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Impact of Mixed Biofertilizers on growth, yield and soil of Groundnut

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ABSTRACT

A field experiment on Bio-Efficiency of Incryl on Groundnut (*Arachis hypogaea* L.) in Punjab Conditions was planned with an objective to know the effect of Incryl & biofertilizers on various chemical properties of groundnut. Groundnut is an important cash crop and most widely grown oil seed crop in India. During the kharif season of 2022, the field experiment was conducted on an agricultural farm at the School of Agriculture of Lovely Professional University in Phagwara, Punjab, to examine the various chemical properties of groundnut. The randomized block design (RBD) of the experiment consisted of seven treatments in five replications (T_1: control + (recommended dose of fertilizer i.e., RDF), (T_2: Incryl @ 1.5kg/acre + recommended dose of fertilizer RDF+), (T_3: Incryl @ 3kg/acre + recommended dose of fertilizer + RDF), (T_4: Incryl @ 6kg/acre + recommended dose of fertilizer + RDF), (T_5: Incryl @ 1.5kg/acre + recommended dose of fertilizer + *Rhizobium* + RDF), (T_6: Incryl @ 1.5 kg/acre + recommended dose of fertilizer + *Trichoderma* enriched vermicompost + RDF), T_7: Incryl @ 1.5kg/acre + *Rhizobium* + *Trichoderma* enriched vermicompost + RDF) and application of Incryl @ 1.5kg/acre + *Rhizobium* + *Trichoderma* enriched vermicompost + recommended dose of fertilizer) (T7) has shown better results among other treatments.

Key words*: Arachis hypogeae, Biofertilizers, Incryl, RDF, Economics, yield, benefit-cost ratio.*

Introduction

Groundnut (*Arachis hypogeae* L.) is a significant commercial oilseed crop in India, China, Brazil, Nigeria, and the United States. Groundnut is regarded to be India's most significant food legume and oilseed crop, with a total production of 9.18 million tonnes and an average productivity of 1.86 t/ha. They are cultivated for both oil extraction and consumption as a food item (Pasupuleti *et al.*, 2013). According to (Dhamsaniya *et al.*, 2012), over 33% of peanut cultivars cultivated worldwide are utilized for consumption purposes. Among the oilseed crops cultivated in India, groundnut is the most important. After soybeans, rapeseed, and cotton, peanuts rank fourth among oilseed crops globally. In 2015, they accounted for 8.7% of the overall oilseed production, contributing 45 million tons to the world's production by (Arioglu, 2014). peanuts are a significant oilseed crop used in the production of vegetable oils. According to a study by (Variath and Janila, 2017), approximately two-thirds of the global peanut yield is utilized in the production of oil, while the remaining one-third is employed in food products. Over the past few years, artificial fertilisers have become necessary for crop cultivation., which is costly for those without the financial means to purchase fertiliser. As a result, the current tendency is to investigate the possibility of complementing organic fertilizers such as FYM, castor cake, vermicompost, and so on with biofertilizers. Biofertilizers and organic manure interact positively in legume crops.

Natural compost joined with biofertilizers will protect and keep up with soil richness. By dissolving insoluble phosphorous sources, biofertilizers (PSB) can assist crops in meeting their phosphorus requirements. According to Glick and Bashan (1997), plant growth-promoting bacteria (PGPB) are a class of free-living microbes that play a variety of roles in encouraging plant development. The vesicular-arbuscular mycorrhizal (VAM) fungal association is blamed for growth promotion when mycorrhizal plants outperform non-mycorrhizal plants in some situations (Gerdeman, 1968) as a result of improved water uptake, increased nutrient acquisition from the soil, the presence of chemicals that encourage growth, and the biological control of soil-borne diseases, which gives the host disease resistance. Groundnut is an economical and beneficial source of oil and protein, making them highly nutritious groundnuts have a high nutritive value due to the fact that they are a cheap source of protein and oil (Atasie *et al.,* 2009). By generating the right environmental conditions for better growth and higher production, the optimum sowing time is a crucial agronomic aspect that greatly determines the potential yield of the crop in any region (Khajuria *et al.,* 2017).

