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Effect of vermicompost and inorganic fertilizers on soil properties and yield of Indian mustard (*Brassica juncea* L.)

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Abstract

A field study was conducted at the Agronomy Farm, College of Agriculture, Bikaner during 2010-11 *Rabi* season to evaluate the effect of vermicompost and inorganic fertilizers on soil properties and yield of Indian mustard (*Brassica juncea* L.). Amongst the treatments, application of vermicompost up to 6 t/ha, and 80 kg N+ 40 kg P_2O_5/ha, significantly increased yield, % protein, % oil content, and soil properties including higher organic carbon and lower pH compared to the other treatments and control. Application of 6 t vermicompost / ha, and 80 kg N+ 40 kg P_2O_5/ha significantly increased net returns in Indian mustard crop over other treatments. Results of this study show that use of vermicompost can minimize the quantity of inorganic fertilizers, recycle the farm waste, and increase the physical properties of soil.

Key words: *Indian mustard, organic carbon, vermicompost, yield*

Introduction

Indian mustard [*Brassica juncea* (L) Czern & Coss] is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat contributing about 81.5% of the total area and 87.5% of the net production in India (DES, 2013). Indian mustard is the predominant crop of oilseed Brassica group of crops in India. Indian mustard oil is an important component of the Indian diet. Oil is used as condiment in pickles, flavouring curries and vegetables, preparation of hair oils, medicines, and soap making. The cake obtained after the oil is extracted is used mostly for cattle feed and manure. Green stem and leaves are a good source of fodder for cattle. Mustard seed, in general, contains 30-33 % oil, 17-25 % proteins, 8-10 % fibers, 6-10 % moisture, and 10-12 % extractable substances (Pandey *et al*., 2013).

Intensive cropping has made the soil deficient in macro as well as micronutrients. This has resulted in decline in productivity and deterioration in soil health and productivity. The success of any cropping system depends upon the appropriate management of resources including balanced use of manures and fertilizers. Use of organic manures may prove a viable option for sustaining the productivity (Tejada *et al.* 2009). Vermicompost application has been known to improve physical, chemical and biological properties of soil (Nagavallemma *et al*., 2004). Although, there are numerous research about the changes in soil properties after organic amendments (Chaney *et al*., 1992), there are not enough information about the main parameters to be monitored over time to assess the effects of vermicompost applications on soil quality. The main objective of the present study, therefore, was to study the effect of vermicompost and inorganic fertilizers on properties of soil and yield of Indian mustard.

Materials and Methods

A field experiment was conducted at the Agronomy Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner during 2010-11 *Rabi* season. The soil of experimental site was loamy sand containing 110.7, 19.9 and 154.1kg/ ha available nitrogen, phosphorus and potassium, respectively at 0-30 cm depth. Organic carbon, pH and Ec respectively, were 0.12, 8.54 and 0.15 which

Table 1. Organic carbon, pH and EC of the experimental soil before sowing

Soil properties	Value	Methods of analysis
Organic carbon (%)	0.12	Walkley and Black's rapid titration (Jackson, 1973)
EC (ds/m) (1:2 soil water suspension at 25^0C)	0.15	Method No. 4 USDA Handbook No.60 (Richards, 1954)
Soil pH (1:2 soil water suspension)	8.54	Method No. 21 b, USDA Handbook No. 60 (Richards, 1954)

were analysed using different methods listed in table 1. The experiment was laid out in a factorial randomized block design with three replications. Seven treatments consisted of two controls, three levels of vermicompost (0, 2, 4 and 6t/ha), and two levels of inorganic fertilizers (40 kg N + 20 kg P_2O_5 /ha and 80 kg N + 40 kg P_2O_5 /ha). Crop received 2.5 mm of rainfall and evaporation ranged from 1.1 to 8.8 mm per day during the crop growing period. Data were statistically analyzed using Gomez and Gomez, 1984 methods.

Results and Discussion

Application of vermicompost at 2, 4 and 6t/ha consistently and significantly increased seed and stover yields, % protein, % oil content, and net return (Table 2). These results are in close conformity with those of Singh *et al*. (2007). Application of both inorganic fertilizer levels, 40 kg N + 20 kg P_2O_5/ha and 80 kg N + 40 kg P_2O_5/ ha also consistently and significantly increased seed and stover yield, % protein, % oil content, and net return (Table 2), which are in agreement with the results of Dongarkar *et al*. (2005) . This may be due to high requirement of nutrient of Indian mustard. Enhanced vegetative growth in terms of branches per plant ultimately resulted in increased number of yield attributes. Similar results were also reported by Dongarkar *et al*. (2005) and Bhat *et al.* (2007) in Indian mustard.

