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Effect of Vermicompost and Molybdenum on Growth and Yield of Groundnut (*Arachis hypogaeal L.*)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted during the *Summer* season 2023, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj (U.P.) to find out the "Effect of Vermicompost and Molybdenum on growth and yield of Groundnut". The experiment was laid out in Randomized Block Design comprising of 9 treatments which include 3 Different levels of Vermicompost 0 t/ha, 3 t/ha, 5 t/ha and Molybdenum 0.5 kg/ha, 1 kg/ha, 1.5 kg/ha. Whose effect is observed in Ground nut. The result was observed in the application of 5t/ha Vermicompost + 1.5 kg/ha Mo was recorded maximum plant height (29.80 cm), Nodules (62.10), plant dry weight (30.96 g/plant), number of pods per plant (39.39), Kernels/pod (2.00), seed index (40.00 g), pod yield (2.38 t/ha) and haulm yield (4.26 t/ha) and harvest index (35.74%).

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At the same time higher gross return (1,61,090.00 INR/ha), net return (100505.80 INR/ha) and benefit cost ratio (1.7) were recorded with application of 5t/ha Vermicompost + 1.5 kg/ha Mo.

Keywords: Groundnut; yield; vermicompost; molybdenum; economics.

1. INTRODUCTION

Groundnut (*Arachis Hypogea* L.) is a leguminous plant that is extensively grown in tropical and subtropical regions between 40°N and 40°S latitudes. It is regarded as the fourth most significant source of edible oil and the third most significant source of vegetable protein in the world because of its very oil-rich edible seeds. In addition to being a significant oilseed crop in India, groundnuts are a valuable agricultural export good.

"Rich in important minerals and vitamins, 45–50% oil, and 27–33% protein, groundnuts are a great source of plant nutrition. Haulms are utilised as cattle feed, and they are crucial to the diets of mothers and children living in resource poverty. Mixed glycerides make up groundnut oil, which is rich in unsaturated fatty acids, particularly oleic (50–65%) and linoleic (18–30%) fatty acids. Groundnut cultivation spans 295 lakh hectares worldwide, yielding 487 lakh tonnes at a productivity of 1647 kg/hectare. India is the world's leading producer of groundnuts, with 101 lakh tonnes and a productivity of 1816 kg per hectare in 2020–21. It has the second-largest groundnut acreage globally, with an annual all-season covering of 55.6 lakh hectares. Groundnut is cultivated in one or more (*kharif, rabi* and summer) seasons, but nearly 80% of acreage and production comes from *kharif* crop" [1]. According to Satish et al., [2], "groundnut is primarily used for extraction of oil, with an analysis of about46.70%. It is also consumed directly because of its high food value, which is again due to its higher content of protein (22.0%), carbohydrate (10.0%) and minerals (3.0%)".

"India is one of the top three groundnut-producing nations in the world. It comes in second only to China (which accounts for 37% of global groundnut production). India's contribution to global groundnut production in 2018 was close to 15 percent. Nigeria contributes 6% of the global groundnut production, placing it third. With 33% of the world's groundnut production, Gujarat is the biggest producer, followed by Rajasthan (21%), Tamil Nadu (14%), and other states. Telangana contributes 5% and Andhra Pradesh 7% to the world's groundnut production. In Andhra Pradesh, the production of groundnuts accounts for around 87 per acre and 91% of the total oilseeds produced. In India, the acreage and production of groundnuts make up 19.1% and 21.3%, respectively, of the total oilseeds. Andhra Pradesh has the largest district-wise groundnut output and area in 2019–20" (Groundnut Outlook Report, January–May 2021).

As a high-value biofertilizer that is both inexpensive and pollution-free while simultaneously increasing plant growth and production through nutrient supply, vermicompositing seems to be the most promising option. Utilising vermicompost stabilises the structure of the soil and encourages soil aggregation. This enhances the soil's air-water balance, boosting its ability to hold water and promoting the deep development of plants' roots. It is shown that there is an improvement in the mineralization of nutrients, which raises agricultural productivity. Compared to the soil where worms reside, vermicomposts have a better capacity for base exchange and more exchangeable calcium, magnesium, and potassium. Mathivannan et.al. [3] conducted pot experiments to examine the impact of vermicompost on groundnut growth and yield.

Molybdenum has a significant role in a variety of enzymatic and physiological functions in plants, including the fixation of nitrogen in leguminous crops through the formation of root nodules. Molybdenum is necessary for the synthesis of the nitrate reductase enzyme, which is also involved in the symbiotic nitrogen fixation process in legumes. The nitrogen-fixing enzyme nitrogenase cannot work and nitrogen fixation cannot occur in the absence of adequate molybdenum and iron levels. According to Totay et.al. [4], molybdenum increased the weight of nodular materials and vegetative development, which enhanced groundnut yield.

