

## Impact of Applying Calcium on Yield and Visual Quality of Groundnut (*Arachis hypogaea* L.)

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### Abstract

Recently, Department of Agriculture (DOA), Sri Lanka had developed four new varieties namely, Thissa, Indi, Walawa and Tikiri. Groundnut is cultivated in the dry and intermediate zones of Sri Lanka mainly under rain fed in October season and, in paddy lands under irrigation in April season. Low yields and the poor quality kernels are the major constraints to cultivation of Groundnut (*Arachis hypogaea* L.) in Sri Lanka. Groundnut is usually grown in well-drained soils with a pH of 6.5. Inadequate and unbalanced supply of nutrients may be one of the reasons for low yields in acidic and sandy soils. Farmers in Dambulla and Maspotha, apply 60-350 kg ha<sup>-1</sup> of Gypsum for their cultivations and obtained a yield of 2000-2500 kg ha<sup>-1</sup>. Therefore, this study was conducted to find out the effect of Calcium using Gypsum on the yield and quality of Groundnut in Maspotha divisional secretariat area of Kurunegala district, in the intermediate zone of Sri Lanka. Soil pH and EC were measured to determine the acidity and salinity levels. The field experiment was conducted during the October seasons 2011/2012 and 2012/2013. Randomized Complete Block Design was used with four treatments (0, 125, 175, 250 kg ha<sup>-1</sup> of Gypsum) and three replicates. The crop management practices were done according to the standard procedures. The nut yield, number of pegs per plant, kernel and shell weight of fifty pegs per plot, dry weight of fifty seeds were measured. The seed quality and filling of seeds in each treatment were also evaluated. The results revealed that with application of 250 kg ha<sup>-1</sup> of Gypsum increased the soil pH from 4.1 to 5.0 and increase the mean pod dry weight per plot of 40 plants, from 578 to 835 g with better quality kernels.

**Keywords:** Groundnut; Gypsum; Kernel weight; Shell weight

### Introduction

The groundnut, *Arachis hypogaea* L. was originated from South America and presently grown in tropical countries [1]. Recently, Department of Agriculture (DOA), Sri Lanka had developed four new varieties namely, Thissa, Indi, Walawa and Tikiri. Groundnut is cultivated in the dry and intermediate zones of Sri Lanka mainly under rain fed in October season and, in paddy lands under irrigation in April season. It is mainly grown in Moneragala, Hambantota, Kurunagala, Anuradhapura, Mullative, Rathnapura and Puttalam districts [2]. In Sri Lanka, Groundnut is used as an oil crop, as a snack and in confectionaries [2]. Groundnut is grown in well-drained sandy loam and clay loam soils. Deep well-drained soils having pH of 6.5 - 7.0 and high fertility are ideal for groundnut.

According to the DOA [2], the application of Calcium (CaCO<sub>3</sub>) is important for proper kernel development in groundnut. Calcium carbonate can be used as a calcium source, but, compared to Gypsum; it is slow releasing due to less solubility. Therefore, Gypsum (CaSO<sub>4</sub>·2H<sub>2</sub>O) can be used at flowering to ensure the adequate availability of Ca in the fruiting zone to enhance the pod development.

Chapman et al. [3] reported that the less amount of soluble calcium in the pegging zone cause low peg formation. The researchers found that the groundnut pegs and pods treated with gypsum had a significantly less pod rot, than the untreated [3]. According to the DOA statistics (2011), the cultivated groundnut extent was 9251 ha and the production was 16800 Mt. with an average yield of 1.8 Mt ha<sup>-1</sup>.

Farmers in Dambulla area apply 60-350 kg ha<sup>-1</sup> of gypsum for their cultivations and obtained a yield of 2500 kg ha<sup>-1</sup>. In Maspotha area, the yield of groundnut is around 750 - 1000 kg ha<sup>-1</sup>. Therefore, this study was conducted to find out the effect of gypsum for higher yield in Maspotha area.

### Methodology

This study was conducted at the Maspotha divisional secretariat area

in Kurunegala district, which belongs to IL1a agro ecological region [4] in October season under rainfed conditions for two consecutive years 2011/2012 and 2012/2013. The average annual rainfall was 1100-1400 mm. Soil type was reddish brown earth. The Groundnut variety Thissa was used for this study. The recommended time for planting is in October and April. The recommended fertilizer rate is 30 kg ha<sup>-1</sup> N, 45 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>, 45 kg ha<sup>-1</sup> K<sub>2</sub>O [2] and no recommendation for Gypsum.

