International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 2644-2648

Received: 09-08-2020
Accepted: 17-09-2020

AV Satpute
PG Student, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

JB Patil
Assistant Professor, Department of Agronomy, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

SM Shende
PG Student, Department of Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

MJ Patil
College Librarian, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

Corresponding Author:
AV Satpute
PG Student, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

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

AV Satpute, JB Patil, SM Shende and MJ Patil

DOI: https://doi.org/10.22271/chemi.2020.v8.i6al.11180

Abstract
A field experiment entitled, "Effect of inorganic and bio-fertilizers on growth and yield 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 *viz.*, 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 *viz.*, B_1- Control, B_2-*Rhizobium* spp.+ PSB (Lignite based), B_3- *Rhizobium* spp.+ PSB (Liquid based). The application of 100% of RDF ha^{-1} was found at par with 125% of RDF ha^{-1} and significantly superior over 75% RDF ha^{-1} in respect of recording higher value of the growth character and yield *viz*., plant height (cm), number of branches $plant^{-1}$, plant spread $plant^{-1}$ (cm), dry matter $plant^{-1}$ (g), number of nodule $plant^{-1}$,weight of nodule $plant^{-1}$ (g), dry pod yield (q ha^{-1}), haulm yield (q ha^{-1}), biological yield (q ha^{-1}), and harvest index (%). The dual seed inoculation of *Rhizobium* spp. + PSB (Lignite based) significantly superior over control and at par with *Rhizobium* spp. + PSB (Liquid based) in respect of recording higher value of growth attributes and yield *viz.*, mean plant height (cm), plant spread (cm), number of branches, dry matter $plant^{-1}$ (g), number of nodule $plant^{-1}$, weight of nodule $plant^{-1}$ (g), dry pod yield (q ha^{-1}), haulm yield (q ha^{-1}), biological yield (q ha^{-1}) and harvest index (%).

Keywords: Inorganic fertilizer levels, bio-fertilizer levels, growth and yield characters

Introduction
The groundnut is valuable food and oilseed crop and commonly called as the king of vegetable oilseed crops or poor man's nut. The groundnut is native of South American leguminous oil seed. 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. During 2018-2019 groundnut was sown in around 27.84 million hectares and production was 46.75 million metric tonnes in world. The groundnut crop gives three times higher yield than that of *kharif* season because productivity in summer season due to availability of adequate sunshine, warm temperature and availability of timely irrigation during the different growth stages of crop and restricted incidence of pest and diseases.

The grim situation of oilseed nutrient in the country indicates that only about 1/3 of fertilizer needs are actually applied. Thus, there is urgent need for steeping use of major, secondary and micro nutrients (Hedge, 2009) [7]. We can solve this problem by adopting use of inorganic fertilizers according to soil testing report and recommended dose of fertilizers. Along with inorganic fertilizers use of organic fertilizers like bio-fertilizers will also help for improving fertility level of soil. A recent FAO study indicates that between 1965 and 1976 fertilizers were responsible for 50 per cent increase in the crop production in developing countries. It has been revealed that the use of *Rhizobium* to groundnut crop was found to reduce the requirement of nitrogen fertilizers. The *Rhizobium* inoculants help to meet the additional N demand of plant. The phosphobacterium, a Phosphate Solubilizing Bacteria, which is able to convert the phosphate present in soil from unavailable form to available to the plant. It has indirect effect on nodulation which contribute to increase in yield (Gosh and Poi, 1998) [6]. The application of liquid bio-fertilizers on legumes crops before sowing plus 20 kg N per hectare enhanced the nodule numbers, fresh weight, dry weight of nodule, yield components and grain

yield in comparison to conventional farmers fertilizer level. The crops build up the soil fertility by fixing large amounts of atmospheric nitrogen through the root nodule and also through leaf fall on the groundnut at maturity (Tran *et al.*, 2007) [18]. Several studies had proved that sustainability of higher yield of groundnut could be achieved through conjunctive use of plant nutrients combining inorganic and bio-fertilizers. It also reduces the cost of cultivation and bio-fertilizers increases the fertilizer use efficiency of plant. Hence, inorganic fertilizers have to be used in combination with bio-fertilizers.

