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Effect of different levels of organic and inorganic fertilizers on soil available nutrient status, nutrient uptake, yield, nutrient use efficiency and economics of summer groundnut (*Arachis hypogaea* L.) grown on inceptisol

RS Dhandore, BM Kamble, PB Margal and PR Nakhate

RS Dhandore
Department of Soil Science and Agricultural Chemistry, RCSM, College of Agriculture, Kolhapur Maharashtra, India

BM Kamble
Department of Soil Science and Agricultural Chemistry, RCSM, College of Agriculture, Kolhapur Maharashtra, India

PB Margal
Department of Soil Science and Agricultural Chemistry, RCSM, College of Agriculture, Kolhapur Maharashtra, India

PR Nakhate
Department of Soil Science and Agricultural Chemistry, RCSM, College of Agriculture, Kolhapur Maharashtra, India

Corresponding Author:
RS Dhandore
Department of Soil Science and Agricultural Chemistry, RCSM, College of Agriculture, Kolhapur Maharashtra, India

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Abstract

The experiment on effect of different levels of organic and inorganic fertilizers on soil available nutrient status, nutrient uptake, yield, nutrient use efficiency and economics of summer groundnut (*Arachis hypogaea* L.) grown on Inceptisol was carried out at Agricultural Research Station, Kasbe Digraj, Dist: Sangli (MS) during summer 2019. The experimental soil was alkaline, calcareous, clay in texture, low in available nitrogen, medium in available phosphorus and very high in available potassium. The experiment was laid out in randomized block design with eight treatments and three replications. The treatment consist of T_1-absolute control, T_2-GRDF (25:50:00 N:P_2O_5:K_2O kg ha^{-1}+ 10 t FYM ha^{-1}), T_3-100% RDN through FYM, T_4-100% RDN through press mud compost (PMC), T_5-100% RDN through vermicompost, T_6-50% RDN through FYM + 50% RDN through PMC, T_7-50% RDN through FYM + 50% RDN through Vermicompost and, T_8-33% RDN through FYM + 33% RDN through PMC + 33% RDN through vermicompost. Biofertilizers – *Rhizobium*, PSB- 25 g kg^{-1} of seed were inoculated to all treatments except T_1, which recommended dose of P – fertilizer (50 kg P_2O_5 ha^{-1}) were applied to T_3 to T_8. The results revealed that the soil pH decreased and EC increased with the different levels of organic and inorganic fertilizers treatments over control. The organic carbon content (0.58%) and dehydrogenase enzyme activity(73.01 µg TPFg^{-1} soil 24 hr^{-1}) in soil at harvest was higher in T_2 as compare to rest of the treatments. The significantly the maximum total uptake of nitrogen (149.95 kg ha^{-1}), phosphorus (28.27 kg ha^{-1}) and potassium (79.45 kg ha^{-1}) by groundnut was observed under T_2 and it was at par with T_5 (142.04 kg ha^{-1}) for total uptake of nitrogen by groundnut. The Fe, Zn, Mn, and Cu content, uptake by kernel, haulm and total Fe, Zn, Mn, and Cu uptake by groundnut were statistically influenced by organic and inorganic fertilizers application. The treatment T_2 was noticed significantly higher in dry pod yield (27.75 q ha^{-1}) and dry haulm yield (49.86 q ha^{-1}). The T_2 was at par with T_5 (26.94 q ha^{-1}) regarding dry pod yield of groundnut. Apparent recovery of nitrogen (190.44%) and agronomic efficiency (15.64 kg ha^{-1}) of nitrogen were noticed higher in 100% RDN through vermicompost as compare to remaining treatments. The highest B:C ratio was obtained in application of 100% RDN through vermicompost. It is concluded from the study that under biofertilizer seed treatment, the application of GRDF (25:50:00 N:P_2O_5:K_2O kg ha^{-1} + 10 t FYM ha^{-1}) or application of 100% recommended dose of nitrogen through vermicompost alongwith 50 kg P_2O_5 ha^{-1} to groundnut recorded higher soil available nutrients, nutrient uptake, yield, nutrient use efficiency and net monetary returns from groundnut.

