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Effect of different organic manures on growth and yield of mustard (*Brassica juncea* L.)

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Abstract
A field experiment was conducted during rabi season (Dec 2018-March 19) to study the effect of different organic manures on growth and yield of mustard (*Brassica juncea* L.) at the Research Farm of the Arunachal University of Studies, Namsai. This experiment comprised of 9 treatments and 3 replications and was evaluated in Randomized Block Design. The treatments consisted of two doses of farm yard manure, vermicompost and poultry manure (@ 5 t and 10 t each), a combination of FYM, vermicompost and poultry manure (2 tonnes each), enriched compost (phosphate solublising bacteria, rock phosphate, azotobacter) @ 5 t/ha and an untreated control. The cultivar used was NRCHB101 mustard variety. The study revealed that application of different organic manures exerted significant variations in most of the growth parameters. Better growth and yield parameters in terms of plant height, number of primary branches per plant, days to 50% flowering, siliquae per plant, seeds per siliqua and yield per plot (4 m^2) was observed by application of poultry manure @ 10 t/ha and this was found to be superior among all other treatments. The second-best results were obtained from plants supplied with vemicompost @ 5 t/ha and 10 t/ha.

Keywords: Mustard, organic manures, growth, yield

Introduction
Mustard (*Brassica juncea* L.) is an herbaceous annual plant belonging to the family Brassicaceae is one of the most prominent oil seed crops next to groundnut in India. It is a rabi season crop and thrives well in dry and cool climate. Heavy rainfall, cloudy rainfall, frost and high humidity during flowering and pod formation is harmful to the crop.

Brassica juncea which is the Indian mustard. It is also known by several other names such as brown mustard, Chinese mustard, leaf mustard and vegetable mustard. Mustard oil is one of the major edible oils in India contributing nearly 28.6% of the total oilseed production in the country and it has also got medicinal importance. Oilseeds are important next to food grains in terms of areas, production and value in the agricultural economy of India.

India stood seventh in the world with the total production mustard yield of 1184 kg/ha which is cultivated in an area of 57.62 lakh/ ha (2016). Haryana is the largest producer of rapeseed-mustard with total production of 1594/ha followed by Uttar Pradesh, Haryana, Madhya Pradesh, West Bengal, Gujarat and Assam and Rajasthan stand first with total cultivated area of 25.49 lakh/ha (2016). The other states with minor production are Orissa and Bihar. This crop is grown in Arunachal also.

Organic manures include well rotten farm yard manures, compost, green manures etc., which can supply essential nutrients to plants and organic matter to the soil which helps in improvement of soil structure, aeration, water holding capacity. It also stimulates the activity of beneficial microorganisms which in return provides micro and macro nutrients in the soil. FYM and composts are the decomposed products of agricultural by-products (animals and crops). Whereas green manures are materials which are undecomposed green plant tissues and are susceptible to decomposition after incorporation. Organic manures help to increase in agricultural production without any damage to soil and surrounding environment unlike synthetic fertilizers.

Mustard is a major oil crop grown in Arunachal Pradesh and it is cultivated during rabi seasons. Mustard was cultivated in 27986 ha of land, with a production of 28514 MT and an average yield or productivity of 1.019 t/ha (Dept. of Agriculture, Govt of Arunachal Pradesh, 2018).

Crop management practices, especially application of organic manures profoundly influence the growth and yield of crops. Arunachal Pradesh generally follows organic farming practices. However, in Arunachal Pradesh farmers are not well known about the specific information and recommendations on use of organic manures and doses on performance of mustard, and hence this project is proposed with the objectives -

1) To determine the most suitable kind and dose of organic manures for growth and yield of mustard under Namsai conditions.
2) To study the effect of various organic manures on yield and quality of mustard.

