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Influence of different organic nutrient sources on productivity and profitability of groundnut (*Arachis hypogaea* L.) in southern Rajasthan, India

R.K. Sharma*, S.K. Sharma and N.L. Dangi

Dryland Faming Research Station, Bhilwara
Maharana Pratap University of Agriculture & Technology, Udaipur-313 001, Rajasthan, India.

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ABSTRACT

A field experiment was conducted during *kharif* 2013-14 at Dryland Farming Research Station, Bhilwara (Rajasthan) to study the effect of organic nutrient sources on productivity and profitability of groundnut (*Arachis hypogaea* L.). The experiment consisted of eight treatments having three organic sources *viz.*, farmyard manure, vermicompost and poultry manure with or without rock phosphate and spray of vermiwsh was laid out in a randomized block design and replicated thrice. The organic sources comprising combined application of vermicompost @ 1 t ha^{-1} and 0.35 t Rock phosphate produced significantly higher number of pods per plant (18.33), number nodules per plant (13.11), pod weight per plant (13.43 g), test weight (36.39 g) and shelling percentage (54.06), pod yield (1377 kg ha^{-1}), halum yield (2944 kg ha^{-1}) of groundnut over the no manure application and superior over rest the treatments. The pod yield increased due to application of vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate to the tune of 61.62 per cent over control. Application of vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate gave highest net return (Rs. 41137 ha^{-1}) and B: C ratio (3.19).

Key words: Economics, Groundnut, Organic sources, Productivity, Vermiwash.

INTRODUCTION

Organic farming is gaining gradual momentum across the world. In India, about 1180000 hectare area is under organic farming with 677257 numbers of certified organic farms (Willer, 2011). Biodynamic farming, i.e., combining biological and dynamic agriculture practices, has recently emerged as an advancement of organic agriculture. Just as organic farming, the product of biodynamic agriculture are nutritionally superior and they taste better than the conventional food (Steiner, 1996), besides having the potential to mitigate some of the negative effects of chemical agriculture.

Groundnut (*Arachis hypogaea* L.) is mainly grown in *kharif* season. Its seed contain high quality edible oil (48 per cent), easily digestible protein (26 per cent) and carbohydrates (20 per cent). Globally, 50 per cent of groundnut produce is used for oil extraction, 38 per cent for confectionary and 12 per cent for seed purpose. Groundnut occupies third position with regards to both area and production in India. It accounted about 22 per cent of area (5.95 million ha) and 24 per cent of production (7.54 million tons) with the productivity of 1268 kg/ha (Anonymous, 2011). The vegetable oil consumption in India is continuously rising and has sharply increased in the couple of years touching around 12.4 kg/ capita/year. This is still lower than the world average consumption of 17.8 kg.

In fact, fertilizers no doubt played a key role in agricultural production and changed country from a region of food scarcity to food sufficiency. But chemical fertilizers have also contributed significantly towards the pollution of water, air and soil. So the current trend is to explore the possibility of supplementing chemical fertilizers with organic ones which are eco-friendly and cost-effective (Datta *et al.*, 2009). Farmyard manure improves soil quality apart from supplying all essential nutrients and enhancing the activity of microorganisms. 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 influence of different organic manures on yield and economics of groundnut in southern Rajasthan.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* season 2013-14 at Dryland Farming Research Station, Arjia, Bhilwara of Maharana Pratap University Agriculture and Technology, Udaipur (Rajasthan). The region is characterized by semi-arid climate with extremes of temperature both in summer and by winter and annual rainfall of about 657.7 mm mostly received in rainy season from July to September. The soil of the experimental field was sandy-loam in texture having pH 8.20, low in organic carbon (0.42 per cent), available nitrogen (176.0 kg ha^{-1}) and medium in available phosphorus (P_2O_5)- (39.0 kg ha^{-1}), high