Keywords: Organic and inorganic fertilizers, nutrient use efficiency, summer groundnut and economics

Introduction

Groundnut (*Arachis hypogaea* L.) is an annual legume crop and it's native from South America. Groundnut has a useful role in offspring deficiencies as a rich source of edible oil and protein which play an important position in Indian diet. Hence groundnut is known as king of oilseed crops (Sathya Priya *et al*. 2013) [30]. Commercially it is thirteenth most important food crop, fourth most important source of vegetable oil and third main source of vegetable protein in the world. India is one of the major producers and rank second in groundnut production after China. During the year 2018-19 in India, area under summer groundnut is 7.902 lakh ha, with the total production of 15.286 lakh tonnes and productivity of 1934 kg ha^{-1} and area under *kharif* groundnut is 40.634 lakh ha, with the total production of 54.410 lakh tonnes and productivity of 1339 kg ha^{-1} (Anonymus, 2019). The plant nutrients which play most important role in the nutrition of groundnut crop are nitrogen, phosphorus and potassium. The average nutrients removed by groundnut crop per tonne yield under field conditions are 58.1 kg N, 19.6 kg P_2O_5 and 30.1 kg K_2O. A balanced application of N:P:K fertilizers in the ratio 1:1.5:1 observed to be better than single nutrients application. The main factors responsible for low yield in groundnut are inadequate and imbalance use of nutrients as well as nutrient deficiencies. The use of organic sources such as traditional generally helpful for improving soil aggregation, structure and fertility improving the moisture holding capacity and increasing crop yield (Marinari *et al.* 2000) [19]. The use of organic manures produced / prepared from various organic waste will save our environment as a whole; simultaneously (Doran and Zeiss 2000; Doran, 2002) [7, 8]. The application of organic manure help in mitigating multiple nutrient deficiencies at same time provides better environment for growth and development by improving in physical, chemical and biological properties of soil (Avitoli *et al.* 2012) [3]. Organic manures improved the soil physical, chemical and biological properties and also increase the efficiency of the applied nutrients especially in light soils (Pandey *et al*. 2000). The increasing use of chemical fertilizer day-by-day is a serious matter of concern and their frequent application is deteriorating bio-physicochemical properties of soil (Mahajan *et al.* 2008) [18]. As a result, soil fertility is being diminished gradually. This in turn is leading to reduction in crop yield per unit area. Besides fertilizers, there are several sources of plant nutrients like organic manures and biofertilizers (Sreedevi *et al.* 2013) [32]. In this context, a field experiment was under taken to study the effect of different levels of organic manures and inorganic fertilizers on soil available nutrient status, nutrient uptake, yield, nutrient use efficiency and economics of summer groundnut (*Arachis hypogaea* L.).

Material and Methods

Experimental site and soils

The field experiment was conducted at Agricultural Research Station, Kasbe Digraj, Dist: Sangli during summer season of the year 2019. The site was selected on the basis of suitability of soil for growing of summer groundnut. The experimental soil was alkaline, calcareous, clay in texture, low in available nitrogen, medium in available phosphorus and very high in available potassium.

Collection and analysis of soil and plant samples

The soil samples were collected from 0-30 cm depth from each plot at the time sowing and harvest of groundnut. The soil samples were air dried and pulverized to pass through 2 mm sieve for analysis. These soils samples were analysed for various chemical properties. The pH (1:2.5) and EC of soil were determined by pH meter and conductivity meter (Jackson 1973) [11]. The soil samples were analyzed for available N by the alkaline permanganate method (Subbiah and Asija, 1956) [33]. Available P (Olsen-P) by 0.5 M $NaHCO_3$ extraction (Olsen *et al.* 1954) [24]. Available K (NH4OAc) by 1N neutral NH4OAc extraction on flame photometer (Knudsen, Peterson and Pratt 1982) [14] and DTPA extractable micronutrients (Fe, Mn, Cu, Zn) by Lindsay and Norvell (1978) [17]. The dehydrogenase activity in soil was estimated by following the method given by Lehnard (1956). This method involves colorimetric determination of 2, 3, 5-triphenyl formazan (TPF) produced by the reduction of 2, 3, 5-triphenyl tetrazolium chloride (TTC). The kernel and haulm samples were collected separately from each plot at the time of groundnut harvest. The samples were oven dried at 60. The plant and grain samples were analyzed for total N by micro kjeldahl method in H_2SO_4:H_2O_2 (1:1) digestion (Parkinson and Allen 1975) [26], total P by vanadomolybdate yellow colour method in nitric acid H_2SO_4:$HClO_4$:HNO3 (1:4:10) digestion (Jackson, 1973) [11], total K on flame photometer in H_2SO_4:$HClO_4$:HNO_3 (1:4:10) digestion (Chapman and Pratt, 1961) [4] and micronutrients *viz*., Fe, Mn, Cu, Zn (Zoroski and Bureau, 1977).

