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Response of Organic Plant Nutrient Sources on Productivity and Profitability of Groundnut (*Arachis hypogaea* L.) and Soil Fertility under Humid Zone of Southern Rajasthan

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A B S T R A C T

A field experiment was conducted at Agricultural Research Station, Banswara (Raj.) during *rainy* season of 2012-14 to evaluate the response of organic plant nutrient sources on productivity and profitability of groundnut and soil fertility status. The experiment consisted of 12 treatment combinations of FYM, vermicompost, neem cake, bone meal, poultry manure, rock phosphate, green manuring, residue mulching and BD500 laid out in randomized block with three replications. Results revealed that combined application of FYM+ rock phosphate + gypsum + biofertilizers + BD 500 (T_{11}) produced higher plant height (79.33cm), pods (42.0 plant^{-1}), kernels (2.02 pod^{-1}), test weight of kernels (347g), pod yield (45.17q ha^{-1}), kernel yield (34.48q ha^{-1}), haulm yield (7633kg ha^{-1}), and shelling (73.22%) followed by T_6 –T_{10} in the case of plant height, kernel test weight, haulm yield and shelling per cent and T_7-T_{10} in case of pod, kernel yield,T_8-T_{10} in case of pods plant^{-1}, T_{10} in case of kernels plant^{-1} and found significantly superior over rest treatments, respectively. The maximum gross return (Rs.134388 ha^{-1}) and net return (Rs 109568 ha^{-1}) and B:C ratio (4.41) recorded higher in combined use of FYM+ rock phosphate+gypsum+biofertilizers+BD500 (T_{11}) and found significantly higher over rest treatments. Maximum organic carbon (0.89%) recorded in T_{10} followed by T_7-T_9 andT_{11} and significantly higher over rest treatments. The maximum available N (292.40kg ha^{-1}) recorded in T_9 followed by T_8, T_{10} and T_{11} and significantly higher over rest treatments. The maximum available phosphorus (39.20kg ha^{-1}) was recorded in T_{11} followed by T_7-T_{10} and T_5 and significantly higher over rest treatments. The higher available potassium was recorded in T_{10} followed by T_7-T_9 and T_{11} and significantly higher over rest treatments. On the based on finding combined application of organic plant nutrient resources were resulted better than a single application.

Introduction

Groundnut (*Arachis hypogaea* L.) is an important oilseed and supplementary food crop of the world. It is fourth most important source of edible oil and third most important source of vegetable protein. Globally, the crop is raised on 26.5 million ha with a total production of 43.9 million tonnes. India ranks first in acreage of 4.69 million ha with second rank in production of 6.56 million tonnes and productivity of 1400kg/ha which is quite low

as compared to other countries (DAC&FW 2016). Among the various factors such as water stress, nutrient deficiency and competition of weeds are limited the productivity of groundnut. Groundnut removes fairly large quantities of nutrients from the soil. In fact, chemical fertilizers played key role to quick supply plant nutrients to soil but they have also played significant role to degradation of soil fertility and soil bio-ecosystem and increases water stress in the crop duration without inadequate manuring. Adequate manuring does not only improve the yield but also maintains the soil health and sustain the productivity (Laxminarayan and Patiram, 2005). Ghosh *et al.,* (2002) further organic manures, valuable by-products of farming and allied industries, contribute to plant growth through their favourable effects on the physical, chemical and biological properties of soil. Many benefits attributed to organic manures have well been documented (Stevenson, 1994).

Nziguheba *et al.,* (1998) also reported that addition of organic materials causes mineralization of more recalcitrant fraction of P through increased microbial activity and resultant biochemical transformation. In groundnut, application of FYM at 10 to 15t ha^{-1} increased the pod and haulm yields and improved the yield parameters like shelling percentage, 100 seed weight and sound mature kernels compared to the recommended dose of fertilizers (Subrahmaniyan *et al.,* 2000). Increased pod yield due to the application of pressmud either separately or in combination with inorganic fertilizer was reported by Sriramachandrasekaran (2001). The one of the constraint in increasing the area under organic groundnut production is lack of suitable organic production practices for different agro-climatic regions. The present investigation was aimed to study the response of organic plant nutrient sources on productivity and profitability of groundnut and soil fertility status under humid climatic zone of Southern Rajasthan.

