Effect of Organic and Inorganic Fertilizers and their Combinations on the Growth and Productivity of Groundnut

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Abstract – Ground is a legume capable of utilizing atmospheric nitrogen (N_2) to fulfill its N requirement. Supplementation of N using inorganic fertilizers may hinder the capacity of N fixation, thus the crop may have to depend on inorganic N fertilizers. On the other hand, well-structured soil may help in improving N fixation and hence growth and development and yield of groundnut. This study tested two field preparation methods (main plots), three combinations of inorganic and organic fertilizers (subplots), and two groundnut varieties (sub-sub plots) in a split-split plot design with three replications at the Grain Legume and Oil Crops Research and Development Centre, Angunukolapelessa in the Hambantota District of the Southern Province of Sri Lanka. The results revealed that land preparation methods had significant effects ($p \leq 0.05$) on total pod weight and the total seed weight, where the ridge and furrow method showed higher values compared to the flatbed method. Three fertilizer combinations had no significant effect ($p \geq 0.05$) on the plant height, canopy width, the number of days to flowering and peg formation, total pod yield, total seed weight, as well as seed filling percentage. The varietal effect was significant ($p \leq 0.05$) for the days to cover the ground, and the canopy width, total pod yield, and seed filling percentage, where the variety Lanka Jambo outyielded the variety, Tissa. This study suggested that the organic fertilizer with inorganic amendments gave similar results compared to the use of inorganic fertilizer only. Further studies are suggested before making recommendations.

Keywords: Groundnut, Yield, Inorganic fertilizer, Organic fertilizer

I. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a popular legume with high contents of edible oil, protein, fats, energy, minerals, and vitamins. Groundnut is mostly cultivated for seeds for human consumption in Sri Lanka. Department of Agriculture, Sri Lanka has released eight groundnut varieties, of which five varieties namely, Tissa, ANKG1, ANKG2 (Lanka Jumbo), ANKG3, and ANKG4 are the cultivated varieties in different agroecological conditions at present. Being a legume, nitrogen fixation mainly provides nitrogen (N) to satisfy the N requirement of the crop. However, the use of N fertilizer, especially urea, has been a practice to supply N to the groundnut, like other short-term leguminous crops. Due to the recent economic crisis and the banned importation of inorganic fertilizers to the country, the application of urea and other recommended fertilizers became impractical and was a critical issue for agricultural production in the country. Hence, there has been a need for finding out alternatives to manage the supply of N and other essential nutrients to promote the cultivation of groundnuts in Sri Lanka.

To facilitate N fixation, promoting atmospheric N to pass to the root environment where nodules are located is a vital requirement. Planting bed preparation [1], use of compost to improve soil structure and supply nutrients [2], and use of gypsum to promote soil aggregation and plant availability of Ca [3] are measures for promoting N availability to root nodules. Due to low availability of nutrients in compost [4], a combination of different sources of nutrients and the soil and planting bed preparation may be required to ensure a favourable soil environment and adequate nutrient requirements for maintaining the productivity of groundnut. Therefore, this study assesses the effect of field preparation method, fertilizer type, and variety on ground nut productivity.

II. MATERIALS AND METHODS

The experiment was conducted during the 2021/22 *Maha* season at the Grain Legume and Oil Crops Research and Development Centre, Angunukolapelessa (DL_{1b}) in the Hambantota District of the Southern Province of Sri Lanka. A 2 x 3 x 2 factorial experiment was arranged in a split-split plot design using two types of planting beds (P), viz. flatbeds, ridge-and-furrows assigned to main plots, and three combinations of fertilizers [viz. F1: 16, 20, and 37.5 kg/ha of N, P, and K, respectively as Urea, Triple Super Phosphate, and Muriate of Potash, followed by 14 kg N as Urea at flowering (DOA recommendation); F2: 6.4 t/ha of compost as basal dressing followed by 35 kg/ha Ca as Gypsum (28 kg S) at flowering; F3: 6.4 t/ha of compost as basal dressing followed by 35 kg/ha Ca as Gypsum (28 kg S) and 4.4 kg/ha of K as MOP at flowering)] assigned to subplots and two popular groundnut varieties, viz. *Tissa* and *Lanka Jambo* assigned to sub-sub plots were tested. All treatments were arranged with three replicates. All the treatments and selected levels were randomly allocated to experimental plots.