Experimental details

The field experiment was laid out in a randomized block design with eight treatments and three replications. The treatments were T_1-absolute control, T_2-GRDF (25:50:00 N:P_2O_5:K_2O kg ha^{-1}+ 10 t FYM ha^{-1}), T_3-100% RDN through FYM, T_4-100% RDN through press mud compost (PMC), T_5-100% RDN through vermicompost, T_6-50% RDN through FYM + 50% RDN through PMC, T_7-50% RDN through FYM + 50% RDN through vermicompost and, T_8-33% RDN through FYM + 33% RDN through PMC + 33% RDN through vermicompost. Biofertilizers – *Rhizobium*, PSB- 25 g kg^{-1} of seed were inoculated to all treatments except T_1, which recommended dose of P – fertilizer (50 kg P_2O_5 ha^{-1}) were applied to T_3 toT_8. The FYM 10 t ha^{-1} was applied half month before sowing of groundnut for treatment T_2 as well as vermicompost, FYM and PMC was applied as per the treatments. The groundnut crop was fertilized with 25 kg N and 50 kg P_2O_5 $ha^{-1}$and for treatment GRDF (General Recommended Dose of Fertilizer) full dose of N, P_2O_5 was applied through urea, single super phosphate to treatment T_2 at the time of sowing. The application of 50 kg P_2O_5 ha^{-1} was applied through single super phosphate to treatments T_3 to T_8. The nutrient uptake, yield, nutrient use efficiency and economics of summer groundnut were calculated by using standard methods. The standard agronomic packages of practices were adopted in groundnut crop. The statistical analysis was carried out by procedure suggested by Panse and Sukhatme (1985) [25].

Results and Discussion

Effect of different levels of organic and inorganic fertilizers on soil chemical properties

The lowest pH of soil (8.26) was obtained in T_2 due to the release of organic acids during the process of decomposition might have attributed to decline in soil pH. Application of organic and inorganic fertilizers recorded higher EC (0.49 dS m^{-1}) in T_2. The increase in EC of soil might be due to more solubilisation of fixed nutrients. Similar findings were also noticed by Kamble *et al*. (2018) [13]. The treatment T_2 was equivalent to T_3 (0.42 dS m^{-1}), T_4 (0.40 dS m^{-1}), T_5 (0.44 dS m^{-1}), T_6 (0.42 dS m^{-1}) T_7 (0.41 dS m^{-1}) and T_8 (0.40 dS m^1). The organic carbon content (0.58%) in soil at harvest was higher in T_2 as compare to rest of the treatments. The increase in organic carbon content in soil might be due to combined application of inorganic fertilizers with organic manures, enhancing slightly the original organic matter status in soil (Devi *et al.* 2013) [6]. The maximum increase in soil organic carbon content was observed with the integrated use of inorganic fertilizers (N+P+K) and organic manure. The treatment T_2 was recorded the highest dehydrogenase enzyme activity at harvest of groundnut (72.1 µg TPF g^{-1} soil 24 hr^{-1}) as compare to remaining treatments. Among the organic treatments, the application of 100% RDN through vermicompost (T_5) was noticed to have higher soil dehydrogenase enzyme activity at harvest of groundnut as compare to100% RDN through FYM and 100% RDN through pressmud compost.Thus it is inferred that N, and P fertilization enhanced the activities of soil enzymes and the effect was more pronounced with organic manures in combination with fertilizers. Similar results were also obtained by Mycin *et al*. (2010) [21].

