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Response of foliar application of magnesium sulphate on yield, yield attributes and quality of groundnut (*Arachis hypogaea* L.)

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ABSTRACT

A field experiment was conducted during Kharif 2025 at the Main Agricultural Research Station (MARS), University of Agricultural Sciences, Raichur, Karnataka, to evaluate the response of foliar application of magnesium sulphate on yield, yield attributes and quality of groundnut (*Arachis hypogaea* L.) variety Dh-256. The experiment was laid out in a Randomized Complete Block Design with six treatments and four replications. The treatments comprised recommended dose of fertilizers (RDF) alone, foliar application of magnesium sulphate at 0.5, 1.0, 1.5 and 2.0 per cent at 30 and 45 days after sowing (DAS) and soil application of magnesium sulphate @ 10 kg ha⁻¹. Significant differences among treatments were observed for number of matured pods plant⁻¹, pod yield plant⁻¹, dry pod yield, haulm yield, harvest index, shelling percentage, kernel yield and oil content, whereas 100-seed weight was not significantly influenced. T₄, receiving 1.5 per cent MgSO₄ foliar spray recorded the higher number of matured pods (34.21 plant⁻¹), pod yield plant⁻¹ (34.58 g), dry pod yield (2881 kg ha⁻¹), haulm yield (4150 kg ha⁻¹), harvest index (40.98 %), shelling percentage (71.84 %), kernel yield (2069.71 kg ha⁻¹) and oil content (52.12 %). T₄ was statistically on par with T₅ and T₃ for these parameters. The 100-seed weight was numerically higher in T₄ (45.42 g), but the treatment differences were non-significant. The study indicated that foliar application of MgSO₄ at 1.5 per cent at 30 and 45 DAS was effective in improving yield and quality of groundnut under the conditions of the experiment.

Keywords: Groundnut, Magnesium sulphate, Foliar application, Yield attributes, Kernel yield, Oil content

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the important oilseed crops grown in India and is valued for its edible oil, protein-rich kernels and nutritious haulm. The yield of groundnut depends on proper pod formation, pod filling and development of well-filled kernels. These processes are closely related to the crop's nutritional status during vegetative and reproductive growth. Therefore, balanced nutrient management is important for achieving good yield and quality in groundnut.

Magnesium (Mg) is an essential secondary nutrient required for several important physiological processes in plants. It is a central component of chlorophyll and plays an important role in photosynthesis, enzyme activation, energy transfer and carbohydrate metabolism. Magnesium also helps in the movement of photosynthates from source leaves to developing sinks. Cakmak *et al.* (2008) [1] explained that adequate Mg supply is important for carbon partitioning and for reducing photooxidative damage in plants. Similarly, Fischer *et al.* (1993) [2] reported that Mg deficiency reduced leaf expansion and net assimilation, showing the importance of Mg for maintaining active plant growth.

The availability of Mg can also influence crop productivity. Wang *et al.* (2020) [3], based on a meta-analysis of Mg fertilization studies, reported an overall positive effect of Mg fertilization on crop yield, particularly where Mg availability was limiting. The response, however, depends on crop species, soil properties, initial Mg status, rate of application and method of nutrient application. Gerendas *et al.* (2013) [4] also emphasized the importance of adequate Mg nutrition for maintaining crop quality.

In groundnut, adequate nutrient availability during the reproductive stage is particularly important because a large proportion of the assimilates produced by the crop is ultimately directed towards pod and seed development. Application of secondary and micronutrients has been reported to improve yield and yield components of groundnut. Rajitha *et al.* (2018) [5] reported beneficial effects of secondary and micronutrient application on yield and yield components of groundnut.

Recent studies have specifically highlighted the importance of Mg nutrition in peanut. Gao *et al.* (2024) [6] reported that Mg fertilizer application increased peanut growth and pod yield under reduced nitrogen application. The improvement was associated with enhanced growth and dry matter accumulation. Hu *et al.* (2024) [7] also studied different rates of Mg fertilizer in peanut and reported changes in nutrient absorption

and photosynthetic characteristics with Mg application. *Ma et al. (2026)* [8] further reported that foliar Mg application improved peanut growth and yield under phosphorus-limited conditions.

