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Effect of inorganic and bio-fertilizers on quality of summer groundnut (*Arachis hypogaea* L.)

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Abstract
A field experiment entitled, "Effect of inorganic and bio-fertilizers quality of summer groundnut (*Arachis hypogaea* L.)" was conducted at PG Research Farm, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur during summer, 2019. The experiment was laid out in factorial randomized block design (FRBD) with three replications and nine treatment combinations of three inorganic fertilizer levels F_1-75% RDF (18.75:37.5:0 kg ha^{-1}), F_2-100% RDF (25:50:0 kg ha^{-1}), F_3-125% RDF (31.25:62.5:0 kg ha^{-1}) and three bio-fertilizers levels B_1-Control, B_2-*Rhizobium* spp. + PSB (Lignite based), B_3- *Rhizobium* spp.+ PSB (Liquid based). The crop was fertilized as per treatments by using urea and single super phosphate was given by placement method. The application of 100% of RDF ha^{-1} was comparable with 125% RDF ha^{-1} significantly over 75% RDF ha^{-1} in respect of recording higher value of quality attributes *viz*., oil content in kernel, oil yield, protein content in kernel and protein yield. The dual seed inoculation of *Rhizobium* spp. + PSB (Lignite based)as well as *Rhizobium* spp. + PSB (Liquid based) in respect of recording higher value of quality attributes *viz*., oil yield, oil content in kernel, protein content in kernel and protein yield. The quality attributes of groundnut were not influenced by the interaction effect of both the factors. This indicates that the both factors under study *viz*., inorganic and biofertilizer levels behaved independently in respect of quality of summer groundnut variety.

Keywords: Inorganic, *Arachis hypogaea*, new variety

Introduction
The groundnut crop is worlds the 13th most important food crop and 4th most important oilseed crop and 3rd most important source of vegetable protein. Groundnut (*Arachis hypogaea* L.) seed contain high quality edible oil (48%), easily digestible protein (26%) and carbohydrates (20%). The bulk of oil production in India is derived from groundnut, rapeseed, sesame, sunflower, soybean and other minor oilseed crops, and among these crops, groundnut (*Arachis hypogaea* L.) is the most dominant annual crop widely cultivated. The groundnut is a commercially and nutritionally very important source of oil. At the global level 50% of the groundnut produced is used for oil extraction, 37% for confectionary use and 12% for seed purpose. In India, 80% of the groundnut produced is used for oil extraction, 11% as seed, 8% as direct food and only 1% of groundnut produce is exported (Anon., 2011) [1]. The groundnutcontains50% oil and 20% protein depends on varieties and climatic conditions. Groundnut oil is edible oil and extensive use in soap making and manufacturing cosmetics and lubricants, olein, sterein and other salts. This contains 20% saturated and 80% unsaturated fatty acid. Poly saturated fatty acids two types i.e. oleic (40-50%) and linoleic (24-35%) (Mathur and Khan, 1997) [11]. While higher oleic acid content provides thermal stability and makes it suitable for deep frying, the higher linoleic acid is good for health. They are rich in protein (21.43%), carbohydrates (6-24.9%) and minerals and vitamins *viz.*, A, B, E and some members of B_2 group except B_{12} (Das, 1997) [8]. Their calorific value is 349 per 100 grams.
Several studies had proved that use of inorganic and biofertilizers in combination helps to increase yield and reduces the cost of cultivation. As use of biofertilizer increases the fertilizer use efficiency of plant. Hence, inorganic fertilizers have to be use in combination with biofertilizers. Cultivation of groundnut can be possible in *kharif*, *rabi* and summer season; among all three seasons, summer is more favourable if irrigation facilities are available. Summer is ideal season by keeping in view crop's requirement of sunshine and high temperature.

Also the crop gives three times higher yield than that of *kharif* season. It is observed that oil content in kernels is found to be higher by 2.28 to 4.5% than *kharif* ones. It can be concluded that adoption of a balanced fertilizer management approach will safeguard the higher productivity and returns from money spent, not only on nutrients but also on relay cropping enterprise. Inorganic crop receiving recommended dose of fertilizers gave the highest productivity and profits. However, it enhanced the cost of production than combined use of RDF and organic sources. Over the years, combined application of RDF and organic fertilizers expected to match or excel the fertilizer based production structure in the groundnut (Poonia *et al.*, 2014) [14].

Materials and methods

The experiment was laid out in factorial randomized block design (FRBD) with three replications and nine treatment combinations of three inorganic fertilizer levels F_1- 75% of RDF (18.75:37.5:0 kg ha^{-1}), F_2- 100% of RDF (25:50:0 kg ha^{-1}), F_3- 125% of RDF (31.25:62.5:0 kg ha^{-1}) and three bio-fertilizers levels B_1- Control, B_2- *Rhizobium* spp. + PSB (Lignite based), B_3- *Rhizobium* spp. + PSB (Liquid based). The gross and net plot size were 5.4 m x 4.8 m and 4.8 m x 3.6 m, respectively. The soil of the experimental plot was sandy loam in texture, low in available nitrogen (231.24 kg ha^{-1}), moderately high in available phosphorus (24.25 kg ha^{-1}) and moderately high in available potassium (243.16 kg ha^{-1}). The soil was slightly alkaline in reaction (pH 8.23).