Materials and Methods

In order to determine the impact of biofertilizers on the growth, yield, and soil of groundnut, a field experiment was conducted in the kharif season of 2022 at the Lovely Professional University's agricultural farm in Phagwara, Punjab. the randomised block design (RBD) method of experiment design was used with 5 replications consisting of 7 treatments (T_1: control + (recommended dose of fertilizer i.e., RDF), (T_2: Incryl @ 1.5kg/acre + recommended dose of fertilizer), (T_3: Incryl @ 3kg/acre + recommended dose of fertilizer), (T_4: Incryl @ 6kg/acre + recommended dose of fertilizer), (T_5: Incryl @ 1.5kg/acre + recommended dose of fertilizer + *Rhizobium*), (T_6: Incryl @ 1.5 kg/acre + recommended dose of fertilizer + *Trichoderma* enriched vermicompost), (T_7: Incryl @ 1.5kg/acre + *Rhizobium* + *Trichoderma* enriched vermicompost + recommended dose of fertilizer). During the kharif season of 2022, the groundnut crop's growing duration ranges between the 25th and 42nd Standard Meteorological Weeks depending on several weather elements and the planting environment. 52.2 mm of rain fell over the entire crop-growing season the highest average weekly maximum temperature of 43.14 ºC was recorded during in the 27th week and lowest weekly average was recorded during in the 42nd week of 31.42 ºC. During kharif 2022, with an average morning and evening relative humidity of 61.8 and 59.09%, respectively.

Experimental site and methodology

The texture of the sandy loam soil at the experimental site was analysed using the Bouyoucous Hydrometer method, which found it to be normal in reaction (pH 7.60), to have a safer range of electrical conductivity (0.21 Ds/m) measured by a glass electrode pH meter and an EC meter, to have low levels of organic carbon (0.61%) using the Walkley and Black's 1934 method, low levels of available nitrogen (154.78 kg/ha) 1954), and potassium, which was estimated to be 76.48 kg/ha through the use of the ammonium acetate extraction method (Jackson, 1973). The examination was spread out in a randomized block plan with mixes of seven medicines and five replications in a planting climate (June 23) in 2022. The dibbling method was used to sow seeds (32 kg/ha) at a specific distance between the rows (30 cm) and the plants (15 cm) in a depth of 5 cm. 40 kg/ha of nitrogen (N), 40 kg/ha of phosphorus (P_2O_5), and 60 kg/ha of potassium (K_2O) were added to the crop as additional nutrients. To keep pests, diseases, and insects out of crops, plant protection methods were used. Using a Knapsack sprayer, a uniform application of 1 l/ha of pendimethalin as pre-emergence was applied the day after sowing for weed control. The boundaries examined during the research were development qualities, yield-crediting characters, soil boundaries, and financial aspects. The length of the root was measured on a scale from the top to the bottom of the plant by uprooting three randomly selected plants within the area of each net plot and tagging them. Uprooting plants and randomly selecting and tagging three plants within each net plot determined the number of nodules. Each net plot's area was randomly selected to determine the number of branches. The harvest was taken from the singular net plot region, and it was sun dried for 3-4 days, then, at that point, physically sifted and cleaned, and the seeds were gathered, estimated, and made an appearance terms of seed yield in q/ha reap list. After the crop had been properly dried, the entire biological yield seed plus stover from the net plot was measured and expressed in kilograms per hect-

are. The total yield per net plot for each treatment was determined by subtracting the total weight of the biological yield from the total weight of the seeds. The yield of stover was measured and expressed in q/ha. The harvest index was estimated by Nichiporovich in 1967 as follows:

Harvest index (%) = Grain yield (q/ha)/ biological yield (q/ha) × 100

Soil available nitrogen (N) was measured using lowry's method, soil available phosphorus (P_2O_5) was measured using Olsen's method and soil available potassium (K_2O) was measured using flame photometer. Soil economics which calculated are Net returns, Gross return, benefit cost ratio, cost of development. The expense of development was cultivating the crops, which included expenses for inputs, labour, and operations for different treatments. determined by including every one of the costs associated with Net returns were determined when the expense of development was deducted from the gross returns.