Materials and Methods

A field experiment was conducted in consecutive three year of 2012-14 at Agricultural Research Station (MPUAT), Banswara (Rajasthan) to find out the response of organic plant nutrient sources on productivity and profitability of groundnut (*Arachis hypogaea* L) and soil fertility. The site of experiment field is located at 23° 33' N latitude, 74^{o} 27'E longitude at an altitude of 220 MSL. The climatic condition of location is humid throughout the rainy season with average annual rainfall of 885mm, mostly received from July to September and mild winter and extreme hot summer. The soil of the experimental field was clay loam in texture having pH 7.6, medium in organic carbon (0.56 per cent), available nitrogen (256 kg ha^{-1}) and medium in available phosphorus (34.09kg ha^{-1}), high in available potassium (290 kg ha^{-1}).The experiment was laid out in randomized block design with twelve treatments and three replications. The treatments consists of T_1 - FYM @ 4 t + rock phosphate @ 260kg ha^{-1} (equivalent to 20 kg N + 60kg P_2O_5 ha^{-1}), T_2- FYM @ 2.2 t ha^{-1}+ bone meal @ 300kg ha^{-1}, T_3– vermicompost @ 1.5 t ha^{-1} + rock phosphate@225kg ha^{-1}, T_4 – neem cake@ 400kg ha^{-1}+ bone meal@280kg ha^{-1}, T_5 – poultry manure @ 1.0 t ha^{-1} + rock phosphate@200kg ha^{-1}, T_6 – T_1+seed treated with biofetilizers, T_7– T_6+ gypsum@500kg ha^{-1}, T_8 – T_6+ gypsum application in two split @250 kg/ha before sowing and 250kg/ha at before flowering, T_9 -T_8+ green manuring incorporated at 20 DAS, T_{10} - T_8+ crop residue mulching @ 4 t/ha, T_{11}-T_8+spray of BD500 and T_{12}-absolutely control. The gross and net plot size was 3.5x 3.5 m and 3.0x3.0 m, respectively. Farm yard manure, rock phosphate, bone meal, vermicompost, neem cake and poultry manure were applied 15 days

before the sowing whereas, gypsum applied at 15 days before sowing and at before flowering in standing crop. Crop residues used as surface mulching between crop rows after crop sowing. *Rhizobium* culture was used as seed treatment. Application of BD 500 was done twice firstly on evening prior to a day before sowing and secondly 30 days after sowing. Variety 'TAG-24' was sown at 30 cm row spacing. For organic crop protection, seed treated by *Tricoderma herzanium* @ 8 g kg^{-1} neem seed kernel extract spray (5%) at 45 and 60 DAS, fresh neem leaf spray (10%) along with 0.2% garlic spray and milk whey (10%) spray were done to control insect- pest of crop during cropping season. All the agronomic practices were carried as per recommendation of organic farming. The observations were recorded replication wise in each treatment from randomly selected plants for plant height, pods $plant^{-1}$, kernels weight. Crop productivity was recorded from pod yield of net area converted to hectare and profitability was calculated from net monetary return and soil fertility was calculated through soil sample analysis after completed cropping system.