*Corresponding author's e-mail: rksdfrs@yahoo.co.in

in available potassium (365.0 kg ha^{-1}) and deficient in DTPA extractable iron (3.2 ppm) and zinc (0.56 ppm). The experiment was laid out in randomized block design with eight treatments and three replications. The treatments consists of T_1 - FYM @ 3 t ha^{-1} (équivalent to 15 kg N ha^{-1}) + vermiwash spray at 30, 45, & 60 DAS, T_2- FYM @ 12 t ha^{-1} (50 % équivalent to 60 kg P ha^{-1}) + vermiwash spray at 30, 45 & 60 DAS , T_3 – vermicompost @ 1 t ha^{-1} (15 kg N équivalent), T_4 – Vermicompost @ 3 t ha^{-1} (50 % P équivalent), T_5 – FYM @ 3 t ha^{-1} + 0.35 t rock phosphate (équivalent to 60 kg P ha^{-1}), T_6 – vermicompost @ 1 t ha^{-1} + 0.35 t rock phosphate (équivalent to 60 kg P ha^{-1}), T_7– poultry manure @ 2.4 t ha^{-1} , T_8 – absolute control (No manure). Besides these, spray of BD 500 + BD 501 according to organic calendar was done. The gross and net plot size was 3.0X 4.5 m and 2.4 X 3.9 m, respectively.

Farm yard manure, vermicompost and poultry manure were applied 15 days before the sowing. Nitrogen content in different organic manures was taken in to consideration against quantities applied in different treatments. FYM contained 0.51% N, 0.21% P and 0.62% K. Poultry manure contained 3.50% N, 1.5% P and 2.4% K. Vermicompost had 1.49% N, 0.89% P and 1.2% K. Variety 'TAG-24' was sown at 30 cm row spacing. seeds were treated by *Tricoderma herzanium* @ 8 g kg^{-1} seed. Application of BD 500 was done twice firstly on evening prior to a day before sowing and secondly 30 days after sowing. BD 501 was sprayed four times viz., at 2-4 leaf stage and latter on at branching, pre-flowering and pod formation stage. For organic management of crop, neem cake @ 200 kg ha^{-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. Production efficiency (kg ha^{-1}day^{-1}) was calculated by dividing final grain ha^{-1} to total life period (days) of crop and economic efficiency (Rs ha^{-1} day^{-1}) by dividing net monetary returns ha^{-1} to total life period (days) of crop.

RESULTS AND DISCUSSION

Yield attributes: The yield attributes *viz.*, number of pods per plant, number nodules per plant, pod weight per plant, test weight and shelling (%) of groundnut differed significantly with the application of different organic nutrient sources (Table 1). The data in table 1 revealed that treatment T_6 i.e. vermicompost @ 1 t ha^{-1} + 0.35 t rock phosphate (equivalent to 60 kg P ha^{-1}) gave the maximum number of pods per plant (18.33) and was found significantly superior over control (10.67) and all other organic sources. It was also observed that treatment T_1 and treatment T_3 was found at par with each other. Similarly, treatment T_2, T_4 and treatment T_7 were also found at par with each other. The highest number nodules per plant (13.11) were found statistically higher with treatment T_6 i.e. vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate (equivalent to 60 kg P ha^{-1}). Similarly, pod weight per plant (13.43 g) was found with the treatment T_6. The test weight and shelling (%) were also recorded significantly highest in treatment T_6 (36.39 g) and (54.06%) over all the treatments, respectively.

This might be due to large availability of nutrients which in turn promoted growth as well as yield attributing characters. Further, physiological role of N and P supplied by FYM and compost in enhancing growth parameters might have led to increased yield attributes and there by yield of crop at application of organic manure. 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 the