Net returns = Gross returns - Cost of cultivation.

Gross return was calculated by the yield is multiplied by selling price

Gross return= yield (q/ha) × selling price

When the net return is divided by the cultivation cost, the benefit-cost ratio is calculated.

Benefit cost ratio = Net return / Cost of Cultivation.

Statistical Analysis

Using an Excel spreadsheet, the data were statistically analysed to determine how the sowing environment and cultivar affected growth traits, yield characteristics, and soil factors. The most contrast test (LSD) was utilized to evaluate the mean distinctions at the 5% degree of likelihood (P = 0.05).

Results and Discussion

Impact of mixed biofertilizers on traits related to growth and yield

The various growth and yield parameters, viz. Plant height, Number of pods, Root length, Number of Nodules, Number of Branches, Grain yield, haulm yield and Harvest Index as data represented in Table 1 revealed that the crop sown during the research trail from treatment T_7 recorded tallest Root length of about 28.3 cm followed by T_4 recorded Root length of about 27.64 cm and followed by T_6 recorded the Root length of about 26.2 cm and the lowest being T_1 recorded Root length of about 22.76 cm. Similar results in case of Number of Nodules from treatment T_7 recorded highest number of nodules of about 35.32 per plant followed by T_4 recorded Number of Nodules of about 34.38 per plant and followed by T_6 recorded the Number of Nodules of about 33.46 and the lowest being T_1 recorded lowest Number of Nodules of about 26.66 per plant. In case plant height from treatment T_7 recorded highest plant height of about 31.06 cm followed by T_4 recorded plant height of about 30.38 cm and followed by T_6 recorded the plant height 29.6 of about and the lowest being T_1 recorded lowest plant height of about 27.8 cm. Similar results were obtained in case of Number of branches from treatment T_7 recorded highest number of branches of about 15.06 per plant followed by T_4 recorded Number of branches of about 12.2 per plant and followed by T_6 recorded the Number of branches of about 13.68 and the lowest being T_1 recorded lowest Number of branches of about 8.82 per plant. In case of grain yield from treatment T_7 recorded highest grain yield of about

Table 1. Effects of mixed biofertilizers on groundnut yield and growth

Treatment	Root length	Plant height	No of Nodules	No of branches	Grain yield t/ha	No of pods	Haulm yield t/ha	Harvest index
T1	22.76	27.8	26.66	8.82	31.02	25.42	38.82	38.3
T2	23.38	28.24	28.4	9	36.44	26.51	39.16	38.8
T3	24.32	28.66	29.42	9.36	38.7	27.4	40.32	39.9
T4	27.64	30.38	34.38	12.2	40.44	31.68	42.82	42.6
T5	25.42	29.44	31.38	10.58	39.3	28.48	41.69	40.5
T6	26.2	29.6	33.46	13.68	39.82	30.42	42.32	41.6
T7	28.3	31.06	35.32	15.06	42.82	33.58	44.25	44.68
C.D.(P=0.05)	0.34	0.39	0.33	0.63	1.21	0.33	1.43	1.49
S. E. M	0.117	0.136	0.113	0.219	0.416	0.113	0.491	0.513

42.82 q/ha followed by T_4 recorded grain yield of about 40.44 q/ha and followed by T_6 recorded the grain yield of about 39.82 q/ha and the lowest being T_1 recorded grain yield of about 31.08 q/ha. In case of number of pods per plant treatment T_7 recorded highest number of pods per plant of about 33.58 per plant followed by T_4 recorded number of pods per plant of about 31.68 per plant and followed by T_6 recorded number of pods per plant of about 30.42 pods per plant and the lowest being T_1 recorded number of pods per plant of about 25.42 pods per plant. Similarly in case of stover yield from treatment T_7 recorded highest stover yield of about 44.25 q/ha followed by T_4 recorded stover yield of about 42.82 q/ha and followed by T_6 recorded the stover yield of about 42.32 q/ha and the lowest being T_1 recorded stover yield of about 38.82 q/ha. In case of harvest Index from treatment T_7 recorded highest harvest index of about 44.68% followed by T_4 recorded harvest index of about 42.6% and followed by T_6 recorded the harvest index of about 41.6% and the lowest being T_1 recorded harvest index of about 38.3.