Results and Discussion

Growth and yield attributes

The plant heights, numbers of pods per plant, pod weight, kernels per pod and kernels test weight were significantly influenced by different organic plant resources. Data showed in the table 1 of all the yield attributing characters were found to be higher in the treatments consisting combination of organic manures than individual manure. Organic manures alone meet the lower nutrient demand, but combination of organic manures has become imperative to sustain high nutrient supply for higher productivity. The combined application of FYM@4t ha^{-1} + rock phosphate @260kg ha^{-1} + gypsum@500kg ha^{-1}+biofertilizers BD 500 (T_{11}) recorded significantly higher plant height (79.33cm), pods $plant^{-1}$ (42), kernels pod^{-1} (2.02) and 1000 kernels weight (347g) followed by organic manures combinations of T_6- T_{10} in the case of plant height, kernels $pod^{-1}$and kernels test weight, while, pods $plant^{-1}$ were at par with T_9-T_{10} and significantly higher over rest treatment, respectively. This might be due to greater conversion of organic sources to available form of plant nutrient to adequate availability of nutrient in root zone to higher uptake by plant for accumulation of biomass in the treatments of combined application of manures. Further, physiological role of nutrients supplied by combination use of organic manures in enhancing growth parameters might have led to increased yield attributes and there by yield of crop. This is attributed to better growth of plants and higher yield by slow release of nutrients for absorption with additional nutrients like gibberellins, cytokinin, and auxins, by the application of organic inputs. These findings are in accordance with Kumawat *et al.,* (2009) and Subrahmaniyan *et al.,* (2000).

Yield

Data presented in Table 2 revealed that different combination of organic manures had significant effect on the pod, kernel and haulm yield and shelling per cent of groundnut. The maximum pod yield (45.17q ha^{-1}) was recorded with the combined use of FYM@4t ha^{-1} + rock phosphate @260kg ha^{-1} +gypsum@500kg ha^{-1} + biofertilizers BD500 (T_{11}) followed by organic manures combination of T_8-T_{10}, but it was significantly increased pod yield of groundnut in the tune of 369 per cent over absolute control (9.63q ha^{-1}) and 11.89, 21.85, 26.99, 35.52, 60.35, 90.59 and 93.86 per cent over T_7, T_6, T_1, T_3, T_4, T_5 and T_2, respectively. These results directly indicated that pod yield was reduced to lower availability of plant nutrient in the soil of treatment of absolute control, bone meal and rock phosphate. Bone meal and rock

phosphate were recorded very slow nutrient releaser. Similarly, the maximum kernels yield (34.48q ha^{-1}), haulm yield (76.33q ha^{-1}) and shelling per cent (73.22%) were also recorded with combined manures, biofertilizers and BD 500 used in T_{11}. These were recorded same statistically trend as pod yield of groundnut. The positive response to combined application of organic manures might be attributed to the better nutrient availability and its favourable effect on soil physical and biological properties resulting increased yield attributes and finally higher yields. The results are in close agreement with the observation of Kachot *et al.,* (2001), Gunri and Nath (2012) and Ola *et al.,* (2013).

Table.1 Response of organic sources of plant nutrients on growth and yield attributes of groundnut (pooled data 2012-2014)

S.No.	Treatment	Plant height (cm)	Pods $plant^{-1}$	Kernels pod^{-1}	Test weight of kernels
T_1	FYM @4t ha^{-1} + Rock Phosphate @260kg ha^{-1}	73.33	30.40	1.86	333
T_2	Bone meal @300kg ha^{-1} +FYM @2.2 t ha^{-1}	63.33	19.60	1.50	300
T_3	Vermicompost @1.5t ha^{-1} + Rock Phosphate @225kg ha^{-1}	68.33	28.50	1.85	320
T_4	Neem cake @400kg ha^{-1} + bone meal @280kg ha^{-1}	65.00	24.49	1.63	300
T_5	Poultry manure @1.0 t ha^{-1} + Rock phosphate@200kg ha^{-1}	61.33	20.62	1.51	330
T_6	T_1+ Seed treatment through Biofertilizers	70.00	32.78	1.88	337
T_7	T_6+ Gypsum @500kg ha^{-1}	74.00	34.52	1.89	347
T_8	T_6+ gypsum @250 kg ha^{-1} before sowing and 250kg ha^{-1} at before flowering	75.00	37.33	1.91	347
T_9	T_8+ green manuring incorporated at 20 DAS	76.00	40.53	1.92	347
T_{10}	T_8+ mulching @ 4 t ha^{-1}	78.00	41.78	1.95	347
T_{11}	T_8+ BD500	**79.33**	**42.00**	**2.02**	**347**
T_{12}	Absolute control	51.67	8.67	1.23	280
	CD (P=0.05)	10.53	3.81	0.16	10.52