Foliar application provides nutrients directly to the foliage and can be useful when nutrient demand is high. In groundnut, application during the reproductive stage may help maintain active leaves and improve the supply of photosynthates to developing pods. However, the response to foliar Mg depends on the concentration used and the growing conditions of the crop.

Information on the response of groundnut to different concentrations of foliar-applied MgSO_4 under the agro-climatic conditions of northern *Karnataka* is limited. Therefore, the present investigation was undertaken to evaluate the effect of different concentrations of foliar magnesium sulphate on yield attributes, yield and quality of groundnut variety Dh-256.

Material and Methods

A field experiment was conducted during *Kharif* 2025 at the Main Agricultural Research Station, University of Agricultural Sciences, Raichur, *Karnataka*, located in the North Eastern Dry Zone (Zone-II) at $16^{\circ}12' \text{ N}$ latitude, $77^{\circ}20' \text{ E}$ longitude and 389 m above mean sea level. The soil was red sandy loam (*Alfisol*). The crop season received 752.2 mm rainfall in 54 rainy days, with mean maximum and minimum temperatures of 32.9 and 20.6°C , respectively. Groundnut variety Dh-256 was evaluated in a Randomized Complete Block Design with six treatments and four replications. The gross and net plot sizes were $4.5 \times 3.0 \text{ m}$ and $3.9 \times 2.4 \text{ m}$, respectively, with a spacing of $30 \times 10 \text{ cm}$. All treatments received RDF of $18:46:25 \text{ kg N:P}_2\text{O}_5:\text{K}_2\text{O ha}^{-1}$ and FYM @ 7.5 t ha^{-1} . The treatments comprised RDF alone (T_1), RDF + MgSO_4 @ $0.5, 1.0, 1.5$ and 2.0 per cent foliar spray at 30 and 45 DAS (T_2 - T_5 , respectively) and RDF + MgSO_4 @ 10 kg ha^{-1} through soil application (T_6). The soil-applied MgSO_4 was incorporated at sowing, whereas foliar treatments were applied at 30 and 45 DAS.

The crop was sown on 25 July 2025 and harvested on 21 November 2025. Weeding was carried out at 20 and 35 DAS, and other crop management practices were followed uniformly across treatments. The number of matured pods was recorded from five randomly selected plants in each plot. Pod yield plant^{-1} was determined by collecting, drying and weighing the pods obtained from the selected plants. A random sample of 100 clean and dried seeds was weighed to determine 100-seed weight. Dry pod and haulm yields were recorded from the net plot and converted to kg ha^{-1} .

Harvest index was calculated as the ratio of economic yield to biological yield and expressed as percentage. Shelling percentage was calculated from kernel weight and pod weight. Kernel yield was calculated from pod yield and shelling percentage. Oil content was determined using a Nuclear Magnetic Resonance (NMR) analyser using clean and dried seed samples and expressed on dry-weight basis.

The data were analysed statistically using the procedure appropriate for Randomized Complete Block Design. Standard error of mean (SEm $\pm$) and critical difference (CD) at 5 per cent were calculated for comparison of treatment means.

Results and Discussion

1. Number of matured pods plant⁻¹

Number of matured pods plant^{-1} is an important yield attribute of groundnut and the treatment means are presented in *Table 1*.

The number of matured pods plant^{-1} differed significantly among the treatments. T_4 recorded the higher number of matured pods (34.21 plant^{-1}), followed by T_5 (33.38) and T_3 (31.43). T_4 was statistically on par with T_5 and T_3 . T_6 recorded 30.34 matured pods plant^{-1} , whereas the lower number was recorded in T_1 (26.85 plant^{-1}).

The higher number of matured pods in T_4 may be due to better crop growth and improved supply of photosynthates during the reproductive stage. Magnesium has an important role in photosynthesis and carbohydrate metabolism, and adequate Mg nutrition may help in

maintaining the supply of assimilates to developing reproductive organs. *Gao et al. (2024)* [6] reported improved peanut growth and pod yield with Mg application under reduced nitrogen supply, which was associated with better photosynthetic activity and dry matter accumulation.