Available nutrient status after harvest of groundnut

The available nitrogen content in soil at harvest was significantly more under T_2 (231 kg ha^{-1}) as compare to rest of the treatments. The T_2 was at par with T_5. Higher available nitrogen content in soil under T_2 at harvest, due to the mineralization of soil N leading to build-up of higher available N. Similar findings were also observed by Kamble *et al*. (2018) [13]. Among the organic treatments, treatment T_5 was noticed to depict higher soil available nitrogen content (223 kg ha^{-1}) at harvest of groundnut as compare to (214 kg ha^{-1}) and T_4 (212 kg ha^{-1}) and these treatment were at par with each other. The soil available nitrogen content was higher where vermicompost was applied an organic source perhaps, introducing the beneficial microorganisms into the rhizosphere of plant which stimulated the nitrogenase enzyme responsible for N fixation of atmospheric N in legumes. Similar results were found by Mycin *et al.* (2010) [21]. The available phosphorus content in soil was higher in T_4 because of composted press mud contains essential plant nutrients inclusive of higher concentration of phosphorus which quickly releases from press mud. Similar findings were also observed by Jat and Singh (2017) [31]. The significantly more available potassium content in soil at harvest was noticed under T_2 (593 kg ha^{-1}) over rest of the treatments. Increase in available K due to organic manures application may be attributed to direct addition of K to available pool of soil K. Similar findings were also observed by Kamble *et al*. (2018) [13]. Soil available poasssium content at harvest stage was found to increased in all the treatments (T_2 to T_8) receiving GRDF, single organic fertilizers and combinations of organic fertilizers as compared to initial soil value (548 kg ha^{-1}). The reason for such increase under organics application might be due to solubilisation action of certain organic acids produced during decomposition and its greater capacity to hold K in available form in soil and also due to the interaction of organic matter with clay.

Available DTPA micronutrient after harvest of groundnut

The DTPA Fe, Zn and Cu content in soil differed significantly as to organic and inorganic fertilizers applications. Whereas, DTPA Mn in soil was found non-significant. The treatment GRDF recorded significantly more DTPA Fe content (4.31mg kg-1) in soil at harvest over rest of the treatments and treament T2was at par with100% RDN through vermicompost. The treatment receiving GRDF recorded increased soil DTPA Fe, Zn, Cu and Mn content at harvest stage over control. The increase in soil DTPA Fe, Zn, Cu, and Mn content were observed in all the treatments receiving GRDF + 10 t FYM ha^{-1}, organic fertilizers and combined application of organic fertilizers (FYM, PMC and vermicompost) over to initial soil status at harvest stage. The higher availability of DTPA Fe, Zn, Cu, and Mn in soil could be ascribed to mineralization of manures, reduction in fixation and completing properties of decomposition products of manures with micronutrients. Results are close in conformity with Sharma *et al*. (2017) [31].

Effect of different levels of organic and inorganic fertilizers on total macronutrient uptake by groundnut

The maximum total uptake of nitrogen (149.95 kg ha^{-1}), phosphorus (28.27 kg ha^{-1}) and potassium (79.45 kg ha^{-1}) by groundnut was observed under the treatment T_2. It clearly indicated that the better total uptake of nitrogen in T_2 over other treatments might be attributed to their better growth and development. Due to addition of FYM reduced the loss of nitrates through leaching from the soil by providing a significant amount of plant nutrients which created a balancing effect on the supply of nitrogen and increased uptake of N. Similar trends were reported by Anwar *et al.* (2007) [2] and Naidu *et al.* (2009) [22]. The higher total phosphorus uptake of groundnut might be due to enhanced supply of plant nutrients under direct addition of nitrogen fertilizer and solubilisation of native phosphorus content of soil and also by increasing nutrient use efficiency and better absorption and utilization of nutrient. Similar results were reported by Choudhary *et al.* (2011) [5, 31]. Among different sources of organic manures, the application of 100% RDN through vermicompost (T_5) depicted higher total uptake of K by groundnut (68.51 kg ha^{-1}) followed by the 100% RDN through FYM (66.74 kg ha^{-1}) and 100% RDN through press mud compost (62.89 kg ha^{-1}). The application of 100% RDN through vermicompost showed more positive influence on total uptake of K by groundnut due to higher availability of K by earthworm by shifting the equilibrium among the forms of K from relatively unavailable forms to more available forms. Increased availability of nutrients in vermicompost especially P might have enhanced root proliferation which helped in more uptake of K (Kumari and Ushakumari, 2002) [15].