Materials and Methods

The experiment was conducted at the Agriculture Research Field, Arunachal University of Studies, Namsai, and Arunachal Pradesh, India. The present study was carried out during the rabi season 2018-2019. Namsai is located at latitude: 27 degree 30' to 80 degree 45'N, longitude: 95 degree 45' to 96 degree 45' E and altitude: 1380 m above MSL. The soil was medium black in texture (vertisol) and the topography of the experimental field was plain.

The experimental materials comprised of one mustard variety i.e. NRCHB101 and four different organic manures *viz*., Farm yard manure, poultry manure, vermicompost and enriched compost (rock phophate, azotobacter and phosphate solublising bacteria).

The experiment was laid out in Randomized Block Design which consisted of 3 replications and 9 treatments *viz*., T_1: FYM @ 5 t/ha, T_2: FYM @ 10 t/ha, T_3: vc @ 5 t/ha, T_4: vc @ 10 t/ha, T_5 pm @ 5 t/ha, T_6 pm @ 10 t/ha, T_7: fym+vc+pm @ 6 t/ha (2 t each).

The selected field area was ploughed with tractor drawn cultivator. After cross harrowing was done followed by planking to make the field levelled. After levelling, plots were laid out. Pre-sowing irrigation was given. Thereafter, optimum soil moisture was maintained by irrigating the field at regular intervals. Plot size of 2 m×2 m was prepared and spacing 40×15 cm was maintained while line sowing the mustard. All other agronomical operations were performed as per recommendation for the crop. The data on various growth and yield parameters were recorded in different treatments and statistical analysis of the data was carried out as per the globally accepted procedures analysis of variance (ANOVA) with the help of OPSTAT software.

Results and Discussions

Plant height

Observations on plant height recorded at 30, 60 and 90 DAS, and number of primary branches per plant at 60 DAS. Data have shown that growth parameters i.e. plant height and no. of primary branches per plant and days to 50% flowering were significantly influenced by application of different organic manures, this finding have been corroborate by Reza1 *et al.* (2016) [5] on experimentation of cabbage by applying different organic manures.

The effect of farm yard manure, vermicompost, poultry manure, enriched compost (rock phosphate, azotobacter, phosphate solublising bacteria) and control (untreated) on plant height of mustard have been presented in table 01. Significant variation (P=0.05) was observed in plant height (cm) of mustard at 30, 60 and 90 DAS when organic manures were incorporated into the soil. Among the treatments, T_6 (PM @ 10 t ha -1) showed the highest

Plant height at all stages 30, 60 and 90 DAS (8.40, 102.80, 140.07 cm). On the other hand, the lowest plant height was observed in T_1 (FYM @ 5 t ha -1) at all stages 30, 60 and 90 DAS (5.90, 75.40, 101.27 cm), this may be due to the fact that of all organic manures, poultry manures has the highest amount of N, P, K, this was reported by Kareem *et al.* (2017) [6] from their experiment reported that application of poultry manure enhanced plant height.

Number of primary branches plant per plant

Primary branches were observed and recorded at 60 DAS. The Findings presented in Table (1) revealed that there was no significant difference on number of primary branches per plant. The highest no. of primary branches per plant were seen at T_6 (PM @ 10 t/ha) 5.80. This were at par with the treatments T_4 (VC @ 10 t/ha), T_5 (PM @ 5 t/ha) and T_7 (FYM+VC+PM), 4.93, 5.13, 5.13 respectively. The treatment T_9 (control) expressed less no. of primary branches per plant i.e. 4.00, similarly Ilodibi *et al.* (2015) [3] from his experiment also found that poultry manure @ 10 t/ha performed better in most growth and yield parameters compared to other organic treatments.

