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Short communication

EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS ON SOIL ORGANIC CARBON AND PRODUCTIVITY OF GROUNDNUT IN LOAMY SAND SOIL

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Groundnut (*Arachis hypogaea* L.) is the premier oil seed crop of country. In India, 80 per cent of the total produce is used for oil extraction, 11 % as seed, 8% as direct food and only 1% produce is exported. India contributes about 20% area and less than 10% of oil seed production of world. Whereas, it accounts 40% of the area (5.95 million ha^{-1}) and 30% of the production (7.54 million tonnes) of total oil seed grown in India. In Rajasthan, groundnut covers an area of 3.30 lakh hectares with 3.50 lakh tonnes of production with an average productivity of 1087 kg ha^{-1}. Vermicompost is a prime source of organic recycling of organic wastes and a good source of macro and micro nutrients in chelated form and fulfills the balanced nutrient requirement of plants at longer period. Besides this, it also helps in maintaining soil fertility and practices of precious eco-friendly environment of the soil. Vermicompost also helps in reducing C:N ratio and in increasing humus content of the soil and provide a wide range of nutrient in the readily available form to the plants, such as nitrate, soluble phosphorus, exchangeable potassium, calcium, magnesium (Singh and Tilak, 2006). Poultry manure is an important source of nutrient and lays direct effect on plant growth. Besides major nutrients, poultry manure also contains traces of micronutrients which are generally not supplied by the commercial fertilizer but essential for plant growth. Use of biofertilizers can have a greater importance in increasing availability of fertilizers nutrients, fertilizer use efficiency and microbial biomass. Hence, the study was conducted using groundnut as test crop.

A field experiment was conducted during *kharif* 2006 at farmer's field, Ghatolia (Kalakh), Jobner is located at 26.05^0 North latitude, 75.28^0 East longitude and 427 meters above mean sea level in Jaipur (Rajasthan). The soil was loamy sand, having pH 8.1, 1.3g kg^{-1} organic carbon, 130.6 kg ha^{-1} available nitrogen, and 20.5 kg ha^{-1} phosphorus and 149.5 kg ha^{-1} potassium. The experiment consisted of 14 treatments, viz T_0, control-RDF of NPK (25 kg N+ 50 kg P_2O_5 + 40 kg K_2O ha^{-1}); T_1, vermicompost 2.5 t ha^{-1}; T_2, Poultry manure 2.5 t ha^{-1}; T_3, Vermicompost 1.25 t ha^{-1} + poultry manure 1.25 t ha^{-1}; T_4, vermicompost 2.5 t ha^{-1} + *Rhizobium*; T_5, vermicompost 2.5 t ha^{-1} + *Rhizobium* + VAM; T_6, vermicompost 2.5 t ha^{-1} + *Rhizobium* + VAM + PSB; T_7, poultry manure 2.5 t ha^{-1} + *Rhizobium*; T_8, poultry manure 2.5 t ha^{-1} + *Rhizobium* + VAM; T_9, poultry manure 2.5 t ha^{-1} + *Rhizobium* + VAM + PSB; T_{10}, vermicompost 1.25 t ha^{-1} + poultry manure 1.25 t ha^{-1} + *Rhizobium*; T_{11}, vermicompost 1.25 t ha^{-1} + poultry manure 1.25 t ha^{-1} + *Rhizobium* + VAM; T_{12}, vermicompost 1.25 t ha^{-1} + poultry manure 1.25 t ha^{-1} + *Rhizobium* + VAM + PSB and T_{13}, 25:50:40 kg NPK ha^{-1} + *Rhizobium* + VAM + PSB. These treatments were applied in randomized block design and with three replications. Groundnut (var. M-13) crop was sown on 13 June and harvested on 20 October, 2006. The application of half dose of N, full doses of P and K and organic manure as per treatments were applied at the time of sowing and remaining half N was top-dressed at the time of first irrigation. The sources of nutrients were taken as urea, diammonium phosphate and muriate of potash, respectively, for N, P and K. Seed was inoculated with *Rhizobium*, PSB and VAM culture as per treatment before sowing using standard method and dried in shade. Intercultural operations were carried out as per requirement of crop. Yield attributes and yields were recorded at harvest. Soil samples collected after harvest of groundnut crop were analysed by adopting standard procedure (Jackson, 1973).

The use of vermicompost, poultry manure in combination with multi strains of biofertilizers (*Rhizobium*, VAM and PSB), all treatments having vermicompost, poultry manure with biofertilizers and RDF NPK along with biofertilizers *i.e. Rhizobium*, VAM and PSB brought about a significant increase in the number of pegs per plant over either RDF or vermicompost, poultry manure and vermicompost along with poultry manure alone. However, the highest number of pegs per plant (50.18) and 22.7% pods per plant were observed under the treatment T_{13} (RDF NPK + *Rhizobium* + VAM + PSB) over rest of the treatment combinations. Jain and Trivedi (2005) reported similar results. The maximum number of effective and non-effective nodules (19.23and 7.36)

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were recorded under the treatment T_{13} (RDF NPK + *Rhizobium* + VAM + PSB) which was 43.3 and 51.7 per cent higher over control, respectively. The maximum pods (21.46 q ha^{-1}), kernel (14.63 q ha^{-1}) and haulm (46.56 q ha^{-1}) were produced under treatment T_{13} (RDF NPK + *Rhizobium* + VAM + PSB) which were significantly superior over rest of treatment combination. The increases were to the tune of 72.0% in pod yield, 44.5% in kernel yield and 76.1% in haulm yield over application of T_0 (RDF – NPK) alone.

