Effect of different calcium sources on yields and quality of groundnuts (*Arachis hypogaea* L.) in Thihawa, Kumbukwewa

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1. Introduction

Groundnut is cultivated in the dry and intermediate zones of Sri Lanka mainly in the Maha season and in paddy lands during Yala season. According to the Department of Agriculture DOA (2006), the application of calcium is important for proper kernel development in groundnut. Calcium carbonate, a source of calcium, is slow releasing due to less solubility compared to gypsum. Therefore, gypsum ($CaSO_4.2H_2O$) can be used at flowering to ensure the adequate availability of calcium in the fruiting zone to enhance pod development. Gypsum application to the soil reduces erosion due to improving soil aggregates by increasing the ability of soil to soak up water after precipitation whereby it improves soil aeration and water percolation through the soil profile. The application of gypsum to soils low in calcium increased the percentage of oil in all peanut cultivars; with less nitrogen content. The application of gypsum to groundnuts grown in Georgia increased germination and reduced aflatoxin contents by 40 percent (Davidson et al.,1983). Chapman et al. (1993) reported that the low calcium in the pegging zone causes low peg formation. The groundnut pegs and pods treated with gypsum had significantly less pod rot than the untreated (Chapman et al., 1993). Farmers in the Dambulla area apply 60-350 kg ha^{-1} of gypsum for their cultivations and obtained a yield of 2500kg ha^{-1}. The yield of groundnut is around 750 - 1000 kg ha^{-1} in Thihawa, Kumbukwewa. Hence, the objective of this study was to evaluate the effect of gypsum and calcium carbonate on groundnut in Thihawa, Kumbukwewa.

2. Materials and Methods

This study was conducted at the Thihawa, Kumbukwewa in Kurunegala district, which belongs to IL3 agro-ecological region. This was conducted in Maha season in October 2019 and variety Thissa was used. The recommended fertilizer rate is 30 kg ha^{-1} nitrogen, 45 kg ha^{-1} phosphate (P_2O_5), 45 kg ha^{-1} potash (K_2O) (DOA,2006) and there was no recommendation for gypsum or calcium carbonate. The experiment was laid according to Randomized Complete Block Design (RCBD) with four treatments with three replicates. The treatments were: DOA recommendation (control) (T1), DOA recommendation + 200 kg $ha\text{-}^{1}$ of gypsum (T2), DOA recommendation + 200 kg $ha\text{-}^{1}$ of calcium carbonate(T3), DOA recommendation + 100 kg ha^{-1} of gypsum + 100 kg ha^{-1} of calcium carbonate (T4). Soil pH, cation exchange capacity (CEC), and electrical conductivity (EC) were measured at the planting, 5 days after application (5 DAA) at the pegging stage and harvest. The number of pegs per plant was calculated by selecting five plants randomly and the pods' fresh weights (g), pods' dry weight (g), kernel weight of fifty pods (g), and shell weight of fifty pods were measured (g). The quality of the kernel was assessed visually by sorting and grouping the seeds according to the size of the kernel of 50 pods into large, medium and small. Data were analyzed using the analysis of variance (ANOVA) procedure by statistical analysis system (SAS) and mean separation was done using Duncan's Multiple Range Test (DMRT) at p= 0.05.

3. Results and Discussion

Initial pH, CEC (cmol kg-1) and EC (micro-Siemens cm^{-1}) values showed the soil was in the acidic range and it was below the recommended pH range. The initial stage pH varied from 5.4 to 5.5, CEC varied from 6.0 cmol kg^{-1} to 6.5 cmol kg^{-1} and EC varied from 200 µS cm^{-1} to 220 µS cm^{-1}. 5 days after application (5 DAA) at the pegging stage, pH varied from 5.4 to 6.0, CEC varied from 7.2 cmol kg^{-1} to 7.8 cmol kg^{-1} and EC varied from 230 µS cm^{-1} to 270 µS cm^{-1}. At harvesting pH varied from 5.4 to 6.0, CEC varied from 7.1 cmol kg^{-1} to 7.7 cmol kg^{-1} and EC varied from 210 µS cm^{-1} to 260 µS cm^{-1}. Warren (2011), observed that gypsum improve the pod filling without changing the soil pH and explained that a good soil EC level was somewhere above 200 µS cm^{-1} and 1200 µS cm^{-1} (1.2 mS cm-1) while any soils < 200 µS cm^{-1} have not enough available nutrients to the plant and a sterile soil with minimum microbial activity and EC above 1200 µS cm^{-1} indicate that of high salt fertilizer or perhaps a salinity problem due to lack of drainage.