Raised beds were used in high lands with the spacing of 45 cm×15 cm. The plot size was 1 m×3 m. Two rows of plants were planted as guard rows for each plot. The total number of plants per plot was 40. After 25 days after planting at pegging earthing up was done to improve pod filling. When the crop was matured at 110 days after planting the whole plants were uprooted and pods were collected and dried. The experiment was laid according to Randomized Complete Block Design (RCBD) with four treatments. Each Treatment had three replicates. The treatments were as follows,

T<sub>1</sub> - 0 kg ha<sup>-1</sup> of gypsum (control)

T<sub>2</sub> - 125 kg ha<sup>-1</sup> of gypsum

T<sub>3</sub> - 175 kg ha<sup>-1</sup> of gypsum

T<sub>4</sub> - 250 kg ha<sup>-1</sup> of gypsum

Soil pH, CEC and Electrical Conductivity (EC) were measured at

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the planting of seeds, 5 days after application (5 DAA) of gypsum at the pegging stage and at harvest. Yield data were collected at harvesting. Randomly 5 plants were selected from each plot and counted the number of pegs per plant. Pods fresh weights (g), Pods dry weight (g), Kernel weight of fifty pods (g), Shell weight of fifty pods (g) were also measured. Dry weights of the seeds were taken after drying the seeds for three days using solar drying system. 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 analysed using the analysis of variance (ANOVA) procedure by statistical analyze system (SAS) and mean separation was done using Duncan's Multiple Range Test (DMRT) at  $p=0.05$ .

## Results and Discussion

### Soil Properties

Initial pH, CEC (cmol kg<sup>-1</sup>) and EC (micro Siemens cm<sup>-1</sup>) values showed that the soil was in the acidic range and it was below the recommended pH range (Table 1). The pH and EC values were slightly increased after five days of applying gypsum and slightly decreased at harvest. CEC also increased with applying gypsum and slightly decreased at harvest.

Warren [5] observed that the gypsum will improve the pod filling without changing the soil pH. The researcher also explained that a good soil EC level will be somewhere above 200  $\mu\text{S cm}^{-1}$  and 1200  $\mu\text{S cm}^{-1}$  (1.2 mS cm<sup>-1</sup>). Any soils <200 does not have enough available nutrients to the plant and may be a sterile soil with minimum microbial activity. An EC above 1200  $\mu\text{S cm}^{-1}$  may indicate that of high salt fertilizer or perhaps a salinity problem due to lack of drainage.

### Plant performances

The seeds were germinated 10 to 14 days of planting. Flowers were formed about 30-40 days after the germination. The days to 50% flowering ranged between 35 to 50 days with a mean value of 41. The pegs developed to a depth of 4 to 5 cm to form pods. The number of pegs per plant significantly increased in T<sub>3</sub> and T<sub>4</sub> when compared to the control and T<sub>2</sub> (Table 2). The treatment T<sub>4</sub> showed the highest peg formation.

Stage	Property	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
Initial	pH	4.2	4.1	4.2	4.1
Initial	CEC (cmol kg <sup>-1</sup> )	6.0	6.5	6.4	6.3
Initial	EC ( $\mu\text{S cm}^{-1}$ )	205	220	200	210
5 DAA*	pH	4.3	4.4	4.3	5.0
5 DAA*	CEC (cmolkg <sup>-1</sup> )	7.2	7.5	7.7	7.8
5 DAA*	EC ( $\mu\text{S cm}^{-1}$ )	230	250	260	270
at harvest	pH	4.3	4.3	4.2	4.8
at harvest	CEC (cmol kg <sup>-1</sup> )	7.1	7.4	7.5	7.7
at harvest	EC ( $\mu\text{S cm}^{-1}$ )	210	235	245	260

\* 5 days after application

**Table 1:** Chemical properties of soil.

Treatment	Number of pegs per plant	Mean pod fresh weight (g)/plot	Mean pod fresh weight (g)/plant	Mean Pod dry weight (g)/plot	Mean Pod dry weight (g)/plant
T <sub>1</sub>	28 <sub>c</sub>	937 <sub>d</sub>	27.1 <sub>c</sub>	578 <sub>d</sub>	13.8 <sub>a</sub>
T <sub>2</sub>	30 <sub>c</sub>	1045 <sub>c</sub>	27.3 <sub>c</sub>	679 <sub>c</sub>	14.3 <sub>c</sub>
T <sub>3</sub>	33 <sub>b</sub>	1235 <sub>b</sub>	27.8 <sub>ab</sub>	754 <sub>ab</sub>	15.1 <sub>b</sub>
T <sub>4</sub>	35 <sub>a</sub>	1357 <sub>a</sub>	28.8 <sub>a</sub>	835 <sub>a</sub>	16.7 <sub>a</sub>
CV%	10	12	11	10	11

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

**Table 2:** Plant performances.

The results showed that there was a significant difference between T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> compared to the control. It appears that gypsum requirement for increased peg formation lies more than 125 kg /ha.