Table 1: Average plant height at 30, 60, 90 DAS and number of primary branches per plant

Treatments	Plant height (cm)			No. of primary branches/plant
	30 DAS	60 DAS	90 DAS	
T_1 FYM @ 5 t/ ha	5.90	75.40	101.27	4.57
T_2 FYM @ 10/ha	6.20	66.33	103.80	4.73
T_3 VC @ 5 t/ha	8.20	96.80	126.00	4.67
T_4 VC @ 10/ha	7.83	105.07	130.80	4.93
T_5 PM @ 5 t/ha	8.27	92.27	122.93	5.13
T_6 PM @ 10 t/ha	8.40	102.80	140.07	5.80
T_7 FYM+VC+PM @ 6 t/ha	6.60	68.43	101.00	5.13
T_8 Enriched compost @ 5 t/ha	6.00	65.33	108.13	4.53
T_9 Control	6.87	69.20	114.93	4.00
S.Em ±	0.58	6.96	7.03	0.38
CD (P=0.05)	1.73	24.59	21.06	1.14
CV%	14.00	14.28	10.42	13.68

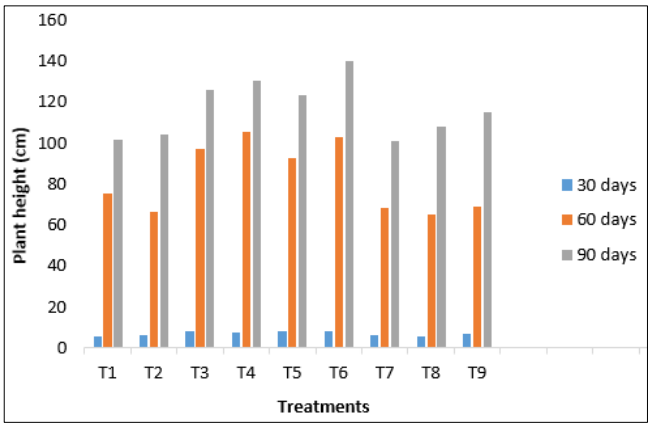

Fig 1: Average plant height under different treatments at 30, 60, 90 DAS

Days to 50% flowering

Treatments that took minimum days to 50% flowering are T_6 (PM @ 10 t /ha), T_5 (PM @ 5 t/ha), T_4 (VC @ 10 t/ha), T_3 (VC @ 5 t/ha) and T_8 (Enriched compost) whereas treatments that required longer days to 50% flowering are T_1 (FYM @ 5 t/ha, T_2 (FYM @ 10 t/ha), T_7 (FYM+VC+FYM @ 2 t/ha each) and T_9 (control).

Heerendra *et al.* (2017) [7] from their experimental studies concluded that, in the development of sustainable agriculture, bio-fertililization and organic manures is of great importance inorder to maintain the soil fertility and prevent further deterioration of nature and environmental pollution. Traditional nutrient management is of great need to increase the nutrient concentration in the soil without causing environmental pollution. Bio-fertilizers combined with organic manure influences the plant growth by enhancing root biomass; total root surface facilitates higher absorption of nutrients and increase in yield by reducing consumption of natural sources of energy. The organic fertilizers have proved that their application has the potential to increase the biomass and productivity of a wide range of crops.

Number of siliquae per plant

Results presented in table (2) shows significant variations in number of siliquae plant per plant under different treatment and doses. Maximum no. of siliqua per plant was reported in T_9 (control) i.e. 115.40, which was at par with T_1 (102.13), T_3 (112.20), T_5 (110.40), T_6 (112.00) and T_8 (101.80) *viz.* FYM @ 5 t/ha, VC 5 t/ha, PM @ 5 t/ha, PM @ 10 t/ha and EC @ 5 t/ha respectively. Minimum no. of siliquae per plant was reported in T_7 (FYM + VC+ PM @ 2 t/ha) 92.60, however treatments that were at par with this are T_4 (95.13) and T_2 (97.07) *viz.* VC @ 10 t/ha and FYM @ 10 t/ha.

