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GROWTH PERFORMANCE OF GROUNDNUT (*Arachis hypogaea* L.) AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT

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ABSTRACT

A field experiment was conducted at Rallakothur village, Ambur taluk of Thirupathur district, during karthigaipattam (Nov 2022-Mar 2023) to study the effect of integrated nutrient management on growth characters of groundnut. At harvest, application of N & K_2O +Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS(T_6) recorded higher growth characters *viz*., plant height (42.19 cm), LAI (4.21) and DMP (5152 kg ha^{-1}).This treatment is on par with application of N & K2O + Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS(T_9).

Key words: Boron, Enriched poultry manure, Enriched sheepyard manure, Humic acid, Seaweed extract, $ZnSO_4$.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a prominent oil seed crop in India sharing about 40% of total oil production (Sunitha *et al*., 2023). It is the most versatile legume crop because of its drought-tolerant characteristics, soil-restoring properties, weed smothering, multipurpose confectionery and dilatory uses (Nayak *et al*., 2023). It is the world's thirteenth most significant food crop, the fourth-largest source of vegetable oil and the third-largest source of vegetable protein (Shete *et al*., 2018; Hoang *et al*., 2022).

Imbalanced and inadequate use of nutrients is one of the major constraints on the lower yield of groundnut. Today, the use of chemical fertilizer is increasing with the increase in population of the nation. Simultaneously, the cost of chemical fertilizer has also been increasing constantly. Besides these, the use of inorganic fertilizer alone is injurious to soil and environmental health. Considering the cost of chemical fertilizers and with the aim of improving soil fertility, Integrated Nutrient Management (INM) is one of the possible ways to address these issues.

Poultry manure is a rich organic manure which helps to improve crop productivity and quality, the availability of nutrients in the soil and soil characteristics (Akshaya *et al*., 2022). Sheep manure is a natural, slow-release fertilizer. It is high in both phosphorus and potassium, which are essential elements for optimal plant growth (Upadhyay *et al.,* 2022). FYM is a blended fertilizer that contains all of the major supplements (N, P, K, Ca, Mg and S) as well as micronutrients (Fe, Mn, Cu and Zn) required for plant development (Lamichhane *et al*., 2022). Zinc is known to be a constituent of enzymes and is also involved in various metabolic processes as a catalyst. Zinc also increases the content of protein, calorific value, amino acid and fat in oilseed crops (Radhika and Meena, 2021). Boron plays various roles in the physiological processes of plants as it induces flowering, fertilization, hormonal metabolism and the translocation of sugars from source to sink, thus contributing to an increase in seed yield (Kumar *et al*., 2022). Biostimulants i.e., humic and fulvic acid enhance nutrient use efficiency, water holding capacity, pH buffering, thermal insulation and also applied as a plant growth stimulant (Yadav *et al*., 2020). Therefore, in view of the above facts and growing concern for sustaining crop productivity and environmental pollution, an investigation was carried out to find out the best nutrient management strategies for groundnut.

MATERIALS AND METHODS

A field experiment was conducted at Rallakothur village, Ambur taluk of Thirupathur district, during karthigaipattam (Nov 2022-Mar 2023) to study the effect of integrated nutrient management on growth characters of groundnut. The experimental field was geographically situated at 12.81° N latitude, 78.67° E longitude with an altitude of +290 meters above mean sea level. It is located at North-Eastern agro-climate zone of Tamil Nadu. The soil of the experimental field was sandy loam in texture. The soil was low in available nitrogen, medium in available phosphorus and medium in available potassium with a pH and EC of 7.4 and 0.18/dSm, respectively.

The experiment was laid out in Randomized Block Design (RBD) with three replications. The details of the field treatments were T_1 - Control (100% recommended dose of fertilizers), T_2 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application), T_3 -N & K_2O + Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} +Borax @ 10 kg ha^{-1} (Basal application), T_4 - N & K_2O + Enriched sheepyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application), T_5 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS, T_6 - N & K_2O +Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS, T_7 - N & K_2O + Enriched sheepyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) +Humic acid @ 2% on 25 and 45 DAS, T_8 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Seaweed extract @

5% on 25 and 45 DAS, T_9 - N & K_2O + Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS, T_{10} - N & K_2O + Enriched sheepyard manure @ 750 kg ha^{-1} +$ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) + Seaweed extract @ 5% on 25 and 45 DAS. Required quantities of well decomposed organic manures and micronutrients were incorporated in the soil as per the treatment schedule. For enhancing the crop growth, 2% Humic acid or 5% Sea weed extract was sprayed at 25 and 45 DAS, based on the treatment schedule. The standard crop management practices were followed during the cropping period.

