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Effect of Bio-fertilizers and Vesicular-arbuscular Mycorrhiza (VAM) on Growth, Yield and Economics of Rabi Groundnut (*Arachis hypogaea*) in Balasore District of Odisha

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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

An on farm trial was conducted to evaluate the effect of Biofertilisers and VAM on growth, yield & economics of Groundnut production. The experiment was laid out in Randomized block design with three treatment combination replicated seven times. The experiment was conducted during the Rabi season of 2019-20 at Narayanpur village under Baliapal block in Balasore district of Odisha. Seven number of farmers were included in this trial. The results of the experiment revealed that integrated application of N-P_2O_5-K_2O @ 20:40:40kg/ha + Seed treatment with Rhizobium@ 50g/kg of seed + Soil application of PSB@ 5kg/ha &VAM@ 10kg/ha at sowing recorded significantly maximum growth & yield attributes resulting 25.4% higher pod yield than sole application of N-P_2O_5-K_2O @ 20:40:40kg/ha.

Keywords: Rabi groundnut; balasore; biofertilizers; rhizobium; PSB; VAM; nodulation; yield.

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1. INTRODUCTION

Groundnut (*Arachis hypogaea*) a member of family leguminaceae, is the 13th most important food crop, 4th important source of vegetable oil and 3rd main source of vegetable protein in the world. India is the second largest producer of groundnut after Brazil, accounting for 22.98 per cent of the total area and 14.52 per cent of the production of the world. As regards the nutritional value of groundnut, its seed contains about 40-50% oil, 20-30% protein and 10-20% carbohydrate [1]. The productivity of groundnut in Odisha is very low (1044 kg/ha) primarily due to its cultivation in acidic soils with low N, P, Ca, S, B besides inadequate organic matter [2]. They further stressed that proper fertilizer management of groundnut crop with right kind of nutrients at right time adopting the right method of application has significant effect on yield and quality. The low yield of groundnut in India was suggested to be due to low nodulation and to competition from indigenous ineffective strains [3]. Bio-fertilizers can play an important role in meeting the nutrient requirement of crops through biological nitrogen fixation (BNF), solubilization of insoluble phosphorus sources (PSB), extend the nutrient absorption to zones not accessible to plant roots (VAM) [4]. Thus it is necessary to look into the mineral nutrition aspects of groundnut for achieving high yield and advocate the suitable package of practices for optimization of yield [5]. The present review is devoted to recent works relating to integrated nutrient management in groundnut seed crops and other crops.

2. MATERIALS AND METHODS

An on-farm trail on groundnut was conducted at Narayanpur village (Longitude - E087016'42.32", Latitude - N21034'54.50") under Baliapal block of Balasore district by Krishi Vigyan Kendra (KVK), Balasore during the Rabi season, 2019-20. The experiment was laid out in randomized block design with three treatment & seven replications. The soil of the experimental area was sandy loam in texture, with pH 6.6, low organic carbon 0.68 percent, available N, P, K and B (416, 25, 247 & 0.77 kg/ha, respectively).The treatment consisted of **(1) T_1**: N-P_2O_5-K_2O@ 20:40:40kg/ha **(2) T_2**: N-P_2O_5-K_2O @ 20:40:40kg/ha + Seed treatment with Rhizobium@ 50g /kg of seed) + Soil application of PSB@ 5kg/ha **(3) T_3**: N-P_2O_5-K_2O @ 20:40:40kg/ha + Seed treatment with Rhizobium@ 50g /kg of seed) + Soil application of Phosphorous Solubilizing Bacteria (PSB) @ 5kg/ha + Vesicular-arbuscular mycorrhiza (VAM) @ 10kg/ha.

Groundnut var. Dharani was sown at 60cm x 20cm spacing with 125kg seed/ha in second week of February. The irrigation was given at whenever Full dose of Phosphorus and Potash were applied at the time of sowing of both the crops as di-ammonium phosphate. The recommended cultural operations and plant protection measures were carried out timely. Seed was inoculated with *Rhizobium leguminosarum.* PSB & VAM incubated with the 200kg prelimed FYM (Lime 10kg) incubated for 7 days at 30% moisture & applied in rhizosphere at the time of planting. Yield attributes characters like pods per plant was counted at physiological maturity stage. On the basis of ten random competitive plants, traits like plant height, pods/plant were recorded. The ratio of weight of seeds after shelling of 100 pods and weight of these pods was expressed as shelling percentage.

Table 1. Effect of bio-fertilizer & VAM on Yield attributing characters & pod yield in Rabi Groundnut, 2019-20

Treatments	Plant Height (cm)	Pods/Plant (no.)	Pod Yield (q/ha)	Haulm Yield (q/ha)	Shelling (%)
T_1	42.9	21.60	20.4	32.17	68.20
	43.4	24.20	22.8	35.81	70.40
	44.7	26.00	25.6	41.61	73.50
CD	0.929	0.942	0.828	1.641	1.058
S.E. (m)	0.298	0.303	0.266	0.527	0.339
CV	1.805	3.344	3.065	3.814	1.270

