Effect of Integrated Nutrient Management on Growth and Yield of irrigated Groundnut (*Arachis hypogaea L.*).

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Abstract: A field experiment was conducted at farmer's field, Peruvalur, Melmalaiyanur taluk of Villupuram district during *kharif* season, 2021 to study the effect of integrated nutrient management in irrigated groundnut (*Arachis hypogaea* L.). The field experiment was laid out in randomized block design with nine treatments and three replications. The treatments are T_1 – Control, T_2 – RDF (25:50:75 kg NPK ha^{-1}), T_3 – RDF + Sulphur @ 75 kg ha^{-1} through gypsum, T_4 – RDF + *Rhizobium* (seed treatment-ST), T_5 – RDF + MN mixture (12.5 kg ha^{-1}), T_6 – RDF + Sulphur @7 5kg ha^{-1} through gypsum + *Rhizobium (*ST) , T_7 – RDF + Sulphur @ 75 kg ha^{-1} through gypsum + MN mixture (12.5 kg ha^{-1}), T_8 – RDF + *Rhizobium* (ST) + MN mixture (12.5 kg ha^{-1}), T_9 – RDF + Sulphur @ 75 kg ha^{-1} through gypsum + *Rhizobium* (ST) + MN mixture (12.5 kg ha^{-1}). The combined application of RDF, sulphur, Rhizobium and MN mixture influenced the plant growth, yield and its characters of groundnut. Among the different treatments tried, application of RDF + Sulphur @ 75 kg ha^{-1} through gypsum + Rhizobium (ST) + MN mixture @ 12.5 kg ha^{-1} (T9) recorded the maximum values of growth and yield characters *viz.*, plant height (46.83 cm), leaf area index (4.10) , dry matter production (5483), CGR , pod yield (2180 kg ha^{-1}), haulm Yield (3598 kg ha^{-1}), kernel yield (1545.84 kg ha^{-1}) and oil yield (752.05 kg ha^{-1}).

Keywords: gypsum, MN mixture, Rhizobium seed treatment, yield, growth. Productivity.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is known as the "King of Oil Seeds," and it is the world's 13th most important food crop, 4th most important source of vegetable oil, and 3rd most important source of vegetable protein (Shete *et al.*, 2018). Thus, groundnut provides nearly half of the 13 essential vitamins and seven of the twenty essential minerals required for human growth and development, in addition being a high-quality fodder for livestock (Sowmya *et al.*, 2022). In the world, it is cultivated over an area of 29.5 million hectares with production and productivity of 48.5 million tonnes and 1647 kg ha^{-1} respectively. In India, it occupies an area of 4.9 million hectares and production of 10.12 million tonnes with a productivity of 2060 kg ha^{-1} (GOI, 2021). In the current situation, when food security and livelihood issues have become national priorities, the use of agricultural chemicals to increase food production is unavoidable. Due to the extremely high nutrient requirements, the optimization of mineral nutrition plays a crucial role in maximizing groundnut output. On the contrary, groundnut farmers utilize relatively little fertilizer, resulting in severe mineral nutrient deficits. Inadequate and imbalanced nutrient use is one of the primary causes of low groundnut production (Rajesh Chaudhri and Roshan Choudhary 2022).

Nitrogen is the most critical nutrient for plant growth and development among the major nutrients. N promotes a flourishing growth of many green leaves. Low levels of nitrogen in plants result in stunted growth and decreased flowering. N is one of the important nutrients required for healthy growth, as demonstrated by numerous experiments (Lomer *et al.*, 2019; Abbas *et al.*, 2020). Phosphorus (P) is an important mineral nutrient that promotes the growth of leguminous crops to produce their own N sources. Though potassium is not a constituent of any compound or structurally bound in groundnut, it is required for translocation of assimilates and involved in maintenance of water status of plant especially the turgor pressure of cells and opening and closing of stomata and increase the availability of metabolic energy for the synthesis of starch and proteins. Besides, it increased peg formation, nodulation, synthesis of sugar and starch, and help in pod growth and filling (Patel *et al*., 2018).

Sulphur, one of the 17 essential elements for plant growth and development, plays a significant role in the nutrition of oilseed crops. It is one among the most important nutrients for all plants and animals and is regarded the fourth most important nutrient for agricultural crops after nitrogen, phosphorus, and potassium. Micronutrients (boron, chlorine, copper, iron, manganese, molybdenum, nickel, and zinc) are vital for plant growth and are required in minute amounts; the application of micronutrients increases agricultural product yield and quality (Reddy *et al*., 2021).