Total micronutrients uptake

The maximum total uptake of iron by groundnut (2574 g ha^{-1}) was observed under the treatment T_2-GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1}) and T_2 was at par with T_5 (2425 g ha^{-1}), clearly indicating that the better total uptake of iron was recorded in T_5 also. The treatment T_5 (2425 g ha^{-1}) was at pat with T_3 for total Fe uptake of groundnut. The significantly highest in the uptake of Fe by groundnut under application of FYM and chemical fertilizers (T_2) might be due to improved physical, chemical and biological properties like, water holding capacity, hydraulic conductivity, buffering effect, improved soil aggregation, aeration, balanced fertilization and availability of nutrients throughout the growth period especially at critical growth periods. The application of GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1}) noted the highest total uptake of Mn (732 g ha^{-1}) followed by T_5 (690 g ha^{-1}) and T_3 (643 g ha^{-1}) and it was at par with T_5. The 100% RDN through FYM (643 g ha^{-1}) was at par with T_4 (619 g ha^{-1}), T_6 (605 g ha^{-1}g ha^{-1}), T_7 (606 g ha^{-1}) and T_8 (601 g ha^{-1}) for total uptake of Mn by groundnut. The significantly lowest uptake of total manganese was (480 g ha^{-1}) noticed in absolute control (T_1). The maximum total uptake of Zn (270 g ha^{-1}) by groundnut was shown under the treatment T_2 remaining at par with T_5. The treatment receiving of GRDF- 25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1} (T_2) recorded significantly the highest total copper uptake by groundnut (136 g ha^{-1}). The treatment T_2 was at par with 100% RDN through vermicompost (T_5) for total copper uptake (128 g ha^{-1}) of groundnut. The application of 100% RDN through FYM (117 g ha^{-1}) was at par with T_4 (111 g ha^{-1}) and T_7 (111 g ha^{-1}) for total copper uptake of groundnut. The treatment receiving 100% RDN through PMC (111 g ha^{-1}) was at par with T_6 (103 g ha^{-1}) and T_8 (107 g ha^{-1}). The combined application of organic fertilizers through FYM, vermicompost, PMC and alone recorded significantly higher total uptake of micronutrientsby groundnut as compare to absolute control. The increase in available micronutrients status of soils in organically treated plots might be due to release of chelating agents from organic matter decomposition which might have prevented micronutrients from precipitation, oxidation and leaching and thereby causing more uptake of micronutrients by groundnut. Result are close in conformity with Naidu *et al.* (2009) [22].

Dry pod and haulm yield

The significantly highest dry pod yield (27.75 q ha^{-1}) and dry haulm (49.86 q ha^{-1}) were obtained in T_2 (GRDF- 25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1}) over the other treatments. The treatment GRDF was at par with treatment 100% RDN through vermicompost (T_5) for dry pod and haulm yield groundnut (Table 2).The application of GRDF to groundnut increased pod yield by 33.86% and haulm yield 35.23% over absolute control (T_1). The application of GRDF- 25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1} increased higher yield of groundnut which could be attributed to favourable changes in physical and chemical characteristics of the soils that might have enabled better pod formation. Moreover, the positive influence of these treatments through immediate supply of nutrients from inorganic sources especially at the early stage of the crop and slow and steady supply of essential nutrients in proper ratio to plant and soil from FYM throughout the crop growth period improved adequate biomass production and improvement in pod yield. These results were close in conformity with Rahevar *et al.* (2015) [28] and Sarade *et al.* (2016) [29]. The application of 100% RDN through vermicompost (T_5) was recorded the highest dry pod yield and haulm yield of groundnut as compare to 100% RDN through FYM and 100% RDN through press mud compost. The treatment 100% RDN through vermicompost (T_5) and 100% RDN through FYM (T_3) were at par with each other for dry pod yield of groundnut. The 100% RDN through vermicompost application to groundnut crop increased dry pod yield as might be due to vermicompost containing adequate amounts of macronutrients and trace element and hormones and this has been hypothesized to result in greater root initiation, increased root biomass, enhanced plant growth and development and altered morphology of plants growth and ultimately increased pod yield. Similar results were also found by Mycin *et al.* (2010) [21] and Mathivanan *et al.* (2013) [20].