The crop, groundnut with variety JL-1085 (Phule Dhani) was sown on 15th of February, 2019 by dibbling method with different inorganic and biofertilizer levels. The crop was fertilized as per treatments by using urea and single super phosphate was given by placement method. In general, the summer season was good for crop growth and development. The experimental data was statistically analyzed by using a standard method of "analysis of variance" as reported by Panse and Sukhatme (1967) [13].

Result and discussion

1) Effect on quality attributing characters

A. Effect of inorganic fertilizers

The quality contributing characters like oil yield125% RDF (953.87 kg ha^{-1}), protein content in groundnut kernels (24.75%) and protein yield of groundnut (469.34kg ha^{-1})were also maximum with the 125% RDF and which was at par with 100%RDF and significantly superior over 75% RDF. These results are in line with finding of Shinde *et al.*, (2000) [18], Sarade *et al.*, (2016) [16], Ismail Sayed and Bodkhe (2013) [9] and Sharma *et al*., (2013) [17] also reported that the oil yield kg ha^{-1} increased with increasing levels of fertilizers due to their graded levels of pod yield.

B. Effect of Bio-fertilizer

The quality contributing characters like oil yield (922.39 kg ha^{-1}), protein content in groundnut kernels (24.90%) and higher the protein yield (463.33 kg ha^{-1})were also maximum with the *Rhizobium* spp. + PSB (Lignite based) and which was at par with *Rhizobium* spp. + PSB (Liquid based) and significantly superior over control. Similar results revealed by Ramesh and Sabale (1999) [15], Sharma *et al*., (2013) [17], and Chaudhari *et al.*, (2019) [5].

C. Effect of Interaction

The interaction effects between the inorganic fertilizer and biofertilizer levels were found to be non-significant in respect of quality of groundnut.

2) Effect on yield of groundnut

A. Effect of Inorganic Fertilizers Levels

The different fertilizer levels had a significant impact on the dry pod yield of groundnut. Among the inorganic fertilizers, the application of 125% RDF recorded significantly the highest dry pod yield (24.95 q ha^{-1}) and dry halum yield (35.48 q ha^{-1}) of groundnut over 75% RDF. However, it was at par with application of 100% RDF in case of dry pod yield.

Table 1: Mean oil content (%), oil yield (kg ha^{-1}), protein content (%) and protein yield (kg ha^{-1}) of groundnut as influenced by different treatments

Treatments	Oil content in kernel (%)	Oil yield (kg ha^{-1})	Protein content in kernel (%)	Protein yield (kg ha^{-1})
Inorganic Fertilizer Levels:				
F_1- 75% of RDF	49.34	734.81	19.79	295.48
F_2- 100% of RDF	50.30	927.83	23.63	441.55
F_3- 125% of RDF	50.72	953.87	24.75	469.34
S. Em±	0.21	9.41	0.31	9.04
C. D. at 5%	NS	28.24	0.94	27.11
Biofertilizer Levels:				
B_1– Control	49.36	792.15	19.27	313.98
B_2 -*Rhizobium spp.*+ PSB (Lignite based)	50.61	922.39	24.90	463.33
B_3-*Rhizobium spp.*+ PSB (Liquid based)	50.38	901.96	23.99	429.06
S. Em±	0.21	9.41	0.31	9.04
C. D. at 5%	NS	28.24	0.94	27.11
Interactions (F × B):				
S. Em±	0.65	28.25	0.94	27.13
C. D. at 5%	NS	NS	NS	NS
General mean	50.12	872.17	22.72	402.12

(24.60 q ha^{-1}) and dry haulm yield (34.60 q ha^{-1}).This may be due to efficient and greater partitioning of metabolites and adequate translocation and accumulation of photosynthesis to developing reproductive structure under adequate fertilization that might have resulted in increase in important growth and yield contributing characters *viz.*, plant spread, number of branches, dry matter accumulation, number of pods and kernels and their weight and thousand kernel weight were significantly increased which resulted in increased dry pod yield with higher level of fertilizer. Further, the fertilizer application provided better conductive condition for higher uptake of nutrients. There results are in conformity with the above finding of Tiwari and Dhakar (1997) [20], Bhalerao *et al.*, (1993) [3], and Chavan *et al.*, (2013) [6].