Table 1: Effect of different organic source on yield attributes of groundnut

Treatments	Number of pods/ plant	Number of nodules/ plant	Pod weight/ plant (g)	Test weight (100 seed), g	Shelling (%)
T_1 - FYM @ 3.0 t ha^{-1} (équivalent to 15 kg N ha^{-1}) + vermiwash spray at 30, 45, & 60 DAS	12.56	10.45	11.60	33.10	50.29
T_2- FYM @ 12.0 t ha^{-1} (50 % équivalent to 60 kg P ha^{-1}) + vermiwash spray at 30, 45, & 60 DAS	14.78	12.56	12.27	34.79	51.74
T_3 – Vermicompost @ 1.0 t ha^{-1} (15 kg N équivalent)	11.78	10.11	11.13	31.04	50.15
T_4 – Vermicompost @ 3.0 t ha^{-1} (50 % P équivalent)	14.33	11.33	12.13	34.05	51.27
T_5 – FYM @ 3.0 t ha^{-1} + 0.35 t Rock phosphate (équivalent to 60 kg P ha^{-1})	16.44	13.00	12.87	34.84	52.56
T_6 – Vermicompost @ 1.0 t ha^{-1} + 0.35 t Rock phosphate (équivalent to 60 kg P ha^{-1})	18.33	13.11	13.43	36.39	54.06
T_7 – Poultry manure @ 2.4 t ha^{-1}	13.33	10.55	11.97	33.49	50.47
T_8 – Absolute control (No manure)	10.67	8.55	10.37	29.66	48.75
S Em±	0.44	0.30	0.22	0.62	0.54
CD(0.05)	1.33	0.90	0.67	1.89	1.63
CV (%)	9.40	7.91	5.51	5.59	5.16

findings of Ola *et al.*, 2013, Sharma *et al.*, 2013, Ram *et al.*, 2013, Patel *et al.*, 2014 and Patil *et al.*, 2013.

Yield: Data presented in Table 2 revealed that different treatments of organic manure had significant effect on the pod and halum yield of groundnut. The maximum pod yield of 1377 kg/ha was recorded with the application of vermicompost @ 1 t ha^{-1} + 0.35 t rock phosphate (equivalent to 60 kg P ha^{-1}) followed by treatment T_5 i.e. FYM @ 3 t ha^{-1} + 0.35 t rock phosphate (1247 kg / ha). Results also revealed that application of vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate recorded significant increase in pod yield of groundnut to the tune of 61.62 per cent over control. Similarly, the maximum halum yield was recorded with application of vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate (2636 Kg/ha). Harvest index varies from 31.99 to 33.47 in all the treatments. Similarly, biological yield gave the same trend as pod yield and halum yield. Different organic nutrient management practices have significantly influenced production efficiency. Results revealed that treatment T_5 i. e. vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate produced the highest production efficiency 13.77 kg $ha^{-1}day^{-1}$ followed by FYM @ 3 t ha^{-1} + 0.35 t Rock phosphate (T_4). Supply of optimum nutrients through treatment T_5 i. e. vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate may be responsible for good productivity. Supply of nutrients in optimum quantity fovours good photosynthetic and growth activities in crop.

Previous research on effect of organic manures in enhancing crop and soil productivity have been reported by Pimentel *et al.*, 2005 and Patil *et al.*, 2010. They have reported that importance of organic farming is understandable given the important role soil organic matter plays in maintaining soil productivity through multiple functions. These findings are in accordance with the findings of Ola *et al.*, 2013, Sharma *et al.*, 2013, Ram *et al.*, 2013, Patel *et al.*, 2014 and Patil *et al.*, 2013. In light of above evidences, it seems that application of biodynamic preparations in combination with organic manures might have resulted in enhancing yield attributes and yield of groundnut under organic production system. The results on pod yield thus confirmed the trend observed earlier in the yield attributing characters. With the increment in supply of essential nutrients to groundnut, their availability, acquisition, mobilization and influx into the plant tissues increased and thus improved yield components and finally the yield. These results are in conformity with those of Singh and Sinsinwar (2006) and Datta *et al.* (2009).