Nutrient use efficiency

The higher apparent recovery of nitrogen in groundnut (190%) was noticed in 100% RDN through vermicompost (T_5) to groundnut as compare to rest of the treatments. The higher apparent recovery of nitrogen and agronomic N use efficiency of groundnut was noticed in 100% RDN through vermicompost application. Vermicompost stimulated nutrient uptake and ultimately influenced the nutrient efficiency and agronomic efficiency due to consistent supply of nutrients with better physical condition of soil as well as availability of other essential macro and micro-nutrients and plant growth regulators, resulting in increased nitrogen use efficiency. Similar results were also reported by Jat and Singh (2017) [31]. Significantly the lowest value of agronomic efficiency is (6.55 kg ha^{-1}) was observed in GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1}) over the rest of other treatments. The lower values of apparent recovery of nitrogen and agronomic efficiency in GRDF might be due to characteristics of mineral inorganic nitrogenous fertilizer, its susceptibility in different types of losses and hence lesser nitrogen use efficiency as compared to organic treatments. Apparent recovery of nitrogen and agronomic efficiency were higher at lower N rates and vice-versa. It has also been reported by Fageria *et al.* (2011) [10].

Economics of groundnut

The highest net returns from groundnut (Rs. 93315 ha^{-1}) was obtained in GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1}). However, the higher B:C ratio (2.32) of groundnut was recorded in 100% RDN through Vermicompost. The treatment 100% RDN through vermicompost (T_5) was noticed to fetch higher net returns from groundnut as compare to other organic treatments. This might be due to increased soil available nutrient, nutrient use efficiency, nutrient uptake and yield of groundnut under vermicompost as compare to other organic treatments. These results are in conformity with those reported by Devi *et al.* (2013) [6] for soybean crop. Similar results for groundnut were found in Kamble *et al.* (2018) [13]. The absolute control showed lower net returns (Rs. 66015 ha^{-1}) and B:C ratio (2.13).

Table 1: Effect of organic and inorganic fertilizers on soil chemical properties after harvest of groundnut

Tr. No.	Treatments	pH (1:2.5)	EC (dS m^{-1})	Organic carbon (%)	DEA (µg TPF g^{-1} soil 24 hr^{-1})
T_1	Absolute control	8.40	0.30	0.46	37.41
T_2	GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1}+ 10 t FYM ha^{-1})	8.26	0.49	0.58	73.16
T_3	100% RDN through FYM	8.30	0.42	0.47	54.86
T_4	100% RDN through PMC	8.28	0.40	0.48	50.47
T_5	100% RDN through Vermicompost	8.31	0.44	0.47	62.17
T_6	100% RDN (50% RDN through FYM + 50% RDN through PMC)	8.28	0.42	0.45	57.29
T_7	100% RDN (50% RDN through FYM + 50% RDN through Vermicompost)	8.32	0.41	0.45	52.44
T_8	100% RDN (33% RDN through PMC + 33% RDN through Vermicompost + 33% RDN through FYM)	8.28	0.40	0.40	58.53
S.Em +		0.036	0.031	0.04	4.99
CD at 5%		NS	0.10	NS	15.13

Table 2: Effect of organic and inorganic fertilizers on soil available nutrients and DTPA micronutrient after harvest of groundnut

Tr. No.	Treatments	Soil available macronutrients (kg ha^{-1})			Soil DTPA micronutrients (mg kg^{-1})			
		N	P	K	Fe	Mn	Zn	Cu
T_1	Absolute control	165	14	513	3.71	3.32	0.29	0.37
T_2	GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1}+ 10 t FYM ha^{-1})	231	28	593	4.31	3.76	0.41	0.51

T_3	100% RDN through FYM	214	26	576	4.17	3.64	0.39	0.47
T_4	100% RDN through PMC	212	32	569	4.15	3.59	0.33	0.44
T_5	100% RDN through Vermicompost	223	27	563	4.22	3.67	0.37	0.48
T_6	100% RDN (50% RDN through FYM + 50% RDN through PMC)	207	26	572	4.17	3.68	0.34	0.42
T_7	100% RDN (50% RDN through FYM + 50% RDN through Vermicompost)	212	23	566	4.18	3.61	0.36	0.44
T_8	100% RDN (33% RDN through PMC + 33% RDN through Vermicompost + 33% RDN through FYM)	209	26	571	4.17	3.60	0.33	0.44
S.Em +		3.68	2.22	7.59	0.038	0.11	0.019	0.02
CD at 5%		11.17	6.75	23	0.12	NS	0.06	0.06

Table 3: Effect of organic and inorganic fertilizers on total macronutrients uptake and total micronutrients uptake after harvest of groundnut

