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Impact of different organic nutrient management practices on productivity and profitability of groundnut (*Arachis hypogaea* L.) in semi arid region of Rajasthan

RK Sharma and Ramavtar

Abstract
A field experiment was conducted during *Kharif* season of three consecutive years 2013, 2014 and 2015 to study the impact of different organic nutrient management practices on productivity and profitability of groundnut (*Arachis hypogaea* L.) at Dryland Farming Research Station, Arjia, Bhilwara (Rajasthan). The experiment comprising eight treatments having three organic sources viz., farmyard manure, vermicompost and poultry manure with or without rock phosphate and vermiwsh spray. Application of vermicompost @ 1 t ha^{-1} along with 0.35 t Rock phosphate had significant effect on the yield attributes viz., number of pods per plant (20.45), number nodules per plant (14.87), pod weight per plant (13.56 g), 100 seed weight (35.99 g) and shelling percentage (54.08) of groundnut after three year experimentation. Application of vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate produced significantly higher pod yield (1402 kg ha^{-1}) and halum yield (2965 kg ha^{-1}) of groundnut over the no manure application and superior over rest the treatments and also gave highest net return (Rs. 49365 ha^{-1}).

Keywords: Farm yard manure, groundnut, organic sources, productivity and vermicompost

Introduction
Interest in food production without synthetic fertilizers and practices is increasing. Such food is commonly referred to as organic (Ramesh *et al*., 2010) [11]. Various organic technologies have been utilized for about 600 years to make agriculture sustainable while conserving soil, water, energy and biological resources (Pimentel *et al.*, 2005) [9]. Organic farming is gaining gradual momentum across the world. In the world, 81.22 million ha area in 172 countries is under organic agriculture which includes both cultivated and wild harvest (FIBL & IFOAM, 2016) [3]. Emerging from 42,000 ha under certified organic farming in 2003-04, the organic agriculture has grown many folds and by 2014-15, India has brought 4.89 m ha area under organic certification process. Out of this, cultivated area accounts for 1.18 m ha (24.1%) while remaining 3.71 m ha (75.9%) is wild forest collection area (Ravi Shankar *et al*, 2016).
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) [1]. 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) [2]. 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 Impact of different organic nutrient management practices on productivity and profitability of groundnut (*Arachis hypogaea* L.) in semi arid region of 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 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.

Result and Discussion

Influence of different organic sources on yield attributes

Yield attributing characters of groundnut viz., number of pods per plant, number nodules per plant, pod weight per plant, test weight and shelling (%) were differed significantly with the application of different organic nutrient sources during all three year of experimentations (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 (20.45) in pooled mean of 3 year and was found significantly superior over control (10.03) and all other treatment of different 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 (14.87) were found statistically higher with treatment T_6 i.e. vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate. Similarly, pod weight per plant (13.56) was found with the treatment T_6. The test weight and shelling (%) were also recorded significantly highest in treatment T_6 (35.99 g) and (54.08%) 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 findings of Ola *et al.*, 2013 [5], Ram *et al.*, 2013 [10], Patel *et al.*, 2014 [6] and Patil *et al.*, 2013 [8].

Influence of different organic sources on yield

Data depicted in Table 2 revealed that different treatments of organic manure had significant effect on the pod and halum yield of groundnut in all three years. On the basis of 3 year pooled mean the maximum pod yield of 1402 kg ha^{-1} 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 (1335 kg ha^{-1}). 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 88.95 per cent over control. Similarly, the maximum halum yield was recorded with application of vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate (2965 Kg ha^{-1}). Harvest index varies from 32.22 to 34.25 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 of mustard crop. Results revealed that treatment T_5 i. e. vermicompost @ 1 t ha^{-1} + 0.35 t Rock phosphate produced the highest production efficiency 13.93 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 [9] and Patil *et al.*, 2010 [7]. 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 [5], Ram *et al.*, 2013 [10], Patel *et al.*, 2014 [6], Sharma *et al.*, 2017 [12] and Patil *et al.*, 2013 [8]. 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 sesame under organic production system. The results on seed yield thus confirmed the trend observed earlier in the yield attributing characters. With the increment in supply of essential nutrients to Indian mustard, 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 Datta *et al.* (2009) [2].