The response observed in the present study was also consistent with the findings of *Rajitha et al. (2018)* [5], who reported improvement in yield components of groundnut with secondary and micronutrient application. The higher response at 1.5 per cent MgSO_4 indicates that this concentration was more favourable for pod development under the conditions of the present experiment.

2. Pod yield plant⁻¹

Pod yield plant^{-1} is an important component of groundnut productivity and the treatment means are presented in *Table 1*.

Pod yield plant^{-1} was significantly influenced by MgSO_4 application. The higher pod yield was recorded in T_4 ($34.58 \text{ g plant}^{-1}$), followed by T_5 (33.62 g) and T_3 (31.71 g). T_4 was statistically on par with T_5 and T_3 . T_6 recorded $30.61 \text{ g plant}^{-1}$, while the lower pod yield was observed in T_1 ($27.16 \text{ g plant}^{-1}$).

The higher pod yield in T_4 may be due to better crop growth, greater photosynthetic activity and improved movement of photosynthates towards developing pods. Magnesium is closely involved in photosynthesis and carbohydrate metabolism and therefore has an important role during pod development.

Gao et al. (2024) [6] reported that Mg application increased peanut pod yield under reduced nitrogen supply. They related the improvement to better photosynthetic performance and assimilate transport. The present results are also in agreement with *Hu et al. (2024)* [7], who observed improvement in peanut yield-related traits with suitable Mg fertilizer application.

The progressive increase in pod yield from T_1 to T_4 also indicates that the crop responded favourably to increasing foliar Mg concentration up to 1.5 per cent. However, increasing the concentration further to 2.0 per cent did not result in a significant additional increase, as T_5 remained statistically on par with T_4 .

3. 100-seed weight

100-seed weight is an important yield attribute reflecting seed size and the treatment means are presented in *Table 1*.

The effect of MgSO_4 application on 100-seed weight was non-significant. The values ranged from 44.24 to 45.42 g . T_4 recorded the higher numerical value of 45.42 g , followed by T_5 (45.25 g) and T_3 (45.19 g). The lower value was recorded in T_1 (44.24 g).

Although T_4 recorded numerically higher seed weight, the differences among treatments were not significant. Therefore, the increase in 100-seed weight cannot be considered a definite response to MgSO_4 application under the conditions of the experiment.

The non-significant response may indicate that seed size was relatively stable among the treatments and could have been influenced more by the genetic characteristics of the variety. The response of seed weight to Mg nutrition can also vary depending on crop growth conditions, soil nutrient status and the level of Mg supplied.

4. Dry pod yield

Dry pod yield is a major indicator of groundnut productivity and the treatment means are presented in *Table 1*.

Dry pod yield differed significantly among the treatments. T_4 recorded the higher dry pod yield (2881 kg ha^{-1}), followed by T_5 (2803 kg ha^{-1}) and T_3 (2726 kg ha^{-1}). T_4 was statistically on par with T_5 and T_3 , whereas T_6 recorded 2664 kg ha^{-1} and T_1 recorded 2520 kg ha^{-1} .

The higher dry pod yield under T_4 may be due to better pod formation and filling resulting from improved crop growth and photosynthate supply. Adequate Mg nutrition helps maintain chlorophyll and photosynthetic activity, which may increase the production of assimilates available for pod development.

Gao et al. (2024) [6] reported higher peanut pod yield and dry matter production with Mg application under reduced nitrogen supply.

Similarly, Ma *et al.* (2026) [8] observed improved peanut productivity with foliar Mg application under phosphorus-limited conditions. These findings support the beneficial role of Mg application in maintaining peanut productivity under conditions where nutrient availability may restrict crop growth.

The dry pod yield recorded under T₄ was 14.33 per cent higher than T₁, showing the advantage of the 1.5 per cent foliar treatment over RDF alone.