Five representative plant samples in each plot were marked randomly for recording biometric observations. Plant height was measured from ground level to the tip of the leaf of the primary branches and expressed in cm. The LAI was worked out by using the formula as proposed by Saxena *et al*. (1972). For DMP, samples were initially air-dried and then oven-dried at 70° C till a constant weight obtained and the weight was recorded and expressed in kg ha^{-1}. The estimated data were analyzed as per the procedure outlined by Gomez and Gomez (1994) and critical difference was worked out at 5 per cent probability level for significant results.

RESULTS AND DISCUSSION

Plant height and Leaf area index

Among the different treatments tested, application of N & K_2O +Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS (T_6) significantly registered the maximum plant height (42.19 cm) and LAI (4.21) at harvest stage which is on par with N & K_2O + Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS (T_9). The increase in plant height and leaf area index due to PM application could be attributed to the increased availability of nitrogen and other nutrients released by PM throughout the experiment. Furthermore, these might be due to a steady and continuous supply of N throughout the entire crop growth period due to the gradual transformation and mineralization of organics. The solubilization of water-insoluble P compounds by organic acids released during the decomposition of organics, resulting in greater P availability to the crop coupled with higher native K availability, might have played a key role in ensuring superior plant height, LAI, and by organics. These results are in line with those of Sherin and Ahuja (2009). Another reason could be efficient and greater partitioning of metabolites and adequate location of nutrients in developing plant structures, which in turn increase plant height and LAI. The present findings are in close agreement with Naing *et al. (*2010) and Ahmad *et al. (*2009).

The increased growth of groundnut with Zn and B applications might be due to significant improvements in nodulation and N fixation. Zinc enhanced plant growth through auxin production and activation of several enzyme systems, as evidenced by Thiyagarajan *et al*. (2003). Boron influenced the nitrogen and carbohydrate metabolism of plants, which might have contributed to better plant growth (Elayaraja and Singaravel, 2016).

The increase in plant height and leaf area index with the foliar application of HA in groundnut was reported earlier by Reddy *et al.* (2020). Humic acid influences plant growth in both direct and indirect ways. Directly, it increases chlorophyll content, accelerates plant respiration and hormonal growth responses, increases penetration in plant membranes, etc. Indirectly, it improves the physical, chemical and biological conditions of soil (Reddy *et al.,* 2020).

Effect of enriched organic manures and micronutrients on plant height (cm) at different growth stages of groundnut

Treatment	Plant height (cm)		
	30 DAS	60 DAS	Harvest
T_1 - RDF	12.94	22.71	30.25
T_2 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} +Borax @ 10 kg ha^{-1} (Basal application)	14.59	26.63	34.02
T_3 - N & K_2O + Enriched poultry manure @750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} +Borax @ 10 kg ha^{-1} (Basal application)	15.09	30.08	36.23
T_4 - N & K_2O + Enriched sheepyard manure @750 kg ha^{-1} + $ZnSO_4$ @15kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application)	14.89	28.89	35.10
T_5 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS	15.43	31.45	38.59
T_6 - N & K_2O +Enriched poultry manure @ 750kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS	15.89	35.15	42.19
T_7 - N & K_2O + Enriched sheepyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) +Humic acid @ 2% on 25 and 45 DAS	15.62	33.12	40.09
T_8 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS	15.41	31.09	38.02
T_9 - N & K_2O + Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS	15.80	34.85	41.84
T_{10} - N & K_2O + Enriched sheepyard manure @750kg ha^{-1} +$ZnSO_4$ @15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Seaweed extract @ 5% on 25 and 45 DAS	15.61	32.67	39.91
SEm±	0.06	0.30	0.33
CD (p=0.05)	0.17	0.90	0.99

Effect of enriched organic manures and micronutrients on Leaf Area Index (LAI) at different growth stages of groundnut