Influence of different organic sources on economics

The data on gross return, cost of cultivation, net return and benefit cost ratio of mustard as influenced by organic nutrient management practices are presented in Table-3. Among the different organic treatments, the cost of cultivation varied from Rs. 16143 to Rs. 27943 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. 35212 ha^{-1} to Rs. 69185 ha^{-1} with the variation of net return from Rs.19069 ha^{-1} to 49365 ha^{-1} and benefit: cost ratio of 2.19 to 3.76. The maximum gross return (Rs.69185 ha^{-1}) and net return (Rs.49365 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 (3.76) 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. 499 ha^{-1} day^{-1} which was superior to other organic nutrient treatments. Jayathilake *et al.* (2003) [4] also reported higher net returns and benefit: cost ratio by organic manure.

Table 1: Effect of different organic source on yield attributes of groundnut (3 year pooled mean)

Treatments	Number of pods plant^{-1}	Number of nodules plant^{-1}	Pod weight plant^{-1}	Test weight (100 seed)	Shelling (%)
T_1 - FYM @ 3.0 t ha^{-1} + vermiwash spray at 30, 45, & 60 DAS	15.30	12.25	12.04	33.05	50.50
T_2- FYM @ 12.0 t ha^{-1} + vermiwash spray at 30, 45, & 60 DAS	17.06	14.00	12.44	34.89	51.69
T_3 – Vermicompost @ 1.0 t ha^{-1}	14.21	11.69	11.36	31.37	50.19
T_4 – Vermicompost @ 3.0 t ha^{-1}	16.62	12.99	12.36	34.76	51.28
T_5 – FYM @ 3.0 t ha^{-1} + 0.35 t Rock phosphate ha^{-1}	18.60	14.74	13.12	35.43	52.79
T_6 – Vermicompost @ 1.0 t ha^{-1} + 0.35 t Rock phosphate ha^{-1}	20.45	14.87	13.56	35.99	54.08
T_7 – Poultry manure @ 2.4 t ha^{-1}	15.02	12.14	12.08	32.88	50.45
T_8 – Absolute control (No manure)	10.03	8.46	10.18	29.31	48.33
S Em±	0.37	0.27	0.21	0.56	0.53
CD(0.05)	1.13	0.81	0.64	1.69	1.60
CV (%)	7.00	6.31	5.22	5.00	3.09

Table 2: Effect of different organic source on yield of groundnut (3 year pooled mean)

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} + vermiwash spray at 30, 45, & 60 DAS	1193	2385	3577	33.32	11.84
T_2- FYM @ 12.0 t ha^{-1} + vermiwash spray at 30, 45, & 60 DAS	1298	2648	3946	32.87	12.89
T_3 – Vermicompost @ 1.0 t ha^{-1}	1154	2214	3368	34.25	11.46
T_4 – Vermicompost @ 3.0 t ha^{-1}	1253	2471	3724	33.65	12.44
T_5 – FYM @ 3.0 t ha^{-1} + 0.35 t Rock phosphate ha^{-1}	1335	2702	4037	33.08	13.26
T_6 – Vermicompost @ 1.0 t ha^{-1} + 0.35 t Rock phosphate ha^{-1}	1402	2965	4367	32.22	13.93
T_7 – Poultry manure @ 2.4 t ha^{-1}	1185	2393	3578	33.09	11.77
T_8 – Absolute control (No manure)	811	1706	2517	32.39	8.06
S Em±	32.53	67.59	86.38		
CD(0.05)	98.68	205.02	262.02		
CV (%)	8.11	8.33	7.12		

Table 3: Effect of different organic source on economics of groundnut (3 year pooled mean)

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} + vermiwash spray at 30, 45, & 60 DAS	17973	58402	40429	3.24	408
T_2- FYM @ 12.0 t ha^{-1} + vermiwash spray at 30, 45, & 60 DAS	23223	63775	40552	2.74	410
T_3 – Vermicompost @ 1.0 t ha^{-1}	19610	56243	36633	2.86	370
T_4 – Vermicompost @ 3.0 t ha^{-1}	27943	61233	33289	2.19	336
T_5 – FYM @ 3.0 t ha^{-1} + 0.35 t Rock phosphate ha^{-1}	17403	65575	48172	3.76	487
T_6 – Vermicompost @ 1.0 t ha^{-1} + 0.35 t Rock phosphate ha^{-1}	19820	69185	49365	3.48	499
T_7 – Poultry manure @ 2.4 t ha^{-1}	21843	58003	36160	2.65	365
T_8 – Absolute control (No manure)	16143	35212	19069	2.19	193

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