Table 1. Effect of magnesium sulphate application on yield attributes of groundnut

Treatment	Number of matured pods plant ⁻¹	Pod yield plant ⁻¹ (g)	100-seeds weight (g)	Dry pod yield (kg ha ⁻¹)
T ₁ - RDF (Control)	26.85	27.16	44.24	2520
T ₂ - RDF + Foliar spray of MgSO ₄ @ 0.5 % at 30 and 45 DAS	28.92	29.15	44.60	2608
T ₃ - RDF + Foliar spray of MgSO ₄ @ 1.0 % at 30 and 45 DAS	31.43	31.71	45.19	2726
T ₄ - RDF + Foliar spray of MgSO ₄ @ 1.5 % at 30 and 45 DAS	34.21	34.58	45.42	2881
T ₅ - RDF + Foliar spray of MgSO ₄ @ 2.0 % at 30 and 45 DAS	33.38	33.62	45.25	2803
T ₆ - RDF + Soil application of MgSO ₄ @ 10 kg ha ⁻¹	30.34	30.61	44.81	2664
S. Em. ±	1.13	1.07	0.24	63
CD @ 5 %	3.42	3.19	NS	187

5. Haulm yield

Haulm yield reflects the biomass production of groundnut at harvest and the treatment means are presented in Table 2.

Haulm yield differed significantly among the treatments. T₄ recorded the higher haulm yield (4150 kg ha⁻¹), followed by T₅ (4084 kg ha⁻¹) and T₃ (4027 kg ha⁻¹). T₄ was statistically on par with T₅ and T₃. T₆ recorded 3958 kg ha⁻¹, while T₁ recorded the lower haulm yield of 3856 kg ha⁻¹.

The higher haulm yield with foliar MgSO₄ application may be related to better vegetative growth and greater dry matter accumulation. Magnesium is closely associated with chlorophyll formation and photosynthetic activity and better Mg nutrition can help maintain active foliage for a longer period.

Gao *et al.* (2024) [6] also reported increased dry matter accumulation in peanut with Mg application. The present findings suggest that the improved vegetative growth under T₄ was reflected in greater biomass production at harvest.

T₄ recorded 7.63 per cent higher haulm yield over T₁. However, T₄ remained statistically on par with T₅ and T₃, indicating that increasing foliar Mg concentration beyond 1.5 per cent did not provide a significant additional increase in haulm production.

6. Harvest index

Harvest index indicates the efficiency of biomass partitioning towards economic yield and the treatment means are presented in Table 2.

Harvest index was significantly influenced by MgSO₄ application. T₄ recorded the higher harvest index (40.98 %), followed by T₅ (40.70 %) and T₃ (40.37 %). T₄ was statistically on par with T₅ and T₃. T₆ recorded 40.23 per cent, while T₁ recorded the lower harvest index (39.52 %).

The higher harvest index in T₄ may be due to better pod and kernel production in relation to total biomass production. A higher harvest index generally indicates better partitioning of the accumulated biomass towards the economic portion of the crop.

The difference between T₄ and T₅ was small, showing that increasing the foliar concentration from 1.5 to 2.0 per cent did not result in a significant improvement in harvest index. The response was therefore

more favourable at 1.5 per cent MgSO₄ under the conditions of the experiment.

7. Shelling percentage

Shelling percentage indicates the proportion of kernels obtained from the pods and the treatment means are presented in Table 2.

Shelling percentage differed significantly among the treatments. T₄ recorded the higher shelling percentage (71.84 %), followed by T₅ (71.18 %) and T₃ (70.38 %). T₄ was statistically on par with T₅ and T₃. T₆ recorded 69.70 per cent, whereas T₁ recorded the lower shelling percentage (68.27 %).

The higher shelling percentage in T₄ may be due to better kernel development and filling. Adequate Mg nutrition supports photosynthetic activity and the movement of photosynthates towards developing seeds. This may have resulted in a greater proportion of kernel weight in relation to total pod weight.

Hu *et al.* (2024) [7] also reported improvement in kernel-related yield traits of peanut with appropriate Mg fertilizer application. The present findings indicate that foliar Mg application at 1.5 per cent was favourable for kernel development under the experimental conditions.

8. Kernel yield

Kernel yield is an important component of groundnut productivity and quality and the treatment means are presented in Table 2.