Materials and methods

The experiment was laid out in factorial randomized block design (FRBD) with three replications and nine treatment combinations of three inorganic fertilizers levels *viz.*, (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) [11].

Result and discussion

I) Growth characters

A. Effect of inorganic fertilizer levels

The application of 125% RDF (31.25:62.5:0 kg NPK ha^{-1}) recorded significantly higher over 75% RDF (18.75:37.5:0 kg NPK ha^{-1}). However, it was on par with 100% RDF (25:50:0 kg NPK ha^{-1}) in respect of plant height, plant spread per plant and number of branches per plant of groundnut. The increase in plant height with higher level of nitrogen and phosphorus application was result of enhanced activities of meristematic tissues of the plant, increase in number and size of the cell and the efficient utilization of nutrients uptake. The increase in vegetative growth of plant due to higher inorganic fertilizers might have increased nutrient uptake, resulting into increase plant spread. The inorganic fertilizer provides favourable condition for activation of meristematic cells and encourage emergence of branches. The similar result was also recorded by Bhosale and Pisal (2015), Sarade *et al.,* (2016) and Chaudhari *et al.,* (2018) [1, 15, 2].

B. Effect of bio-fertilizer levels

The dual seed inoculation with *Rhizobium* spp. + PSB (Lignite based) cultures recorded significantly superior over control. However, it was on par with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based) in respect of plant height, plant spread per plant and number of branches per plant of groundnut. The phosphorus solubilizing microorganism increase the availability of phosphorus, whereas *Rhizobium* spp. also enhances the supply of nitrogen. Therefore, combination of both might have increased vegetative growth. This result was inconformity with those Panwar and Singh (2003), Zalate and Padmani (2009) and Sivamurugan *et al.,* (2018) [12, 16].

C. Effect of interaction

The interaction effect between inorganic fertilizer and bio-fertilizers were found to be non-significant in respect of growth character of groundnut.

Table 1: Growth characters influenced by different treatments

Treatments	Plant height (cm)	Plant spread (cm)	Number of branches plant^{-1}	Mean dry matter plant^{-1}
Inorganic Fertilizer Levels:				
F_1- 75% of RDF	25.13	23.68	9.34	30.59
F_2- 100% of RDF	29.92	26.18	11.16	34.54
F_3- 125% of RDF	30.56	26.35	11.46	34.83
S. Em±	0.22	0.15	0.10	0.24
C. D. at 5%	0.67	0.47	0.31	0.72
Biofertilizer Levels:				
B_1– Control	26.94	24.23	9.91	31.68
B_2 -*Rhizobium spp.*+ PSB (Lignite based)	29.50	26.12	11.12	34.19
B_3-*Rhizobium spp.*+ PSB (Liquid based)	29.18	25.85	10.92	34.08
S. Em±	0.22	0.15	0.10	0.24
C. D. at 5%	0.67	0.47	0.31	0.72
Interactions (F× B):				
S. Em±	0.67	0.47	0.10	0.72
C. D. at 5%	NS	NS	NS	NS
General mean	28.54	25.40	10.64	33.32

II) Effect on dry matter plant^{-1}

A. Effect of inorganic fertilizer levels

The application of 125% RDF (31.25:62.5:0 kg NPK ha^{-1}) recorded significantly higher dry matter per plant of groundnut over 75% RDF (18.75:37.5:0 kg NPK ha^{-1}). However, it was on par with 100% RDF (25:50:0 kg NPK ha^{-1}). The dry matter production increased significantly with every increased level of inorganic fertilizers. The increase in plant vigour in terms of plant height, leaf number, plant spread and their area per plant due to these treatments were found to be useful in increasing photosynthetic activities and there by accumulation of more carbohydrates and consequently higher dry matter. These results are in agreement with finding of Kulkarni *et al.,* (1986) and Sardhi *et al.,* (1990) [8]