Table.2 Response of organic plant nutrient sources on yield and shelling of groundnut (pooled data 2012-2014)

S.No.	Treatment	Pods yield (q ha^{-1})	Kernels yield (q ha^{-1})	Haulm yield (q ha^{-1})	Shelling (%)
T_1	FYM @4t ha^{-1} + Rock Phosphate @260kg ha^{-1}	35.57	25.36	71.33	55.00
T_2	Bone meal @300kg ha^{-1} +FYM @2.2 t ha^{-1}	23.30	14.37	61.67	37.00
T_3	Vermicompost @1.5t ha^{-1} + Rock Phosphate @225kg ha^{-1}	33.33	22.87	68.67	52.00
T_4	Neem cake @400kg ha^{-1} + bone meal @280kg ha^{-1}	28.17	17.14	61.13	47.78
T_5	Poultry manure @1.0 t ha^{-1} + Rock phosphate@200kg ha^{-1}	23.70	14.40	60.67	45.11
T_6	T_1+ Seed treatment through Biofertilizers	37.07	26.43	71.33	62.44
T_7	T_6+ Gypsum @500kg ha^{-1}	40.37	29.67	73.33	63.11
T_8	T_6+ gypsum @250 kg ha^{-1} before sowing and 250kg ha^{-1} at before flowering	41.47	31.42	75.67	65.11
T_9	T_8+ green manuring incorporated at 20 DAS	42.56	32.21	75.67	68.11
T_{10}	T_8+ mulching @ 4 t ha^{-1}	42.97	32.54	76.00	72.22
T_{11}	T_8+ BD500	**45.17**	**34.48**	**76.33**	**73.22**
T_{12}	Absolute control	09.63	4.79	49.33	21.33
	CD (P=0.05)	4.14	3.29	5.62	10.23

Table.3 Response of organic plant nutrient sources of economics (pooled data 2012-2014)

S.No.	Treatment	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
T_1	FYM @4t ha^{-1} + Rock Phosphate @260kg ha^{-1}	23520	104769	81249	3.45
T_2	Bone meal @300kg ha^{-1} +FYM @2.2 t ha^{-1}	28036	81917	53880	1.92
T_3	Vermicompost @1.5t ha^{-1} + Rock Phosphate @225kg ha^{-1}	27550	98004	70454	2.56
T_4	Neem cake @400kg ha^{-1} + bone meal @280kg ha^{-1}	31600	106806	75206	2.38
T_5	Poultry manure @1.0 t ha^{-1} + Rock phosphate@200kg ha^{-1}	22300	98902	76602	3.44
T_6	T_1+ Seed treatment through Biofertilizers	23770	106990	83220	3.50
T_7	T_6+ Gypsum @500kg ha^{-1}	24020	118578	94558	3.94
T_8	T_6+ gypsum @250 kg ha^{-1} before sowing and 250kg ha^{-1} at before flowering	24220	122016	97796	4.04
T_9	T_8+ green manuring incorporated at 20 DAS	25470	118712	93242	3.66
T_{10}	T_8+ mulching @ 4 t ha^{-1}	25020	126813	101793	4.07
T_{11}	T_8+ BD500	24820	134388	109568	4.41
T_{12}	Absolute control	20700	49367	28667	1.38
	CD (P=0.05)		3566	3566	0.15

Table.4 Response of organic plant nutrient sources on soil fertility status after groundnut harvest