Under vermicompost and inorganic nutrient application, there were observed significant positive organic carbon and pH changes after harvest. Application of three rates of vermicompost and two rates of organic fertilizers consistently and significantly increased organic carbon, and decreased soil pH. Although, application of vermicompost decreased the EC, and inorganic fertilizer increased the EC slightly, this was all statistically non significant (Table 3). The EC of soil did not differ significantly in different treatments. Higher availability of NP under combined application of nutrients may be due to improved physical, chemical and biological properties on account of organic matter addition, as observed earlier by

Table 2. Effect of vermicompost and inorganic fertilizers on yield, protein, oil and net return of mustard

Treatment	Yield (kg/ ha)		Protein content	Oil content	Net return
	Seed	Stover*	in seed (%)	in seed (%)	(₹/ha)
Vermicompost					
Control	820.9	1237.6	18.6	37.5	11,472
2.0 t/ ha	1058.7	1426.2	21.4	38.8	15,559
4.0 t/ ha	1241.6	1667.2	23.8	39.8	18,489
6.0 t/ ha	1456.0	1933.6	25.7	40.6	22,141
CD (*P*=0.05)	67.2	179.6	0.8	0.8	1,697
Inorganic fertilizers					
Control	923.0	1194.6	18.5	38.4	12,461
40 kg N + 20 kg P_2O_5 /ha	1167.5	1653.6	22.6	39.2	17,514
80 kg N + 40 kg P_2O_5 /ha	1342.3	1850.3	26.0	39.9	20,772
CD (*P*=0.05)	58.2	155.5	0.7	0.7	1,469

Stover*= leaves and stalks of the crops

Table 3. Effect of vermicompost and inorganic fertilizers on organic carbon, pH and EC in soil after harvest of mustard

Treatment	Organic carbon (%)	pH	EC (dS/m)
Vermicompost			
Control	0.097	8.43	0.114
2.0 t/ ha	0.129	8.28	0.108
4.0 t/ ha	0.153	8.14	0.104
6.0 t/ ha	0.182	8.04	0.101
CD (*P*=0.05)	0.014	0.10	NS
Inorganic fertilizers			
Control	0.114	8.34	0.104
40 kg N + 20 kg P_2O_5 /ha	0.139	8.22	0.106
80 kg N + 40 kg P_2O_5 /ha	0.168	8.12	0.110
CD (*P*=0.05)	0.012	0.09	NS

NS: no significant

Table 4 Correlation coefficient between yield and different attributes of mustard

Seed yield (Y) Particular	Correlation coefficient (r)
1. Number of branches/ plant	0.937**
2. Number of siliquae/ plant	0.932**
3. Number of seeds/ siliqua	0.943**
4. Test weight	0.981**
5. Total N uptake	0.989**
6. Total P uptake	0.991**
7. Oil content	0.979**

** Significant at 1% levels of significance

Chand *et al.* (2011) and Kumar *et al.* (2011). Application of 6 t/ha vermicompost increased the net returns to ₹22141/ ha in Indian mustard crop, The application of inorganic fertilizers (80 kg N + 40 kg P_2O_5/ ha) also increased the net return to 20772/ ha.

Correlation coefficient was calculated between seed yield and number of branches per plant, number of siliquae per plant, seeds per siliqua, test weight, total N uptake, total P uptake and oil content (Table 4). Results revealed that seed yield was significantly and positively correlated with number of branches per plant (r= 0.937**), number of siliquae per plant (r= 0.932**), number of seeds per siliqua (r=0.943**), test weight (r=0.981**), total N uptake (r=0.989**), total P uptake (r=0.991**), and oil content (r=0.979**). These results are in close conformity with those of Mekonnen *et al.* (2013).

Conclusion

After the analysis of nutrient status in post harvest soil it can be concluded that organic and inorganic application in soil in combined form is the best strategy for improving soil fertility for longer periods. Vermicompost will increase soil organic matter status, which act as a reservoir for nutrients and hence improve soil physicochemical attributes for yield under dryland condition. This study indicates that combined application of manure (vermicompost) and inorganic fertilizers help to increase crop productivity and improve soil fertility and soil quality. Present investigations will be useful to farmers; agronomist, researchers and environmentalists as it will provide information in maintaining long term soil fertility; sustained higher productivity of crop and lessen the harm caused to the soil by the use of chemical fertilizers.

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