B. Effect of bio-fertilizer levels

The dual seed inoculation with *Rhizobium* spp. + PSB (Lignite based) cultures recorded significantly higher dry matter accumulation per plant of groundnut over control. However, it was on par with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based). This is mainly because P- solublizer microorganisms and nitrifing bacteria enhanced the plant vegetative growth due to additional nutrient uptake, which ultimately reflected in increasing in plant vigour in terms of plant height, leaf number, plant spread and their area per plant. That might have been useful in harvesting more solar energy which enhanced photosynthetic activities and there by accumulation of more carbohydrates and consequently higher dry matter. These results are in

agreement with finding of Panwar and Singh (2003) and Dhadge *et al.,* (2014) [12, 5].

C. Effect of interaction

The interaction effect between in organic fertilizer and bio-fertilizers were found to be non-significant in respect of mean dry matter accumulation per plant of groundnut during all the crop growth stages.

III) Effect on number of nodules plant^{-1}

A. Effect of inorganic fertilizer levels

Application of 125% RDF (31.25:62.5:0 kg NPK ha^{-1}) and 100% RDF (25:50:0 kg NPK ha^{-1}) where at par in respect of number of nodules per plant of groundnut at flowering and significantly superior over 75% RDF (18.75:37.5:0 kg NPK ha^{-1}). This result was correlated with the finding of Sagare *et al.,* (1986) and Kulkarni *et al.,* (1986) [14, 8]

Table 2: Mean number and weight of root nodules plant^{-1} (g) of groundnut at flowering as influenced by different treatments

Treatments	At flowering	
	Number of nodules plant^{-1}	Weight of nodules plant^{-1} (g)
Inorganic Fertilizer Levels		
F_1- 75% of RDF	50.24	0.93
F_2- 100% of RDF	53.88	1.23
F_3- 125% of RDF	54.71	1.26
S. Em±	0.29	0.01
C. D. at 5%	0.89	0.04
Biofertilizer Levels		
B_1– Control	50.22	0.97
B_2 -*Rhizobium spp*.+ PSB (Lignite based)	54.72	1.24
B_3-*Rhizobium spp*.+ PSB (Liquid based)	53.88	1.21
S. Em±	0.29	0.01
C. D. at 5%	0.89	0.04
Interactions (F× B)		
S. Em±	0.89	0.04
C. D. at 5%	NS	NS
General mean	52.94	1.14

B. Effect of bio-fertilizer levels

The dual seed inoculation with *Rhizobium* spp. + PSB (Lignite based) and *Rhizobium* spp. + PSB (Liquid based) where at par in respect of number of nodules per plant of groundnut at flowering and significantly superior over control. The additional uptake of nitrogen and phosphorus increased the root length of plant. This resulted in increased nodulation. These results are corroborating with the finding of Detroja *et al.,* (1997) [4] and Zalate and Padmani (2009).

C. Effect of interaction

The interaction effect due to inorganic fertilizer and biofertilizer levels were found to be non-significant in respect of mean number of root nodules per plant of groundnut at various treatment.

IV) Effect on weight of root nodules plant^{-1} (g)

A. Effect of inorganic fertilizer levels

The mean of the highest weight of root nodules per plant (1.26 g) at flowering stage was recorded with the application of 125% RDF (31.25:62.5:0 kg NPK ha^{-1}) which was significantly higher over 75% RDF (18.75:37.5:0 kg NPK ha^{-1}), expect 100% RDF (25:50:0 kg NPK ha^{-1}). Lowest mean weight of wet root nodules per plant was observed at 75% of RDF ha^{-1}, that might be due to lower availability of plant nutrients. Similar, results reported by Kulkarni *et al.,* (1986) and Vala *et al.,* (2017) [8, 19].

B. Effect of bio-fertilizer levels

The application of dual seed inoculation with *Rhizobium* spp. + PSB (Lignite based) cultures recorded highest weight of root nodules plant^{-1} (1.24 g) of groundnut over control. However, it was on par with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based) (1.21 g). The weight of root nodules plant^{-1} increased due to the increase in number of root nodules plant^{-1}, which was due to the application of bio-fertilizers. These results are corroborating with the finding of Detroja *et al.,* (1997) [4] and Zalate and Padmani (2009).