Number of seeds per siliqua

The findings represented in table (2) shows that no. of seeds/siliqua varied significantly under different treatments. Maximum no. of seeds/siliqua was reported in T_6 PM @ 10 t/ha i.e. 14.60 and other treatments that are at par with this are T_4 (13.27), T_1 (12.47), T_3 (12.07) and T_2 (12.00), *viz.* VC @ 10 t/ha, FYM @ 5 t/ha, VC @ 5 t/ha and FYM @ 10 t/ha. T_7 resulted significantly minimum no. of seeds per siliqua.

Seed yield per plot

The data presented in table (2) shows that the seed yield was significantly affected by different treatments and hence variation. T_6 (PM @ 10 t/ha) produced maximum seeds per plot i.e. 203.25/g and T_4 (VC 10 t/ha) 170.22 g and T_5 (PM @ 5 t/ha) 183.18 g were found at par with T_6. While T_1 (FYM @ 5 t/ha) 85.80 g resulted in significantly lowest seed yield per plot and this was at par with T_9-control (99.45 g) and T_2 (FYM @ 10 t/ha) 115.20 g.

T_6 (pm @ 10 t/ha) produced highest seed yield per plot (g/4 m^2) i.e.203.25 g, this finding is in line with the results of Sheikh *et al.* (2015) [4] in sorghum, Lim (2016) [2] in mustard and Ahmed *et al.* (2007) [1] in mustard.

Table 2: Average no. of siliquae per plant, seeds per siliqua and yield per plot (4 sqm) under different treatments

Treatments	No. of siliquae/plant	Seeds/siliqua	Yield/plot (g/4 sqm)
T_1 FYM @ 5 t/ha	102.13	12.47	85.80
T_2 FYM @ 10/ha	97.07	12.00	115.20
T_3 VC @ 5 t/ha	112.20	12.07	158.8
T_4 VC @ 10/ha	95.13	13.27	170.22
T_5 PM @ 5 t/ha	110.40	11.80	183.18
T_6 PM @ 10 t/ha	112.00	14.60	203.25
T_7 FYM+VC+PM @ 6 t/ha	92.60	10.07	127.17
T_8 Enriched compost @ 5 t/ha	101.80	11.73	113.67
T_9 control	115.40	11.00	99.45
S.Em ±	10.73	0.96	14.37
CD (P=0.05)	32.17	2.89	43.09
CV%	17.82	13.88	17

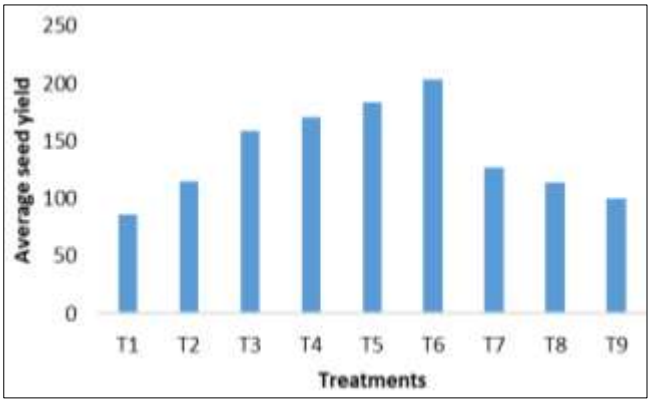

Fig 2: Average seed yield of mustard under different treatments.

Conclusions

Application of T_6 (PM @ 10 t/ha) recorded maximum yield and quality production of mustard. Second best results were obtained from T_4 (VC 10 t/ha) and T_5 (PM @ 5 t/ha). Based on best growth and yield of mustard, poultry manure is best suitable for good production of mustard in Namsai soil condition of Arunachal Pradesh. Application of organic manures not only influenced the growth and yield of mustard but it also helped in enhancing the soil fertility.

Based on the results and conclusions drawn from the research, the following suggestions can be made:

- Further study of even higher levels of organic manures should be carried out.
- These findings are based on experimentation in one field, hence the experiment need to be repeated in different field for drawing the final conclusion and recommendations.

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