Tr. No.	Treatments	Total macronutrients uptake (kg ha^{-1})			Total micronutrients uptake (g ha^{-1})			
		N	P	K	Fe	Mn	Zn	Cu
T_1	Absolute control	94.47	13.51	48.72	1653	480	184	82
T_2	GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1}+ 10 t FYM ha^{-1})	149.95	28.27	79.45	2574	732	270	136
T_3	100% RDN through FYM	131.03	20.45	66.74	2298	643	245	117
T_4	100% RDN through PMC	128.84	22.71	62.89	2194	619	237	111
T_5	100% RDN through Vermicompost	142.04	21.18	68.51	2425	690	258	128
T_6	100% RDN (50% RDN through FYM + 50% RDN through PMC)	126.05	20.40	63.01	2126	605	229	103
T_7	100% RDN (50% RDN through FYM + 50% RDN through Vermicompost)	124.86	20.07	65.25	2116	606	232	111
T_8	100% RDN (33% RDN through PMC + 33% RDN through Vermicompost + 33% RDN through FYM)	122.90	19.37	65.31	2085	601	230	107
S.Em +		2.65	1.07	1.72	70.34	14	5.97	3.08
CD at 5%		8.04	3.25	5.54	213.37	42.48	18.12	9.36

Table 4: Effect of organic and inorganic fertilizers on yield and nitrogen use efficiency after harvest of groundnut

Tr. No.	Treatments	Dry pod yield (q ha^{-1})	Dry haulm yield (q ha^{-1})	Nitrogen use efficiency	
				Apparent recovery of N (%)	Agronomic efficiency (kg ha^{-1})
T_1	Absolute control	20.73	35.11	-	-
T_2	GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1}+ 10 t FYM ha^{-1})	27.75	49.86	82.32	6.55
T_3	100% RDN through FYM	25.74	44.79	146.40	13.48
T_4	100% RDN through PMC	25.49	43.68	137.16	12.68
T_5	100% RDN through Vermicompost	26.94	47.48	190.44	15.64
T_6	100% RDN (50% RDN through FYM + 50% RDN through PMC)	25.02	43.54	129.60	10.56
T_7	100% RDN (50% RDN through FYM + 50% RDN through Vermicompost)	25.06	43.02	121.04	10.92
T_8	100% RDN (33% RDN through PMC + 33% RDN through Vermicompost + 33% RDN through FYM)	24.75	42.77	113.59	10.80
	S.Em +	0.43	0.76	0.46	0.64
	CD at 5%	1.33	2.32	1.43	1.98

Table 5: Effect of organic and inorganic fertilizers applications on economics of groundnut

Tr. No.	Treatments	Cost of cultivation (□ ha^{-1})	Gross returns (□ ha^{-1})	Net returns (□ ha^{-1})	B:C ratio
T_1	Absolute control	58365	124380	66015	2.13
T_2	GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1}+ 10 t FYM ha^{-1})	73185	166500	93315	2.27
T_3	100% RDN through FYM	68192	154440	86247	2.26
T_4	100% RDN through PMC	67487	152940	88312	2.26
T_5	100% RDN through Vermicompost	69602	161640	92037	2.32
T_6	100% RDN (50% RDN through FYM + 50% RDN through PMC)	67868	150120	82251	2.21
T_7	100% RDN (50% RDN through FYM + 50% RDN through Vermicompost)	68928	150360	81431	2.18
T_8	100% RDN (33% RDN through PMC + 33% RDN through Vermicompost + 33% RDN through FYM)	68438	148440	80001	2.16
S.Em +		-	-	235.70	-
C.D. at 5%		-	-	714.92	-

Rate of urea ₹5.32 kg^{-1}, Single super phosphate ₹8.6 kg $^{-1}$, FYM - ₹1,200 t^{-1}, PMC ₹4500 t^{-1}, VC ₹5000 t^{-1}, Dry pod of groundnut ₹60 kg $^{-1}$

Conclusions

It can be concluded from the study that the for biofertilier treated groundnut seed, application of GRDF (25:50:00 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1}) or 100% RDN through vermicompost along with 50 kg P_2O_5 ha^{-1} (as SSP) to groundnut recorded higher yield, soil available nutrient, nutrient use efficiency, nutrient uptake and economics of groundnut.

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