Impact of mixed bio-fertilizers on soil and Economics: The various soil and economic parameters, viz. Available nitrogen(N), Available Phosphorus (P_2O_5), Available Potassium (K_2O), cost of cultivation, Net Returns, Gross Returns and Benefit cost ratio as data represented in Table 2 revealed that the during the research trail from treatment T_7 recorded highest available Nitrogen of about 158.02 q/ha followed by T_4 recorded available nitrogen of about 157.42 q/ha and followed by T_6 recorded the available nitrogen of about 157.42 q/ha and the lowest being T_1 recorded available nitrogen of about 153.42 q/ha. Similar results were obtained in case of Available Phosphorus from treatment T_7 recorded maximum available Phosphorus of about 19.96 q/ha followed by T_4 recorded available Phosphorus of about 23.98 q/ha and followed by T_6 recorded the Available Phosphorus of about 23.36 q/ha and the lowest being T_1 recorded lowest Available Phosphorus of about 19.96 q/ha. Similarly in case of Available potassium T_7 recorded highest available Potassium of about 137.16 q/ha followed by T_4 recorded available potassium of about 136.4 q/ha and followed by T_6 recorded the available potassium of about 134.98 q/ha and the lowest being T_1 recorded available potassium of about 132.4 q/ha. In case of cost of cultivation from treatment T_7 recorded highest cost of cultivation of about 259292 Rs followed by T_4 recorded cost of cultivation of about 230492 Rs and followed by T_6 recorded the cost of cultivation of about 259292 Rs and the lowest being T_1 recorded cost of cultivation of about 205176 Rs. Similarly in case of Net returns from treatment T_7 recorded highest net return of about 326178 Rs followed by T_4 recorded net return of about 485296 Rs and followed by T_6 recorded the net return of about 471718 Rs and the lowest being T_1 recorded net return of about 326178 Rs. In case of Gross Return from treatment T_7 recorded highest gross return of about 757914 Rs followed by T_4 recorded gross return of about 715788 Rs and followed by T_6 recorded the gross return of about 731010 Rs and the lowest being T_1 recorded gross return of about 531354 Rs. In case of benefit cost ratio from treatment T_7 recorded highest benefit cost ratio of about 1.99 followed by T_4 recorded benefit cost ratio of about 1.94 and followed by T_6 recorded the benefit cost ratio of about 1.89 and the lowest being T_1 recorded benefit cost ratio of about 1.58.

Conclusion

The findings of this study can be summarised by stating that the Application of mixed fertilizers have

Table 2. Economics and soil effects of mixed biofertilizers on groundnut

Treatment	N	P	K	Cost of cultivation	Gross return	Net return	B:C Ratio
T1	153.42	19.96	132.4	205176	531354	326178	1.58
T2	155.44	20.94	133.18	230492	644988	414496	1.66
T3	156.48	21.4	134.18	230492	684990	454498	1.82
T4	157.42	23.98	136.4	230492	715788	485296	1.94
T5	156.52	22.32	134.92	230492	695610	465118	1.86
T6	157.42	23.36	134.98	259292	731010	471718	1.89
T7	158.02	24.42	137.16	259292	757914	498292	1.99
C.D.(P=0.05)	0.27	0.38	0.39				
S.e.M	0.093	0.131	0.135				

significant impact on both growth and yield attributes. The crop sown during the research trail performed significantly better in terms of Root length, Number of nodules, Number of branches, plant height, number of nodules, Grain yield, Haulm yield and Harvest Index and similar results were found among the soil and economics of groundnut viz. Available N, P, K, cost of cultivation, net returns, gross returns and benefit cost ratio. Hence based on present study, it can be concluded that Treatment T_7 among the others treatment showed better results.

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