C. Effect of interaction

The interaction effect due to inorganic fertilizer and biofertilizer levels were found to be non-significant in respect of mean weight of root nodules per plant of groundnut at flowering stage.

V) Dry pod and halum yield (q ha^{-1})

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. 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 resultated 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. These results are in conformity with the above finding of Tiwari and Dhakar (1997), Bhalerao *et al.,* (1993) and Chavan *et al.,* (2013) [17, 3].

B. Effect of Biofertilizer Levels

The different biofertilizer treatments significantly differed in respect of the pod yield. The highest pod yield of groundnut was obtained due to dual inoculation of *Rhizobium* spp. + PSB (Lignite based) the dry pod yield (24.42 q ha^{-1}) and dry haulm yield (34.32 q ha^{-1}) of groundnut recorded significantly superior over the control. However, it was on par with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based). 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) and Chavan *et al.,* (2013) [10, 3].

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.

II. Harvest index (%)
A. Effect of Inorganic Fertilizers Levels
The effect of inorganic fertilizer levels was found to be non-significant in respect of harvest index of groundnut. However, application of 75% RDF (18.75:37.5:0 kg NPK ha^{-1}) recorded the highest harvest index (41.74%) of groundnut, because of higher nitrogenous fertilization produce excessive haulm yield. These results are in conformity with the above finding of Kumaran (2000) [9].

Table 3: Mean dry pod yield, haulm yield, biological yield in (q ha^{-1}) and harvest index (%) of groundnut as influenced by different treatments

Treatments	At harvest			
	Dry pod yield (q ha^{-1})	Dry haulm yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
Inorganic Fertilizer Levels				
F_1- 75% of RDF	21.05	29.37	50.42	41.74
F_2- 100% of RDF	24.60	34.60	59.43	41.33
F_3- 125% of RDF	24.95	35.48	60.44	41.34
S. Em±	0.20	0.28	0.33	0.40
C. D. at 5%	0.60	0.84	1.00	NS
Biofertilizer Levels				
B_1 – Control	22.18	31.27	53.63	41.37
B_2 - *Rhizobium spp.*+ PSB (Lignite based)	24.42	34.32	58.77	41.60
B_3 - *Rhizobium spp.*+ PSB (Liquid based)	23.98	33.86	57.88	41.44
S. Em±	0.20	0.28	0.33	0.40
C. D. at 5%	0.60	0.84	1.00	NS
Interactions (F× B)				
S. E m±	0.60	0.85	1.00	1.21
C. D. at 5%	NS	NS	NS	NS
General mean	23.53	33.15	56.76	41.47

B. Effect of Biofertilizer Levels
The effect of biofertilizer was found to be non-significant in respect of harvest index of groundnut. The dual inoculation of *Rhizobium* spp. + PSB (Lignite based) (41.60%) and dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based) (41.44%) recorded highest harvest index numerical value of groundnut over the control.

C. Effect of Interaction
The effect of interaction between inorganic fertilizer and biofertilizer levels were found to be non-significant in respect of harvest index of groundnut.

Conclusions
1. The application of 100% of RDF was at par with 125% of RDF in respect of recording higher value of growth and yield of summer groundnut. 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 growth and yield. Hence, dual seed inoculation of either *Rhizobium* spp. + PSB Lignite based or liquid found suitable to summer groundnut found remunerative.