S.No.	Treatment	Organic carbon (%)	Available nitrogen (kg ha^{-1})	Available phosphorus (kg ha^{-1})	Availability Potassium (kg ha^{-1})
T_1	FYM @4t ha^{-1} + Rock Phosphate @260kg ha^{-1}	0.77	221.64	29.12	284.60
T_2	Bone meal @300kg ha^{-1} +FYM @2.2 t ha^{-1}	0.69	173.56	31.10	267.33
T_3	Vermicompost @1.5t ha^{-1} + Rock Phosphate @225kg ha^{-1}	0.72	206.48	32.94	285.67
T_4	Neem cake @400kg ha^{-1} + bone meal @280kg ha^{-1}	0.64	218.00	34.87	282.67
T_5	Poultry manure @1.0 t ha^{-1} + Rock phosphate@200kg ha^{-1}	0.69	204.68	36.48	287.00
T_6	T_1+ Seed treatment through Biofertilizers	0.80	226.92	32.47	295.00
T_7	T_6+ Gypsum @500kg ha^{-1}	0.83	270.60	36.92	300.67
T_8	T_6+ gypsum @250 kg ha^{-1} before sowing and 250kg ha^{-1} at before flowering	0.84	274.66	37.00	302.60
T_9	T_8+ green manuring incorporated at 20 DAS	0.88	292.40	38.94	311.33
T_{10}	T_8+ mulching @ 4 t ha^{-1}	0.89	286.48	37.33	319.53
T_{11}	T_8+ BD500	0.86	280.83	39.20	311.22
T_{12}	Absolute control	0.41	118.56	16.76	181.67
	CD (P=0.05)	0.06	19.96	3.6	22.23

Economics

The data on cost of cultivation, gross return, net return and benefit cost ratio of groundnut as influenced by organic sources of plant nutrient are presented in table 3. Among the different organic treatments, the cost of cultivation varied from Rs. 20700 to Rs.31600 ha^{-1}. The maximum cost of cultivation (Rs.31600 ha^{-1}) was calculated of

the combined used of neem cake (400kg ha^{-1}) + bone meal (280kg ha^{-1}) and minimum cost of cultivation (Rs 20700 ha^{-1}) was recorded in absolute control due to without use of organic plant nutrient sources. The maximum gross return of Rs. 1,34,388 ha^{-1} and net return of Rs.1,09,568 ha^{-1} and B:C ratio of 4.41 were calculated in a treatment having combined application of FYM@4t ha^{-1} + rock phosphate @260kg ha^{-1}+gypsum@500kg ha^{-1} + biofertilizers + BD 500 (T_{11}). The gross return, net return and B:C ratio under T_{11} were recorded significantly higher over rest treatment. These values might be higher due higher pod yield with low input purchasing cost compared to other treatment. These results are conformity with findings of Ram *et al.*, (2013), Sharma *et al.*, (2013) and Hargilas and Sharma (2015).

Soil fertility status

The nutrient availability in the soil revealed that application of different sources of plant nutrient influenced the per cent organic carbon, available nitrogen, phaphorus and potassium in the soil after harvesting of groundnut (Table 4). The combined application of FYM@ 4t ha^{-1} + rock phosphate @ 260kg ha^{-1} + gypsum@500kg ha^{-1} + biofertilizers + crop residual mulching @4t ha^{-1} (T_{10}) recorded significantly higher soil organic carbon (0.89%) over T_1-T_6 and T_{10}, respectively. Whereas, this treatment combination statistically at par with T_7-T_9.The lesser organic carbon increased in treatment of neem cake +bone meal and organic carbon in the soil decreased continuously in absolute control after harvesting of groundnut. The organic carbon per cent in the soil might be affected to addition of quantity of low concentrated organic manures. Compared to initial nitrogen availability in the soil, there was improvement in actual N status under combined use of all organic nutrient sources. While, nitrogen availability was reduce in individual N resources used. The maximum available N (292.40kg ha^{-1}) recorded in combined application of FYM+rock phosphate+biofertilizers+gypsum+ green manuring (T_9) followed by T_8, T_{10} and T_{11} and it significantly higher over rest treatments. The maximum available phosphorus (39.20kg ha^{-1}) was recorded under FYM@ 4t ha^{-1}+ rock phosphate @ 260kg ha^{-1}+ gypsum@500kg ha^{-1} + biofertilizers+ BD500 (T_{11}) followed by T_7-T_{10} and T_5 and significantly higher over rest treatments. The higher available potassium was recorded in combined use of FYM@ 4t ha^{-1}+ rock phosphate @260kg ha^{-1}+ gypsum@500kg ha^{-1} + residual mulching (T_{10}) followed by T_7-T_9 and T_{11} and significantly higher over rest treatments. The availability of nutrient in soil after harvesting of crop might be depending on addition of organic resources in the soil. The results of experiment are strongly support the finding of Deshmukh *et al.*, (2005) and Hargilas and Sharma (2015).