MATERIALS AND METHODS

A field experiment was conducted at farmer's field, Peruvalur, Melmalaiyanur taluk of villupuram district during kharif season, 2021 to study the effect of integrated nutrient management in irrigated groundnut (*Arachis hypogaea* L.). The experimental field was geographically situated at 12°40' North latitude and 79°39' East Longitude with an altitude of + 243m MSL. The texture of the experimental field soil was sandy clay loam with neutral pH, low in available nitrogen and medium in available phosphorus and potassium. The popular variety TMV 14 was chosen for the study. The experiment was laid out in Randomized Block Design (RBD) with nine treatments and three replications. The treatments are T_1 – Control, T_2 – RDF (25:50:75 kg NPK ha^{-1}), T_3 – RDF + Sulphur @ 75 kg ha^{-1} through gypsum, T_4 – RDF + *Rhizobium* (seed treatment-ST), T_5 – RDF + MN mixture (12.5 kg ha^{-1}), T_6 – RDF + Sulphur @7 5kg ha^{-1} through gypsum + *Rhizobium (*ST) , T_7 – RDF + Sulphur @ 75 kg ha^{-1} through gypsum + MN mixture (12.5 kg ha^{-1}), T_8 – RDF + *Rhizobium* (ST) + MN mixture (12.5 kg ha^{-1}), T_9 – RDF + Sulphur @ 75 kg ha^{-1} through gypsum + *Rhizobium* (ST) + MN mixture (12.5 kg ha^{-1}).

The recommended seed rate of 120 kg ha^{-1} was used for the trial. The seeds were sown by hand dibbling at the specified spacing of 30 X 10 cm. The fertilizers were applied to the experimental field as per the recommended manurial schedule of 25: 50: 75 kg N, P_2O_5 and K_2O ha^{-1}. Urea (46% N), single super phosphate (16% P_2O_5) and muriate of potash (60% K_2O) fertilizers were used to supply N, P and K nutrients, respectively. The entire dose of phosphorus, half dose of nitrogen was applied basally, and the remaining half dose of nitrogen and potassium were applied as two equal splits on 25 and 40 days after sowing. Sulphur @ 75 kg ha^{-1} through gypsum was applied at two equal splits (basal and 40 DAS) to the respective treatment plots. MN mixture @ 12.5 kg ha^{-1} was applied basally to the respective treatment plots. Five plants were selected randomly in each plot. Then, the selected plants were tagged and used for recording all biometric observations in different growth stages of crop.

RESULTS AND DISCUSSION

GROWTH CHARACTERS (Table.1)

The results of the field experiment on groundnut crop revealed that the growth characters were favourably influenced by the application of RDF, sulphur through gypsum, biofertilizer and micronutrient mixture. Among the different treatments tried, application of 100 per cent RDF + Sulphur @ 75 kg ha^{-1} through gypsum + Rhizobium (ST) + MN mixture @ 12.5 kg ha^{-1} (T_9) recorded the maximum values of plant height (46.83 cm), LAI (4.10), DMP (5483 kg ha^{-1}) and CGR (4.70). Major nutrients involved with different plant growth functions *viz*., cell enlargement, greater photosynthetic activity, formation of carbohydrates, translocation of solutes. These were the reasons for increased plant height in the present investigation. These findings were in line with the results of Mangesh *et al.* (2013). Treatments co-inoculated with rhizobium enhanced the synthesis of chlorophyll and plant height, resulting in significant increases in plant dry weight and yield. A similar result of finding was in concomitance with Nellipally *et al.* (2020.)

The increase in growth could be ascribed to better root formation due to sulphur, which in turn activated higher absorption of N, P, K and sulphur from soil and improved metabolic activity inside the plant. Application of micronutrient mixture plays an important role for activating many growth enzymes in plant and involving in the biosynthesis of growth matter such as auxin which produces more plant cells and more dry matter. Results of present studies are similar to those reported by Tejeswara Rao *et al.* (2013) and Sabra *et al.* (2019).

YIELD ATTRIBUTES AND YIELD (Table.2)

The yield attributes and yield were significantly influenced by the application of RDF, sulphur through gypsum, biofertilizer and micronutrient mixture. Among the various treatments imposed in the study, application of 100 per cent RDF + Sulphur @ 75 kg ha^{-1} through gypsum + Rhizobium (ST) + MN mixture @ 12.5 kg ha^{-1} (T_9) recoded the higher number of pegs $plant^{-1}$ (37.02), number of pods $plant^{-1}$ (25.78), pod (2180 kg ha^{-1}), kernel (1545.84 kg ha^{-1}), haulm (3598 kg ha^{-1}) and oil yield (752.05 kg ha^{-1}). The gypsum act as soil amendment and improves the soil physical, chemical, and biological condition, which in turn help to improve the nutrient availability for groundnut. Improvements in yield have resulted in favourable influence of sulphur on growth and efficient partitioning and translocation of metabolites to reproductive structures. These findings were in line with the results of Tejeswara Rao *et al.* (2013) and Naresha *et al.* (2014).