The mean pod fresh and dry weight per plots is given in Table 2. The T<sub>4</sub> treatment showed a significantly higher yield compared to other treatments. The T<sub>2</sub> and T<sub>3</sub> treatment showed a significant difference, and T<sub>1</sub> treatment without gypsum showed a significantly lower yield than other treatments. Therefore, T<sub>4</sub> treatment with 250 kg ha<sup>-1</sup> of gypsum could be identified as the best performer.

The treatment T<sub>4</sub> showed significantly higher pods dry weight yield when compared to other treatments (Table 2). The treatments T<sub>3</sub> and T<sub>4</sub> were not significant. The treatment T<sub>1</sub> gave the lowest yield. Therefore, T<sub>4</sub> with 250 kg ha<sup>-1</sup> of gypsum could be identified as best treatment to obtain higher yields.

### The mean kernel weight and mean shell weight

The mean kernel weight showed a significant difference ( $p<0.05$ ) among treatments (Table 3). The treatment T<sub>4</sub> showed a significantly higher kernel yield and a good quality appearance compared to other treatments. The treatment T<sub>1</sub> gave the lowest yield with half-filled nuts. Therefore, according to the results, the treatment T<sub>4</sub> with 250 kg ha<sup>-1</sup> of gypsum can be recommended as the best treatment to obtain higher kernel yield.

The results showed that the mean shell weight was also significantly different ( $p<0.05$ ) among treatments (Table 3).

### The quality of the kernel

The results showed that the quality of the kernel of 50 pods was significantly different ( $p<0.05$ ) among treatments (Table 4). With the application of 250 kg ha<sup>-1</sup> of gypsum the T<sub>4</sub> treatment gave better kernel size compared to other treatments. However, all the treatments with application of Ca showed an improvement in kernel size.

## Conclusion

The application of 250 kg ha<sup>-1</sup> of gypsum increased the mean pod dry weight from 578 to 835 g with better quality kernels in pH 4.1 soils at Maspotha divisional secretariat area in Kurunegala district in the intermediate zone of Sri Lanka in October season under rainfed conditions. Thus, with application of 250 kg ha<sup>-1</sup> of gypsum, groundnuts produce the higher number of pegs per plant and increased kernel weight.

Treatment	mean kernel weight (g)/plant	mean kernel weight (g)	mean shell weight (g)/plant	mean shell weight (g)
T <sub>1</sub>	11.4 <sub>d</sub>	0.41 <sub>c</sub>	12.0 <sub>d</sub>	0.43 <sub>c</sub>
T <sub>2</sub>	12.4 <sub>c</sub>	0.41 <sub>c</sub>	13.7 <sub>c</sub>	0.46 <sub>b</sub>
T <sub>3</sub>	14.2 <sub>b</sub>	0.43 <sub>b</sub>	16.7 <sub>b</sub>	0.51 <sub>a</sub>
T <sub>4</sub>	16.2 <sub>a</sub>	0.46 <sub>a</sub>	17.7 <sub>a</sub>	0.51 <sub>a</sub>
CV%	10	10	11	11

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

**Table 3:** The mean kernel weight and mean shell weight.

Treatment	Size of the kernel		
	Large (%)	Medium (%)	Small (%)
T <sub>1</sub>	20 <sub>d</sub>	30 <sub>a</sub>	50 <sub>a</sub>
T <sub>2</sub>	30 <sub>c</sub>	30 <sub>a</sub>	40 <sub>b</sub>
T <sub>3</sub>	50 <sub>b</sub>	20 <sub>b</sub>	30 <sub>c</sub>
T <sub>4</sub>	60 <sub>a</sub>	20 <sub>b</sub>	20 <sub>d</sub>

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

**Table 4:** The size of the kernel.

## References

1. Reddy PS (1998) Groundnut. Indian Council of Agricultural Research. Krishi, New Delhi. 583.
2. DOA (2006) Annual report. Socio Economic & Planning Centre, Department of Agriculture.
3. Chapman SC, Ludlow MM, Blamy FPC, Fischer KS (1993) Effect of drought during pod filling on utilization of water and on growth of cultivars of Groundnut (*Arachis hypogaea* L.). Field Crop Research 32: 243-255.
4. Punyawardana BVR (2008) Agro ecological regions and rainfall of Sri Lanka.
5. Warren AD (2011) Gypsum as an Agricultural amendment. General guidelines. Chapter 3, School of Environment and Natural Resources, The Ohio State University, USA.

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