On the basis of field experimentation, it can be concluded that combined application of FYM, rock phosphate, gypsum with bio-fertilizer and mulching in the groundnut cultivation favoured for better nutrition to higher productivity and profitability with enrichment of soil fertility status under humid zone of Southern Rajasthan

References

DAC&FW,2016.Agricultural at a glance, 2016. DAC & FW, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi.

Deshmukh, K.K, Khatik, S.K. and Dubey, D.P. 2005. Effect of Integrated use of inorganic, organic and bio fertilizers on production, Nutrient availability of plateau and Satpura hills. *Journal of Soils and Crops*, 15: 21-25.

Ghosh PK, KG Mandal, KK Bandyopadhyay,

KM Hati, A Subba Rao, AK Tripathi (2002). Role of plant nutrient management on oilseed production. *Fertiliser News*, 47(11): 67-77.

Gunri, S.K. and Nath, R. 2012.Effect of organic manures, bio-fertilizers and bio-pesticides on productivity of summer groundnut (*Arachis hypogaea* L.) in red and laterite zone of West Bengal. *Legume Research*, 35(2): 144-148.

Hargilas and Sharma, S.N. 2015. Effect of different combinations of organic manures and biofertilizers on growth, yield, grain quality and economics in organic farming of scented rice. *Journal of Plant Development Sciences*, 7(5): 381-388

Kachot, N.A., Malavia, D.D., Solanki, R.M. and Sagarka, B.K. 2001.Integrated nutrient management in rainy season groundnut (*Arachis hypogea* L). *Indian Journal of Agronomy*, 46 (3): 516-522.

Kumawat, R.N., Mahajan, S.S., Mertia, R.S.2009.Growth and development of groundnut (*Arachis hypogaea*) under foliar application of *panchgavya* and leaf extracts of endemic plants. *Indian Journal of Agronomy*, 54(3): 324-331.

Laxminarayana, K. and Patsram, 2005. Influence of inorganic, biological and organic manures on yield and nutrient uptake sf groundnut (*Arachis hypogaea* L.) and soil properties. *Indian journal of Agricultural sciences*.75 (4):218-21.

Nziguheba G, Palm, C.A., Buresh, R.J, Smithson, P.C. 1998.Soil phosphorus fractions and adsorption as affected by organic and inorganic sources. Plant and Soil 198: 159-168.

Ola, B. L., Pareek, B. L., Yadav, R. S., Shivran, A. C. and Sharma, O. P. (2013). Influence of integrated nutrient management on productivity and quality of groundnut in western Rajasthan. *Annals of Agricultural Research New Series* 34: 156-159.

Ram Chatra, Singh, H. B., Patel, R. B., Singh, Hanuman and Kumar, Gopal. 2013. Effect of various nutrient sources on productivity and economics of groundnut. *Annals of Agricultural Research New Series* 34: 176-178.

Sharma, Sheela, Jat, N. L., Shivran, A. C., Choudhary, Shripal, Puniya, M. M. and Jeetarwal, R. L. (2013).Effect of fertility levels and bio- fertilizers on yield and economics of groundnut. *Annals of Agricultural Research New Series* 34: 353-356**.**

Sriramachandrasekaran, M.V. 2001.Effect of industrial and organic wastes on groundnut in typic ustifluvent soil. *American Agriculture. Research, New series*, 22(3): 436-438

Stevenson FJ (1994). Humus Chemistry: Genesis, Composition, Reactions, Second edition John Wiley & Sons Inc. New York.

Subrahmaniyan K, P Kalaiselvan, N Arulmozhi (2000). Studies on the effect of nutrient spray and graded level of NPK fertilizers on the growth and yield of groundnut. *International Journal of Tropical Agriculture*, 18(3): 287-290.

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