2. MATERIALS AND METHODS

The experiment was conducted during *Zaid* season of 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the field constituting a part of

central gangetic alluvium is neutral and deep. The soil of the experimental field was sandy loam in texture, nearly neutral in soil reaction (pH 7.4), low level of organic carbon (0.51%), available N (108.69 Kg/ha), P (80.5 kg/ha), K (83.3 kg/ha) The treatment consists of T1: 0t/ha Vermicompost + 0.5kg/ha Mo , T2: 0t/ha Vermicompost + 1kg/ha Mo, T3: 0t/ha Vermicompost + 1.5kg/ha Mo, T4: 3t/ha Vermicompost + 0.5 kg/ha Mo, T5: 3t/ha Vermicompost + 1 kg/ha Mo, T6: 3t/ha Vermicompost + 1.5 kg/ha Mo, T7: 5t/ha Vermicompost + 0.5 kg/ha Mo, T8: 5t/ha Vermicompost + 1 kg/ha Mo, T9: 5t/ha Vermicompost + 1.5 kg/ha Mo.

The experiment was laid out in Randomized Block Design, with 9 treatments replicated thrice. The observations were recorded for plant height, Number of Root nodules/plant, plant dry weight, Number of pods/plant, Number of Kernels/pod, seed index (g), Pod yield (t/ha), Haulm yield (t/ha) and harvest index (%). The collected data was subjected to statistical analysis by analysis of variance method. Pearl millet, variety (Indigenous) were selected for sowing. Seeds are sowed of spacing (30x10cm).

3. RESULTS AND DISSCUSSION

3.1 Growth Parameters

Plant height (cm): The data revealed that significantly maximum plant height was recorded with Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo) i.e., 29.80 cm at 80 DAS. However, treatment T8 (5t/ha Vermicompost + 1kg/ha Mo) i.e., 28.60 cm and treatment T9 3t/ha Vermicompost + 1.5kg/ha Mo i.e.,28.90 cm is statistically at par with treatment T9. Whereas minimum plant height was seen in Treatment T1 with 0t/ha Vermicompost + 0.5kg/ha Mo.

Foliar application of molybdenum has a significant effect on the traits such as plant height and biological performance. The result was in conformity with those of Manjili et.al. [5].

Number of Nodules/plant: In treatment 9 [5t/ha Vermicompost + 1.5kg/ha Mo] was recorded significant and maximum number of nodules/plant (62.10) at 80 DAS. which was superior to all the treatment and there was significant difference among the treatments.

Application of molybdenum of recorded maximum number of nodules per plant. Chandra et.al. (2022). The application of vermicompost and zinc showed the highest plant height and number of root nodules/plant, it might have accelerated the metabolic and physiological activity of the plant and put up more growth by assimilating more amounts of plant nutrients and ultimately increased the plant height. Similar results were also found by Thirunavukkarasu and Vinoth [6].

Plant dry weight (g/plant): Significantly maximum plant Dry weight was recorded with Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo) i.e., 30.96 g/plant. However, treatments T6 (3t/ha Vermicompost + 1.5kg/ha Mo) i.e., 30.24 g/plant and treatment 8 (5t/ha Vermicompost + 1kg/ha Mo) 11.98 g/plant is statistically at par with treatment T9. Whereas minimum plant Dry weight was seen in Treatment T1 with 0t/ha Vermicompost + 0.5 kg/ha Mo.

“Molybdenum might be due to better nodulation of crop owing to better availability of B. The improvement in nodulation might have resulted in higher amount of nitrogen fixation and there by better vegetative growth and dry matter production”. DV Hipara et.al. [7]. “Increased population of beneficial microorganisms or the presence of biologically active plant growth influencing substances such as plant growth regulators or plant hormones in the vermicompost and humic acids”. Patil et.al. [8].

3.2 Yield Parameter

Number of pods/plant: Significantly the highestnumber of pods per plant was recorded in Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo). However, treatment 8 (5t/ha Vermicompost + 1kg/ha Mo) i.e., 37.00. Whereas minimum number of pods per plant are seen in Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo).

Molybdenum levels plays a key role in root and shoots growth, flower fertility, Boron is important nutrient for nodule forming bacteria therefore, increased nodule count results in more nitrogen fixation which increased the pegs (pods) /plant. Similar findings were recorded by Srinivasan et.al. [9].

Number of kernels/pod: At harvest, there is significant significantly highest number of kernel per pod was recorded in Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo). i.e., 2.00. Whereas minimum number of kernel per pod are

seen in Treatment T1 (0t/ha Vermicompost + 0.5kg/haMo).

Molybdenum levels shows clear effect on mature pods and filled pods Crak et al. [10]. Increased values in these yield attributes might have been on account of the overall improvement in vegetative growth and nodulation which favorably influenced the flowering and fruiting and ultimately resulted into increased number of matured pods and pod weight per plant. These findings are in agreement with the results obtained by Chaudhary et. al. [11].