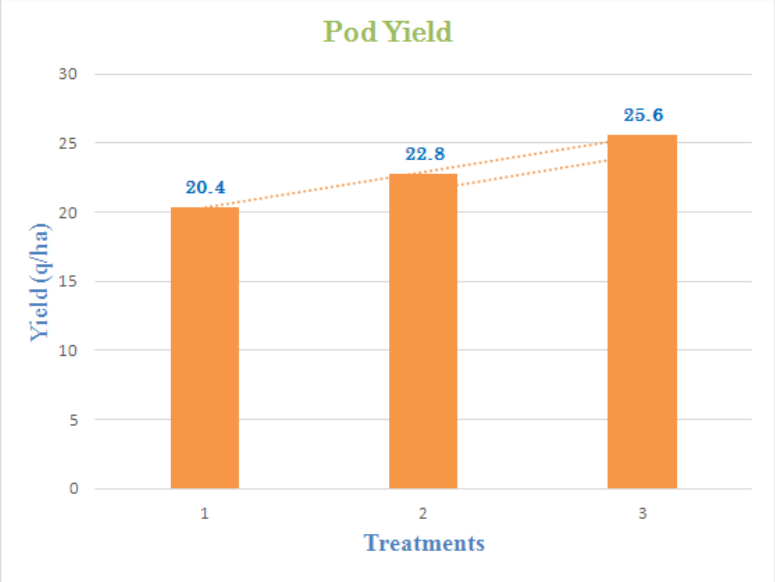

Fig. 1. Effect of different dose of Biofertilisers & VAM on Pod yield in Rabi Groundnut

Table 2. Effect of bio fertilizer & VAM on economic parameters in Rabi Groundnut, 2019-20

Treatment	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Marginal Rate of Return Over T1	BC ratio
T_1	58000	103836	45836	-	1.79
	58600	116052	57452	20.3	1.98
	60050	130304	70254	12.1	2.17

3. RESULTS AND DISCUSSION

3.1 Effect on Growth Attributes & Yield

Seed inoculation with bio fertilizer *Rhizobium* & soil application of PSB significantly enhanced the plant height as well as pods per plant, haulm yield, shelling percentage and eventually pod yield in Rabi Groundnut crop as compared to the control plot (Table 1). Biofertilisers inoculation resulted in greater nodulation. The additional supply of nitrogen and phosphorus helped in formation of new cell and thus, proliferation of growth. Phosphorus is an important constituent of co-enzymes involved in photosynthesis which might have been increased accumulation of photosynthesis. Rhizobium bacteria have the capacity to fix atmospheric nitrogen to soil and make it available to plant. Phosphorus solubilizing microorganisms reserved in available form of readily hydrolyses organic phosphate and degrade them in the soil through production of organic acids. Biofertilisers inoculation resulted in 11.76% & 11.31% higher pod & haulm yield in Rabi Groundnut. These recordings corroborates the findings of Ban et al. [4], Ola et al. [7], Patil et. al. [4] & Zalate et al. [8]. The number of seeds/pod is a varietal character which indirectly depends on the pod growth. The factors those influence pod growth may affect the seeds/pod. In the present study, application of N-P2O5-K2O @ 20:40:40kg/ha + Seed treatment with Rhizobium@ 50g /kg of seed + Soil application of PSB@ 5kg/ha & VAM@ 10kg/ha recorded the highest number of seeds/pod, indicating the formation of more number of two-seeded pods in these treatments. The combined application of Rhizobium, PSB & VAM along with recommended dose of NPK significantly increases the plant height, pods per plant, haulm yield & shelling percentage as observed by Kausale et al. [9]. Pod yield, haulm yield & shelling percentage were significantly improved by 25.4, 29.5 & 7.7% under T3, respectively as compared the sole application of 20:40:40kg/ha NPK. Integrated application of RDF + Rhizobium + VAM + PSB might have provided sufficient and balanced nutrients in readily available form throughout the growth period of the crop and the increased availability of plant nutrients, their uptake leading to the greater photosynthesis production of metabolites and enzymatic

activities might have influenced into increased nodulation and extensive root system and the greater production of metabolites and their translocation to various sinks especially the productive strictures (pods and seeds) could have helped to increase into the number of pods per plant besides increasing the overall growth as recorded by Sharma et al. [10]. The dual inoculation with AM fungi and Rhizobium biofertilizer is more effective in increasing growth, nutrition, chlorophyll content and biomass production of legumes are in accordance with the findings of Arumugam et al. [11] & Choudhury et al. [12].

3.2 Effect on Economics

The selling price of Groundnut is RS 5090/- per quintal. (Local market rate) was considered while calculating the economics. The results revealed that maximum net return (Rs. 70254/- per ha) & BC ratio (2.17) were recorded from the treatment T3. Marginal Rate of Return for T2 over T1 is 20.3 while that of T3 over T1 is 12.1 which indicates T2 dominated T3 but BC ration in case of T3 is higher than that of T2 & an extra profit of Rs 12802/- per ha has been obtained in T3 than T2. Favorable BC ratio was self-explanatory of economic viability which further convinced the farmer about the use of bio fertilizer & VAM in Groundnut production.

4. CONCLUSION

Seed inoculation with Rhizobium along with soil application of PSB & VAM incubated with FYM in combination with chemical fertilizer NPK can improve the crop productivity in Rabi Groundnut. Farmers of different villages of Baliapal, Jaleswar & Bhograi block showed positive response for the execution of this technology. However more awareness about judicious use of fertilizers after soil testing is required. Potential yield of the crop specifically the variety can be achieved through scientific knowledge, good quality need based input & proper application these inputs by the practicing farmers. Horizontal spread of this technology can be achieved through various extension activities like Frontline demonstration, training, method demonstration, Field day, exposure visit, extension literatures & kisan gosthi etc.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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