B. Effect of Biofertilizer Levels

The different biofertilizer treatments significantly differed in respect of the pod yield. The highest pod yield of groundnut were obtained due to dual inoculation of *Rhizobium* spp. + PSB (Lignite based) the dry pod yield (24.42 q ha^{-1}) and dry haulm yield (34.32q ha^{-1}) of groundnut recorded significantly superior over the control. However, it was on par with dualseed inoculation with *Rhizobium* spp. + PSB (Liquid based) with respect to the dry pod yield (23.98 q ha^{-1}) and dry haulm yield (33.86 q ha^{-1}).The important growth and yield contributing characters *viz*., plant spread, number of branches, dry matter accumulation, number of pods and kernels and their weight and thousand kernel weight were significantly increased with the application of P-solubilizer treatments with *Rhizobium* inoculation due to additional nitrogen and phosphorous uptake, resulting in increased dry pod yield. Increase in root nodules due to P-solubilizer and nitrifying bacteria also helped in increasing better root development and dry pod yield by fixing more nitrogen and consequently increasing its absorption. These results were found to be in conformity with Mausumi Raychaudari *et al.,* (2003) [12] and Chavan *et al.,* (2013) [6].

C. Effect of Interaction

The interaction effects between the inorganic fertilizer and biofertilizer levels were found to be non-significant in respect of yield of groundnut.

3) Effect on economics of groundnut

A. Effect of Inorganic Fertilizers Levels

The different fertilizer levels had a significant impact on the economics of groundnut. Among the inorganic fertilizers, the application of 125% RDF recorded significantly the highest gross monetary returns (Rs 130569.00 ha^{-1}) and net monetary returns (Rs 72347.86 ha^{-1}) of groundnut over 75% RDF. Similar results reported by Chavan *et al.,* (2014), Kathmale *et al.,* (2000) [10], Waghmode *et al.,* (2017) [21] and Bala and Nath (2015) [2].

B. Effect of Biofertilizer Levels

The different biofertilizer treatments significantly differed in respect of economics. The highest economic return of groundnut were obtained due to dual inoculation of *Rhizobium* spp.+ PSB (Lignite based) of groundnut recorded significantly superior over the control. However, it was on par with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based) the gross monetary returns (Rs 127769.48 ha^{-1}) and net monetary returns (Rs 69632.58 ha^{-1}). Similar results revealed by Chatra Ram *et al.,* (2008) [4], Singh *et al.,* (2011) [19] and Datta *et al.,* (2014) [7].

C. Effect of Interaction

The effect of interaction between inorganic fertilizer and biofertilizer levels were found to be non-significant in respect of economics of different treatments of groundnut.

Table 2: Mean dry pod yield, haulm yield in (q ha^{-1}), gross monetary returns and net monetary returns in (Rs ha^{-1})of groundnut as influenced by different treatments

Treatments	Dry pod yield (q ha^{-1})	Dry haulm yield (q ha^{-1})	Gross monetary returns (Rs ha^{-1})	Net monetary returns (Rs ha^{-1})
Inorganic Fertilizer Levels:				
F_1- 75% of RDF	21.05	29.37	110032.46	52088.47
F_2- 100% of RDF	24.60	34.60	128681.46	70512.96
F_3- 125% of RDF	24.95	35.48	130569.00	72347.86
S. Em±	0.20	0.28	1028.78	1028.78
C. D. at 5%	0.60	0.84	3084.28	3084.28
Biofertilizer Levels:				
B_1– Control	22.18	31.27	116047.90	58141.94
B_2 -*Rhizobium spp*.+ PSB(Lignite based)	24.42	34.32	127769.48	69632.58
B_3-*Rhizobium spp*.+ PSB (Liquid based)	23.98	33.86	125465.54	67173.78
S. Em±	0.20	0.28	1028.78	1028.78
C. D. at 5%	0.60	0.84	3084.28	3084.28
Interactions (F × B):				
S. Em±	0.60	0.85	3086.34	3086.34
C. D. at 5%	NS	NS	NS	NS
General mean	23.53	33.15	123094.31	64982.77

Conclusion

1) The application of 100% of RDFwas at par with 125% of RDF in respect of recording higher value of quality attributes of summer groundnut resulting into higher quality. Hence, application of 100% RDF to summer groundnut found remunerative.
2) The dual seed inoculation of *Rhizobium* spp. + PSB (Lignite based) as well as *Rhizobium* spp. + PSB (Liquid based) were comparable in respect of higher values quality attributes resulting into quality. Hence, dual seed inoculation of either *Rhizobium* spp. + PSB Lignite based or liquid found suitable to summer groundnut found remunerative.
3) The application 100% RDF and 125% of RDF were comparable in respect of recording higher values of dry pod yield, haulm yield, gross and net monetary returns for summer production of groundnut. Hence, application of 100% RDF found remunerative for summer groundnut.
4) The dual seed inoculation of *Rhizobium spp*. + PSB (Lignite based) and *Rhizobium spp*. + PSB (Liquid based) were comparable in respect of recording higher values of dry pod yield, haulm yield, gross and net monetary returnsfor summer production of groundnut. Hence, application of *Rhizobium spp*. + PSB Lignite based or liquid based found beneficial for summer groundnut.

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