References

1. Bhosale NA, Pisal AA. Effect of Nutrient Management on Productivity ofsummergroundnut (*Arachis hypogaea* L.) Adv. Agril. Res. & Techno. J 2015;1(1):88-91.
2. Chaudhari PK, Chaudhari PP, Desai NH. Yield and quality of *kharif*groundnut (*Arachis hypogaea* L.) as influenced by organic and inorganic sources of nutrients. Inter. J, of Agric. Sci 2018;10(6):5424-5426.
3. Chavan AP, Jain AK, Mahadkar UV. Direct & residual effect of fertilizers and bio-fertilizers on yield, nutrient uptake and economic of groundnut. Indian J. Agron 2013;59(1):53-58.
4. Detroja KS, Malavia BB, Kaneria VD, Khanpara, Patel RK. Effect of phosphatic fertilizer, phosphobacteria and seed size on plant on plant stand, growth and yield of summer groundnut (*Arachis hypoagea* L.). Indian J. Agron 1997;42(3):495-497.
5. Dhadge SM, Satpute NR. Effect of integrated nutrient management on growth, yield and quality of summer groundnut (*Aarchis hypogaea* L.). Inter. J. agric. Sci 2014;10(1):314-316.
6. Gosh G, Poi SC. Response of *Rhizobium*, phosphorus solubilizing bacteria and mycorrrhizal, organisms on some legume crops. Env. Ecol 1998;16(3):607-610.
7. Hedge DM, Sudhakara Babu SN. Declining factor productivity and improving nutrient use efficiency in oilseed. Indian J. Agron 2009;54(1):1-8.
8. Kulkarni JH, Joshi PK, Sajitra VK. Influence of phosphorus and potassium application on nodulation, nitrogen accumulation and yield of groundnut. Legume Res. J 1986;9(1):34-38.
9. Kumaran S. Role of organic manure, fertilizer levels, split application of phosphorus and gypsum application on shelling percentage, harvest index, pod and oil yield of irrigated groundnut. Res. on Crops 2000;1:344-347.
10. Mausumi Raychandhuri, Ngachan SV, Raychaudhari S, Singh AL. Yield response of groundnut (*Arachis hypoagea* L.) to dual inoculation and liming of an acid hill ultisol of Manipur. Indian J Agril Sci 2003;73(2):86-88.
11. Panse VG, Sukhatme P V. Stastical methods for agricultural research workers. ICAR publication, New Delhi 1967.
12. Panwar AS, Singh NP. Effect of conjunctive use of phosphorus and bio-organics on growth and yield of groundnut (*Arachis hypoagea* L.). Indian J. Agron 2003;48(3):214-216.
13. Rao VP, Gangakisan AG. Response rainfed groundnut to nitrogen application. J. Maharashtra Agric. Univ 1993;18(3):460-461.
14. Sagare BN, Bhalkar DV, Deshmukha VA. Studies on nodulation and N fixation by groundnut as affected by various levels of Sulphur and phosphate. PKV. Res. J 1986;10:10-15.
15. Sarade PK, Andhale RP, Ughad SR. The Effect of integrated nutrient management on growth, yield and quality of summer groundnut. Advance in Life Sci 2016;5(2):466-470.
16. Sivamurugan AP, Ravikesavan R, Singh AK, Jat SL. Effect of different levels of P and liquid biofertilizers on growth, yield attributes and yield of maize. Chem. Sci. Rev. Lett 2018;7(26):520-523.

17. Tiwari RB, Dhakare LL. Productivity and economics of summer groundnut (*Arachis hypoagea* L.) as affected by irrigation, fertilization and weed control. Indian J. Agron 1997;42(3):490-494.
18. Tran, Thi Ngoc Son, Cao Ngoc Diep, Truong Thi Minh Giang, Tran Thi Anh Thu. Effect of co-inoculants (Bradyrhizobium and phosphate solubilizing bacteria) liquid on soyabean under ricebased cropping system in the mekong delta. Omon Rice 2007;15:135-143.
19. Vala FG, Vaghasia PM, Zala KP, Buha DB. Effect of integrated nutrient management on productivity of summer groundnut (*Arachis hypogaea* L.). Int. J. Curr. Microbiol. App. Sci 2017;6(10):1951-1957.
20. Zaltae PY, Padmani DR. Effect of organic manure and biofertilizers on growth and yield attributing characters of *kharif* groundnut. Inter. J. of Agric. Sci 2009;5(2):343-345.