When plant performance is considered; treatment T2(20) with gypsum revealed the highest peg formation whereas the least was in (T1) and (T3). The results showed there was no significant difference between (T1) and (T3), but there was a significant difference in (T2) compared to the control (T1). The highest mean pod fresh weight was in (T2) (23.3g/ plot) and the least was in (T1) (20.5 g/plot). The T2 treatment showed a significantly higher yield compared to other treatments. (T1) without gypsum showed a significantly lower yield than other treatments. Therefore, (T2) with 200 kg ha^{-1} of gypsum could be identified as the best treatment to obtain higher yields. When the yield is considered, kernel weight and 100 pod weight showed a significant difference ($p< 0.05$) among treatments (Table 1). The treatment (T2) (2800 Kg/ha) showed a significantly higher kernel yield and a good quality appearance compared to other treatments. The treatment (T1) (2458 Kg/ha) gave the lowest yield with half-filled nuts. Therefore, according to the results, the treatment (T2) with 200 kg ha^{-1} of gypsum was the best treatment to obtain a higher kernel yield. The results showed that the individual seed weight was not significantly different (p > 0 .05) among treatments (Table 1).

Table 01. The Yield, kernel dry weight, individual seed weight, 100-kernel weight, 100 pod weight and mean pod weight

Treatment	Yield (Kg/ha)	The dry weight of kernel (g)/plot	Individual seed weight (g)	100 kernel weights (g)	100 pod weights (g)	Mean Pod weight (g)
T1	2458^{d}	12.7^{b}	0.40^{a}	39.83^{b}	113.8^{b}	1.14^{b}
T2	2800^{a}	13.1^{a}	0.41^{a}	40.83^{a}	116.7^{ab}	1.17^{ab}
T3	2550^{c}	13.2^{a}	0.41^{a}	41.32^{a}	118.1^{a}	1.18^{a}
T4	2694^{b}	13.2^{a}	0.41^{a}	41.36^{a}	118.2^{a}	1.18^{a}

*Values within a column followed by a common letter are not significantly different at P=0.05, according to DMRT

According to Salke et al. (2010), gypsum application increased the number of nodules per plant and the dry weight of nodules per plant. When considering the quality of seeds, in (T1) the percentage of the large-sized kernel, medium-sized kernel and small-sized kernels are 20%,30% and 50% respectively and in (T2) the percentage of the large-sized kernel, medium-sized kernel and small-sized kernels are 60%,30% and 10% respectively.

The results showed that the quality of the kernel of 100 pods was significantly different ($p<0.05$) among treatments. The T2 treatment gave a better kernel size compared to other treatments with the application of 200 kg ha^{-1} of gypsum. However, all the treatments with the application of calcium showed an improvement in kernel size. As same as the present study, it appeared due to gypsum's positive effect on soil chemical characteristics, especially around the rhizosphere increased the number of peg in groundnut (Salke et al., 2010).

4. Conclusions

It is evident from the results that adding gypsum with DOA recommendation increased the groundnut yield. The treatment with DOA recommendation + 200 kg ha^{-1} of gypsum increased the nut yield from 2458 to 2800 kg ha^{-1} with better quality kernels in pH 4.4 soil at Thihawa, Kumbukwewa. A significant effect was found on yield when applying DOA recommendation + 100 kg ha^{-1} of gypsum + 100 kg ha^{-1} of calcium carbonate, but no significant effect was found on 100 kernel weight. Thus, with the application of 200 kg ha^{-1} of gypsum, groundnut produces a higher number of pegs per plant and increased kernel weight.

5. References

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