Treatment	LAI		
	30 DAS	60 DAS	Harvest
T1 - RDF	0.93	3.60	3.18
T_2 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} +Borax @ 10 kg ha^{-1} (Basal application)	1.02	3.74	3.36
T_3 - N & K_2O + Enriched poultry manure @750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} +Borax @ 10 kg ha^{-1} (Basal application)	1.16	4.12	3.61
T_4 - N & K_2O + Enriched sheepyard manure @750 kg ha^{-1} + $ZnSO_4$ @15kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application)	1.09	3.93	3.49
T_5 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS	1.28	4.36	3.82
T_6 - N & K_2O +Enriched poultry manure @ 750kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS	1.51	4.87	4.21
T_7 - N & K_2O + Enriched sheepyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) +Humic acid @ 2% on 25 and 45 DAS	1.40	4.63	4.02
T_8 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS	1.25	4.27	3.76
T_9 - N & K_2O + Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS	1.47	4.79	4.16
T_{10} - N & K_2O + Enriched sheepyard manure @750kg ha^{-1} +$ZnSO_4$ @15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Seaweed extract @ 5% on 25 and 45 DAS	1.36	4.54	3.98
SEm±	0.02	0.04	0.04
CD (p=0.05)	0.07	0.13	0.12

Dry matter production

The maximum dry matter production of 5152 kg ha $^{-1}$ at harvest stage was obtained with the application of N & K_2O +Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS (T_6) which is on par with N & K_2O + Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS (T_9). Enhanced dry matter accumulation might be due to the integrated effects of poultry manure compost and chemical fertilizer in improving the major and micronutrients availability, as well as improving soil physical, chemical and biological properties (Dwivedi *et al.*, 1990). Total dry matter maintained in vegetative parts and its further translocation from source to sink is the major factor that governs the economic yield of the crop. This higher dry matter accumulation may be due to the higher photosynthetic ability of the crop, as reflected by the higher dry matter accumulation in the leaf and the higher translocation of metabolites from the leaf and stem to the reproductive part during the reproductive phase of crop growth. These results are in conformity with the findings of Nagaraj *et al.* (2018).

The increase in dry matter production might be attributed to the beneficial and favourable effects of the application of zinc and boron, their role in the synthesis of IAA, metabolism of auxins, biological activity, stimulating effect on photosynthetic pigments, and enzyme activity, which in turn encourage the vegetative growth of plants (Der *et al*., 2015).

HA increased the porosity of the soil and improved the growth of the root system, which lead to an increase in the shoot system, as evidenced by Garcia *et al.* (2008) and Sarhan (2011). The higher dry matter production at the harvest stage was recorded with a foliar spray of HA due to supply of all the three major nutrients through foliar application at the critical stage. Further, it also enhances the photosynthetic activity, leading to the production and accumulation of more carbohydrates and auxins, which favour the retention of more flowers. ultimately leading to a greater number of reproductive parts plant^{-1}. Similar observations were earlier noticed by Veerabhadrappa and Yeledhalli (2005) and Reddy *et al.* (2020).

Effect of enriched organic manures and micronutrients on dry matter production (kg ha^{-1}) at different growth stages of groundnut

Treatment	DMP (kg ha^{-1})		
	30 DAS	60 DAS	Harvest
T1 - RDF	751	2682	3932
T_2 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} +Borax @ 10 kg ha^{-1} (Basal application)	822	2865	4192
T_3 - N & K_2O + Enriched poultry manure @750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} +Borax @ 10 kg ha^{-1} (Basal application)	927	3080	4523
T_4 - N & K_2O + Enriched sheepyard manure @750 kg ha^{-1} + $ZnSO_4$ @15kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application)	878	2979	4364
T_5 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS	994	3228	4746
T_6 - N & K_2O +Enriched poultry manure @ 750kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS	1117	3513	5152
T_7 - N & K_2O + Enriched sheepyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) +Humic acid @ 2% on 25 and 45 DAS	1057	3376	4944
T_8 - N & K_2O + Enriched farmyard manure @ 750 kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS	966	3167	4655
T_9 - N & K_2O + Enriched poultry manure @ 750 kg ha^{-1} + $ZnSO_4$ @15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) +Seaweed extract @ 5% on 25 and 45 DAS	1095	3458	5081
T_{10} - N & K_2O + Enriched sheepyard manure @ 750kg ha^{-1} +$ZnSO_4$ @15 kg ha^{-1} + Borax @ 10 kg ha^{-1} (Basal application) + Seaweed extract @ 5% on 25 and 45 DAS	1031	3317	4866
SEm±	10.65	24.34	36.51
CD (p=0.05)	31.64	72.33	108.49

CONCLUSION

The results from the present investigation concluded that the integrated application of N & K_2O +Enriched poultry manure @ 750kg ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} + Borax @10 kg ha^{-1} (Basal application) + Humic acid @ 2% on 25 and 45 DAS appeared to be an effective integrated nutrient management system for enhancing the growth characters of groundnut.

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