Table 1: Effect of organic manures and biofertilizers on yield attributes and yields of groundnut and organic carbon in soil

Treatments	Peg per plant	Pods per plant	Effective nodules per plant	Non-effective nodules per plant	Pod yield (q ha^{-1})	Kernel yield (q ha^{-1})	Haulm yield (q ha^{-1})	Organic carbon (g kg^{-1})			
								30 DAS	60 DAS	90 DAS	At harvest
T_0 RDF - NPK	34.38	14.53	13.51	4.85	12.47	8.41	26.43	1.3	1.4	1.4	1.6
T_1 VC 2.5 t ha^{-1}	32.65	13.18	12.43	4.57	11.76	7.93	24.93	2.0	1.8	1.9	2.1
T_2 PM 2.5 t ha^{-1}	31.27	12.86	12.18	4.38	11.23	7.58	23.80	1.7	1.8	1.9	2.1
T_3 VC 1.25 t ha^{-1} + PM 1.25 t ha^{-1}	33.46	13.64	12.79	4.62	12.34	8.32	26.16	2.0	1.8	1.9	2.1
T_4 VC 2.5 t ha^{-1} + *Rhizo.*	38.79	16.78	14.96	5.53	14.46	9.78	30.94	2.0	2.1	2.0	2.1
T_5 VC 2.5 t ha^{-1} + *Rhizo.* + VAM	40.26	17.99	16.22	6.02	15.68	10.61	33.55	2.0	2.2	2.0	2.2
T_6 VC 2.5 t ha^{-1} + *Rhizo.* + VAM + PSB	43.38	18.87	16.39	6.14	16.25	11.03	34.93	2.0	2.2	2.0	2.2
T_7 PM 2.5 t ha^{-1} + *Rhizo.*	39.34	16.92	15.34	5.68	14.59	9.87	31.22	1.7	1.9	2.2	2.5
T_8 PM 2.5 t ha^{-1} + *Rhizo.*+ VAM	43.67	19.06	16.78	6.35	16.40	11.13	35.26	1.7	1.9	2.3	2.6
T_9 PM 2.5 t ha^{-1} + *Rhizo.* + VAM + PSB	44.13	19.24	16.93	6.44	16.94	11.50	36.46	1.7	1.9	2.3	2.6
T_{10} VC 1.25 t ha^{-1} + PM 2.71.25 t ha^{-1} + *Rhizo.*	39.76	17.11	15.56	5.89	14.78	10.00	31.62	2.0	2.1	2.0	2.2
T_{11} VC 1.25 t ha^{-1} + PM 1.25 t ha^{-1} + *Rhizo.* + VAM	44.89	19.87	17.12	6.47	17.25	11.71	37.26	2.1	2.2	2.3	2.6
T_{12} VC 1.25 t ha^{-1} + PM 1.25 t ha^{-1} + *Rhizo.* + VAM + PSB	45.23	20.59	17.55	6.65	17.92	12.16	38.70	2.1	2.2	2.4	2.7
T_{13} RDF - NPK + *Rhizo.* + VAM + PSB	50.18	22.75	19.23	7.36	21.46	14.63	46.56	1.5	1.6	1.6	1.8
C.D. (P = 0.05)	4.19	1.98	1.29	0.52	1.75	1.22	3.91	0.014	0.017	0.019	0.022

VC = Vermicompost, PM = poultry manure, Rhizo = Rhizobium

The application of RDF-NPK along with *Rhizobium*, VAM and PSB proved superior in increasing yield attributes and yield. It is obvious that the integrated application of RDF-NPK + *Rhizobium* + VAM + PSB might have provided sufficient and balanced nutrients in readily available form throughout the growth period of the crop and the increased availability of plant nutrients. Their uptake leading to the greater photosynthesis production of metabolites and enzymatic activities might have influenced into increased nodulation, nodule mass and extensive root system and the greater production of metabolites and their translocation to various sinks especially, the productive strictures (pods and seeds) could have helped to increase into the number of pods per plant besides increasing the over all growth. Results of the present investigation are in similar line with those of Sharma *et al.* (2005). The highest organic carbon content in soil was recorded under treatment T_{12} at 30, 60, 90 days and at harvest (2.1, 2.2, 2.4 and 2.7 g kg^{-1}) and it was lowest (1.3, 1.4, 1.4 and 1.6 g kg^{-1}) under T_0 (RDF – NPK) alone. This treatment T_{12} (vermicompost 1.25 t ha^{-1} + poultry manure 1.25 t ha^{-1} + *Rhizobium* + VAM + PSB) gave significantly higher build up of organic carbon. The increase in organic carbon content of soil with application of vermicompost + poultry manure + biofertilizers might be due to the additive effect of vermicompost in maintaining higher organic carbon level (Rajkhowa *et al*., 2003).

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