Seed index (g): The highest seed index was recorded in Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo). i.e., 40.00 g. Whereas minimum seed index is seen in Treatment T1 (0t/ha Vermicompost + 0.5kg/ha Mo).

Reported that with vermicompost applications in corn, the 1000-kernel weight increased as the dose of the compost increased Ozel and Oktem [12].

Pod yield (t/ha): In treatment, the highest pod yield was recorded in Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo). i.e., 2.38 t/ha. Whereas minimum pod yield is seen in Treatment T1 (0t/ha Vermicompost + 0.5kg/ha Mo).

Molybdenum responsible for nodule tissue and increase in N2 fixation. Similar result was concluded by Mohamed et.al*.* [13].

Haulm Yield (t/ha): The highest haulm yield was recorded in Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo). i.e., 4.26 t/ha. Whereas minimum haulm yield is seen in Treatment T1 (0t/ha Vermicompost + 0.5kg/ha Mo).

Molybdenum increased nitrogen fixation which affects plant growth rate and metabolism which results in higher haulm yields. A similar result was reported by Bhagiya et.al*.* [14].

3.3 Harvest Index (%)

Significantly The highest harvest index was recorded in Treatment T9 (5t/ha Vermicompost + 1.5kg/ha Mo). i.e., 35.74%. Whereas minimum harvest index is seen in Treatment T1 (0t/ha Vermicompost + 0.5kg/ha Mo) [15-17].

Increased values in these yield attributes might have been on account of the overall improvement in vegetative growth and nodulation which favorably influenced the flowering and fruiting and ultimately resulted into increased number of matured pods and pod weight per plant. These findings are in agreement with the results obtained by Chaudhary et.al. [11].

Table 1. Effect of vermicompost and molybdenum on growth attributes of ground nut

		80 DAS		
S.no.	**Treatments**	**Plantheight (cm)**	**Dryweight (g/plant)**	**Nodules/plant**
1	0t/ha Vermicompost + 0.5kg/ha Mo	22.70	24.12	40.00
2	0t/ha Vermicompost + 1kg/ha Mo	23.00	24.89	46.00
3	0t/ha Vermicompost + 1.5kg/ha Mo	25.90	25.60	48.00
4	3t/ha Vermicompost + 0.5kg/ha Mo	25.60	25.45	46.00
5	3t/ha Vermicompost + 1kg/ha Mo	27.30	27.67	48.70
6	3t/ha Vermicompost + 1.5kg/ha Mo	28.90	30.24	53.10
7	5t/ha Vermicompost + 0.5kg/ha Mo	26.10	26.40	48.00
8	5t/ha Vermicompost + 1kg/ha Mo	28.60	28.40	50.60
9	5t/ha Vermicompost + 1.5kg/ha Mo	29.80	30.96	62.10
	F test	S	S	S
	SEm(±)	1.01	1.27	1.90
	CD (P=0.05)	2.15	2.68	4.03

Table 2. Effect of vermicompost and molybdenum on yield attributes of ground nut

S.no.	Treatments	Number of pods/plant	Number of kernels/ Pod	Seed index(g)	Seed yield (t/ha)	Haulm yield (t/ha)	Harvest Index (%)
1.	0t/ha Vermicompost + 0.5kg/ha Mo	23.6	1.71	35.5	1.58	3.69	29.94
2.	0t/ha Vermicompost + 1kg/ha Mo	25.00	1.75	35.8	1.65	3.70	30.85
3.	0t/ha Vermicompost + 1.5kg/ha Mo	25.8	1.87	37.10	1.7	3.74	31.65
4.	3t/ha Vermicompost + 0.5kg/ha Mo	25.67	1.80	36.05	1.68	3.71	31.08
5.	3t/ha Vermicompost + 1kg/ha Mo	28.0	1.93	38.3	1.87	4.14	31.08
6.	3t/ha Vermicompost + 1.5kg/ha Mo	38.0	1.97	39.41	2.10	4.18	33.46
7.	5t/ha Vermicompost + 0.5kg/ha Mo	27.0	1.93	37.56	1.9	4.13	31.94
8.	5t/ha Vermicompost + 1kg/ha Mo	37.00	1.98	39.3	2.15	4.16	34.10
9.	5t/ha Vermicompost + 1.5kg/ha Mo	39.93	2.00	40.0	2.38	4.26	35.74
	F-test	S	S	S	S	S	S
	SE m (±)	1.21	0.08	1.39	0.13	0.08	1.46
	CD at 5%	2.56	0.16	2.95	0.28	0.18	3.09

4. CONCLUSION

From the results, Application of Vermicompost at 5 t/ha and Molybdenum at 1.5 kg/ha along with the recommended dose of Nitrogen, Phosphorus and Potash recorded highest (treatment 9), seed yield and benefit cost ratio.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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