18** | **6.75** | **0.85** | **1.11** | **1.76** | **4.30** | **2.01** | **8.67** | **1.12** | **2.61** | **0.49** | **1.22** |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CD (p=0.05)** | **15.37** | **19.77** | **2.52** | **3.10** | **5.22** | **12.67** | **5.97** | **25.75** | **3.32** | **7.75** | **1.44** | **3.62** |



**Table 2. Oil content (%), Protein content (%), Aflatoxin content (μg kg$^{-1}$), Refractive Index, Acid Value (mg KOH g$^{-1}$) and Iodine Value (g 100 g$^{-1}$) of groundnut as influenced by different levels of Gypsum and CaMS Super application at harvest**

| **Treatment Details** | **Oil content** | **Protein content** | **Aflatoxin content** | **Refractive Index** | **Acid value** | **Iodine value** |
|---|---|---|---|---|---|---|
| **$T_1$**: Control | 45.77 | 20.31 | 30.50 | 1.4629 | 1.32 | 90.10 |
| **$T_2$**:100% RDF (40:40:50 NPK kg ha$^{-1}$) (P is applied through SSP) | 46.82 | 21.38 | 27.50 | 1.4682 | 1.72 | 72.11 |
| **$T_3$**:100% RDF + Gypsum @ 500 kg ha$^{-1}$ at flower initiation stage (Farmers practice) | 46.15 | 22.25 | 24.53 | 1.4649 | 1.66 | 74.60 |
| **$T_4$**:100% RDF + Gypsum @ 500 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) | 47.40 | 22.46 | 23.68 | 1.4645 | 1.70 | 86.22 |
| **$T_5$**:100% RDF + Gypsum @ 625 kg ha$^{-1}$ at flower initiation stage | 47.68 | 22.94 | 20.54 | 1.4636 | 1.00 | 85.20 |
| **$T_6$**:100% RDF + Gypsum @ 625 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) | 48.43 | 23.56 | 20.38 | 1.4336 | 0.90 | 80.21 |
| **$T_7$**:100% RDF + Gypsum @ 750 kg ha$^{-1}$a at flower initiation stage | 47.43 | 22.73 | 18.43 | 1.4632 | 0.80 | 86.90 |
| **$T_8$**:100% RDF +Gypsum @ 750 kg ha$^{-1}$ (50% at flower initiation stage + 50% at pod development stage) | 47.72 | 23.00 | 17.95 | 1.4635 | 0.90 | 87.32 |
| **$T_9$**:100% RDF + CaMS Super @ 250 kg ha$^{-1}$ at flower initiation stage (Farmers practice) | 46.25 | 21.63 | 26.57 | 1.4632 | 0.80 | 88.30 |
| **$T_{10}$**:100% RDF + CaMS Super @ 250 kg ha$^{-1}$ (50% at flower initiation stage+ 50% at pod development stage) | 46.58 | 21.93 | 26.19 | 1.4636 | 1.00 | 89.41 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **SEm±** | **2.67** | **0.90** | **1.62** | **0.10** | **0.05** | **4.58** |
| **CD (p=0.05)** | **NS** | **NS** | **4.80** | **NS** | **0.14** | **13.59** |