Kernel yield was significantly affected by MgSO₄ application. T₄ recorded the higher kernel yield (2069.71 kg ha⁻¹), followed by T₅ (1995.18 kg ha⁻¹) and T₃ (1918.56 kg ha⁻¹). T₄ was statistically on par with T₅ and T₃. T₆ recorded 1856.81 kg ha⁻¹, while the lower kernel yield was recorded in T₁ (1720.40 kg ha⁻¹).

The higher kernel yield in T₄ was mainly associated with the higher pod yield and shelling percentage recorded in this treatment. Thus, the advantage of foliar Mg application was reflected not only in total pod production but also in the quantity of kernels obtained from the pods.

Gao *et al.* (2024) [6] reported improved peanut pod yield with Mg application, while Hu *et al.* (2024) [7] observed favourable changes in yield-related traits and nutrient absorption with suitable Mg fertilizer rates. The present results follow a similar trend, with the higher kernel yield recorded at 1.5 per cent foliar MgSO₄.

9. Oil content

Oil content is an important quality parameter of groundnut and the treatment means are presented in Table 2.

Oil content differed significantly among the treatments. T₄ recorded the higher oil content (52.12 %), followed by T₅ (51.09 %) and T₃ (50.23 %). T₄ was statistically on par with T₅ and T₃. T₆ recorded 49.83 per cent, while the lower oil content was recorded in T₁ (47.50 %).

The higher oil content recorded under T₄ may be associated with improved crop growth and assimilate availability during seed development. Magnesium has an important role in photosynthesis and carbo-

hydrate metabolism and adequate Mg nutrition may help maintain the supply of assimilates required for seed development and oil accumulation.

Gerendas *et al.* (2013) [4] reported that Mg nutrition has an important role in crop quality, while Wang *et al.* (2020) [3] observed an overall positive response of crops to Mg fertilization. The present results indicate that adequate Mg supply through foliar application was favourable for oil accumulation in groundnut.

The difference between T₄ and T₅ was small and statistically non-significant, suggesting that increasing MgSO₄ concentration from 1.5 to 2.0 per cent did not provide a further significant improvement in oil content.

Table 2. Effect of magnesium sulphate application on haulm yield and quality parameters of groundnut

Treatment	Haulm yield (kg ha ⁻¹)	Harvest index (%)	Shelling percentage	Kernel yield (kg ha ⁻¹)	Oil content (%)
T ₁ - RDF (Control)	3856	39.52	68.27	1720.40	47.50
T ₂ - RDF + Foliar spray of MgSO ₄ @ 0.5 % at 30 and 45 DAS	3932	39.88	69.12	1802.65	49.38
T ₃ - RDF + Foliar spray of MgSO ₄ @ 1.0 % at 30 and 45 DAS	4027	40.37	70.38	1918.56	50.23
T ₄ - RDF + Foliar spray of MgSO ₄ @ 1.5 % at 30 and 45 DAS	4150	40.98	71.84	2069.71	52.12
T ₅ - RDF + Foliar spray of MgSO ₄ @ 2.0 % at 30 and 45 DAS	4084	40.70	71.18	1995.18	51.09
T ₆ - RDF + Soil application of MgSO ₄ @ 10 kg ha ⁻¹	3958	40.23	69.70	1856.81	49.83
S. Em. ±	48	0.20	0.62	50.57	0.72
CD @ 5 %	142	0.63	1.83	151.82	2.20

Conclusion

Foliar application of magnesium sulphate significantly influenced yield and quality parameters of groundnut. Among the treatments, T₄ receiving MgSO₄ @ 1.5 per cent foliar spray at 30 and 45 DAS recorded the higher number of matured pods, pod yield plant⁻¹, dry pod yield, haulm yield, harvest index, shelling percentage, kernel yield and oil content. T₄ was statistically on par with T₅ and T₃ for these parameters, whereas 100-seed weight was not significantly influenced by MgSO₄ application. Under the conditions of the present investigation, foliar application of MgSO₄ @ 1.5 per cent at 30 and 45 DAS along with RDF and FYM was effective in improving yield and quality of groundnut variety Dh-256.

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Abbreviations

DAS, days after sowing; RDF, recommended dose of fertilizers; SEM ±, standard error of mean; CD, critical difference; NS, non-significant.

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