Economics: The data on gross return, cost of cultivation, net return and benefit cost ratio of groundnut as influenced by organic nutrient management practices are presented in Table 3. Among the different organic treatments, the cost of cultivation varied from Rs. 15310 to Rs. 26610 ha^{-1} with a maximum with vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate (T_6). Input cost of some of the organic treatments were more than the control due to higher cost of organic manures. The gross return ranged from Rs. 36704 ha^{-1} to Rs. 59957 ha^{-1} with the variation of net return from Rs.21394 ha^{-1} to 41137 ha^{-1} and benefit: cost ratio of 2.40 to 3.32. The maximum gross return (Rs. 59957 ha^{-1}) and net return (Rs. 41137 ha^{-1}) were recorded with the application of vermicompost @ 1 t ha^{-1} + 0.35 t rock phosphate (T_6) but higher and benefit: cost ratio (3.32) was recorded with the application of FYM @ 3.0 t ha^{-1} + 0.35 t rock phosphate due to low cost of FYM. Similarly, application of vermicompost @ 1 t ha^{-1} + 0.35 t rock phosphate (T_6) gave the highest economic efficiency Rs. 411.37 ha^{-1} day^{-1} which was superior to other organic nutrient treatments. Jayathilake *et al.* (2003) also reported higher net returns and benefit: cost ratio by organic manure.

Table 2: Effect of different organic source on yield of groundnut

Treatments	Pod yield (kg ha^{-1})	Halum yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Production efficiency (kg ha^{-1} day^{-1})	Harvest Index (%)
T_1 - FYM @ 3.0 t ha^{-1} (équivalent to 15 kg N ha^{-1}) + vermiwash spray at 30, 45, & 60 DAS	1136	2352	3488	11.36	32.57
T_2- FYM @ 12.0 t ha^{-1} (50 % équivalent to 60 kg P ha^{-1}) + vermiwash spray at 30, 45, & 60 DAS	1241	2580	3821	12.41	32.46
T_3 – Vermicompost @ 1.0 t ha^{-1} (15 kg N équivalent)	1062	2111	3173	10.62	33.47
T_4 – Vermicompost @ 3.0 t ha^{-1} (50 % P équivalent)	1185	2488	3673	11.85	32.25
T_5 – FYM @ 3.0 t ha^{-1} + 0.35 t Rock phosphate (équivalent to 60 kg P ha^{-1})	1247	2636	3883	12.47	32.06
T_6 – Vermicompost @ 1.0 t ha^{-1} + 0.35 t Rock phosphate (équivalent to 60 kg P ha^{-1})	1377	2944	4321	13.77	31.99
T_7 – Poultry manure @ 2.4 t ha^{-1}	1167	2451	3617	11.67	32.30
T_8 – Absolute control (No manure)	852	1722	2574	8.52	33.23
S Em±	31.15	80.09	105.88		
CD(0.05)	94.49	242.92	321.14		
CV (%)	8.07	9.97	8.90		

Table 3: Effect of different organic source on economics of groundnut

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B: C ratio	Economic efficiency (Rs. ha^{-1} day^{-1})
T_1 - FYM @ 3.0 t ha^{-1} (équivalent to 15 kg N ha^{-1}) + vermiwash spray at 30, 45, & 60 DAS	16890	49161	32271	2.91	322.71
T_2- FYM @ 12.0 t ha^{-1} (50 % équivalent to 60 kg P ha^{-1}) + vermiwash spray at 30, 45, & 60 DAS	21390	53747	32357	2.51	323.57
T_3 – Vermicompost @ 1.0 t ha^{-1} (15 kg N équivalent)	18610	45605	26995	2.45	269.95
T_4 – Vermicompost @ 3.0 t ha^{-1} (50 % P équivalent)	26610	51432	24822	1.93	248.22
T_5 – FYM @ 3.0 t ha^{-1} + 0.35 t Rock phosphate (équivalent to 60 kg P ha^{-1})	16320	54185	37865	3.32	378.65
T_6 – Vermicompost @ 1.0 t ha^{-1} + 0.35 t Rock phosphate (équivalent to 60 kg P ha^{-1})	18820	59957	41137	3.19	411.37
T_7 – Poultry manure @ 2.4 t ha^{-1}	20610	50636	30026	2.46	300.26
T_8 – Absolute control (No manure)	15310	36704	21394	2.40	213.94

Sale price of groundnut = Pod- Rs. 35 /kg and Halum - Rs. 4 /kg
Vermicompost @ Rs. 4.0/- per kg, poultry manure @ Rs. 3.0/- per kg and FYM @ Rs. 0.50/- per kg

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