As observations, growth and yield characters were recorded. Both the canopy width and plant height were recorded at 50% flowering. At harvest, total pod yield, total seed weight, and percent filled seeds were recorded. In addition, the number of days to flowering and peg formation was recorded. Data were statistically analyzed using ANOVA and the means were separated using Fisher's protected LSD [5].

III. RESULTS AND DISCUSSION

Phenological stages

The effects of factors on the time to reach a specific growth stage were significantly influenced by fertility management and the variety. The time to ground cover formation was shortened in the treatment that had the DOA-recommended fertilizers (F1), while Compost + Gypsum + KCl (F3) received plots had taken non-significantly a longer time (three days). Compost followed by Gypsum and KCl at flowering took five more days to reach the ground cover compared to the DOA-recommended synthetic fertilizer treatment. Vegetative growth of the variety Lanka Jumbo in the early stages was significantly lower than the variety Tissa.

Growth Characteristics

Plant height, canopy width, and the number of branches per plant at 50% flowering were significantly greater in the Tissa variety than in Lanka Jumbo. On the other hand, plant height was significantly greater in the DOA-recommended fertility management practice than compost + gypsum + KCl combination, but the compost + gypsum combination showed a non-significantly lower plant height than the DOA recommended fertilization.

Yield of groundnut

Total pod yield was significantly influenced by the type of plots and the variety. Ridge and furrows (2040 kg/ha) outyielded flatbeds (1694 kg/ha). Of the two varieties, Lanka Jumbo gave a significantly greater pod yield (2153 kg/ha) than Tissa. Total seed weight was significantly greater in ridge and furrows (1682.6 kg/ha) compared to flatbeds (1273.8 kg/ha). The percentage of filled seeds was greater in the variety Tissa (72.83%) than in Lanka Jumbo. However, the total seed yield was non-significantly greater in Lanka Jumbo (1595.2 kg/ha) than in Tissa (1361.3 kg/ha). This indicates fertilizer treatments had no significant effects on pod yield and seed yield as well as seed filling percentage.

Table 1. Effects of plot type, fertility management, and variety on total pod yield, total seed yield, and the percentage of filled seeds of groundnut.

Treatment 1/	Total Pod Yield kg/ha 2/	Total seed Weight kg/ha	Filled seeds %
Type of plots (P)			
Ridge & Furrow	2040 a	1683 a	70.83 a
Flatbeds	1695 b	1274 b	65.00 a
LSD ($p<0.05$)	322	280	ns
Fertility management (F)			
F1 -Urea +MOP + TSP	1788 a	1399 a	68.08 a
F2 - Compost + CaSO4	1847 a	1369 a	65.66 a
F3 - Compost + CaSO4 + KCl	1968 a	1667 a	70.00 a
LSD ($p<0.05$)	ns	ns	ns
Peanut Variety (V)			
Tissa	1582 b	1361 a	72.83 a
Lanka Jumbo	2153 a	1595 a	63.00 b
LSD ($p<0.05$)	323	ns	9.71
CV%	23.79	26.06	19.68

Legend: 1/ LSD - Least significant difference; MOP – Muriate of potash.
TSP – Triple super phosphate; $CaSO_4$ – Calcium Sulphate (Gypsum);
KCL – Potassium Chloride; CV – Coefficient of variability.
2/ Values within a column followed by the same letter are not significantly different at $p\leq 0.05$.

IV. CONCLUSION

Groundnuts performed better in ridge and furrow-type plots than in flatbed-type plots during the *Maha* season. Although different growth characteristics showed different effects between the two varieties, Lanka Jumbo had inherently higher pod and seed yields than the variety of Tissa. The results confirmed that the use of compost together with inorganic amendments helps maintain the crop growth and the yield of groundnuts similar to the DOA-recommended synthetic fertilizer.

Acknowledgment

The authors acknowledge the financial and logistical support provided by the Department of Agriculture, Sri Lanka.

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