Micronutrient plays an important role in cell division, sugar transport, flowering, fruiting and plant hormone regulation that led to improve the yield. These results are in harmony with these obtained by Bellaloui *et al.* (2013), Singh and Chaudhari (2015) and Sabra *et al.* 2019. Due to the integrated nutrient use of inorganic fertilizers, gypsum and bio fertilizers by providing cooperative effect and in turn upgraded the soil condition, stimulate root system with healthier absorption of nutrients, and expressed superior progress of plant growth resulting in higher photosynthetic activity and translocation of photosynthates to the sink which resulted in higher pod and haulm yields. The present findings are in close agreement with the results obtained of earlier (Joshi *et al.*, 2018, Purbajanti *et al.*, 2019, Kamalakann and Elayaraja, 2020.

Table 1. Effect of INM on growth characters of irrigated groundnut

Treatments		Plant height (cm) at Harvest stage	Leaf Area Index (LAI) at Harvest stage	Dry matter production (kg ha^{-1}) at Harvest stage	Crop growth rate (g m^{-2} day^{-1}) 60 DAS – Harvest
T_1	Control	25.05	2.65	3152	2.75
T_2	RDF - NPK (25:50:75) kg ha^{-1}	32.10	3.20	3925	3.44
T_3	RDF + Sulphur @ 75 kg ha^{-1} through gypsum	37.51	3.54	4608	3.82
T_4	RDF + Rhizobium (ST)	33.93	3.29	4021	3.46
T_5	RDF + MN mixture (12.5 kg ha^{-1})	36.70	3.48	4504	3.75
T_6	RDF + Sulphur @ 75 kg ha^{-1} through gypsum + Rhizobium (ST)	40.45	3.80	4981	4.25
T_7	RDF+ Sulphur @ 75 kg ha^{-1} through gypsum + MN mixture (12.5 kg ha^{-1})	42.80	3.96	5223	4.46
T_8	RDF + Rhizobium (ST) + MN mixture (12.5 kg ha^{-1})	39.41	3.71	4896	4.08
T_9	RDF + Sulphur @75 kg ha^{-1} through gypsum + Rhizobium (ST) + MN mixture (12.5 kg ha^{-1})	46.83	4.10	5483	4.70
SEm±		0.70	0.04	51.18	0.06
CD (*p*=0.05)		2.1	0.13	152.10	0.18

Table 2. Effect of INM on yield attributes and yield of irrigated groundnut

Treatments		No. of pegs plant^{-1}	No. of pods plant^{-1}	Pod yield (kg ha^{-1}) at Harvest stage	Kernel yield (kg ha^{-1}) at Harvest stage	Haulm yield (kg ha^{-1}) at Harvest stage	Oil yield (kg ha^{-1}) at Harvest stage
T_1	Control	24.00	14.02	1062	698.58	2205	333.71
T_2	RDF - NPK (25:50:75) kg ha^{-1}	29.07	19.04	1629	1145.19	2879	549.46
T_3	RDF + Sulphur @ 75 kg ha^{-1} through gypsum	31.75	21.43	1826	1284.04	3123	618.52
T_4	RDF + Rhizobium (ST)	29.77	19.65	1649	1169.14	2925	560.72
T_5	RDF + MN mixture (12.5 kg ha^{1})	31.28	20.97	1782	1252.21	3048	602.43
T_6	RDF + Sulphur @ 75 kg ha^{-1} through gypsum + Rhizobium (ST)	33.52	23.10	1990	1405.34	3351	679.48
T_7	RDF+ Sulphur @ 75 kg ha^{-1} through gypsum + MN mixture (12.5 kg ha^{-1})	35.11	24.25	2088	1478.93	3472	716.10
T_8	RDF + Rhizobium (ST) + MN mixture (12.5 kg ha^{-1})	33.14	22.78	1923	1356.48	3253	654.09
T_9	RDF + Sulphur @75 kg ha^{-1} through gypsum + Rhizobium (ST) + MN mixture (12.5 kg ha^{-1})	37.02	25.78	2180	1545.84	3598	752.05
SEm±		0.44	0.36	26.93	21.88	39.74	11.56
CD (*p*=0.05)		1.32	1.08	80.02	65.00	118.00	34.02

CONCLUSION

The integrated nutrient management practices conspicuously influenced the growth and yield of irrigated groundnut crop. Based on the results of the field experiment, it is concluded that application of 100 per cent RDF + Sulphur @ 75 kg ha^{-1} through Gypsum +*Rhizobium* (ST) + MN mixture @ 12.5kg ha^{-1} is the most beneficial and cost-effective practice for augmenting higher groundnut yield. Also, this practice is found to be agronomically sound and economically viable and can be recommended to the groundnut growers for realizing better yield and returns.

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