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Effect of Organic and inorganic Fertilizers on Growth, Yield and Yield Attributing Traits of Mustard (*Brassica juncea* L.) cv.-Pusa Mustard 21

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ABSTRACT: The present experiment was carried out at research field of Seed Science and Technology in the Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology and Science, Naini Agriculture Institute, Prayagraj (U.P.) during *Rabi* season 2020-2021, in order to standardize the suitable treatment of mustard (Pusa Mustard-21). Two organic manures viz. Farmyard manure and Vermicompost are studied with different doses of NPK, are replicated thrice with thirteen treatment combinations in a Randomized Block Design (RBD). Different fertilizer treatments with control (Unhardened) were evaluated by screening of various doses viz., T_0 – Control, T_1 – FYM 10 t/ha + 25% N:P:K, T_2 – FYM 10 t/ha + 50% N:P:K, T_3 - FYM 10 t/ha + 100% N:P:K, T_4 – Vermicompost 5 t/ha + 25% N:P:K, T_5 – Vermicompost 5 t/ha+ 50% N:P:K, T_6 – Vermicompost 5 t/ha + 100% N:P:K, T_7 – FYM + Vermicompost + 25% N:P:K, T_8 – FYM + Vermicompost + 50% N:P:K, T_9 – FYM + Vermicompost + 100% N:P:K, T_{10} – FYM 10 t/ha, T_{11} – Vermicompost 5 t/ha, T_{12} – DAP (spray) @ 1%. The only chemical fertilizer application is influential elements for yield and quality of mustard seed. So, the amelioration of soil condition and increase yield potentiality by applying combination of organic and inorganic fertilizers rather than only inorganic (chemical) fertilizers. It was concluded that the present study of mustard variety Pusa Mustard 21 treating with FYM + Vermicompost+100% N:P:K enhanced the Field emergence percentage, Plant height (cm), Numbers of branches per plant, Numbers of siliqua per plant, Number of seeds per siliqua, Seed yield per plant (gm), Seed yield per plot (gm), Biological Yield per plot (gm) and Harvest index followed by Vermicompost 5 t/ha + 100% N:P:K and FYM + Vermicompost + 50% N:P:K as compared to control (untreated) seeds. Observed highest germination and yielding parameters in FYM+Vermicompost+100% N:P:K. The economy of different treatment concerned, the treatment T_{12} (DAP Spray @ 1%) provides highest net profit of ₹33380.50 with cost benefit ratio is 1: 2.71 however, the minimum net profit of ₹8412.50 was recorded in the treatment T_7 (FYM + Vermicompost + 25% N:P:K) with cost benefit ratio is 1:1.21. This research elucidates the efficacy of different fertilizers' (organic and inorganic) application on growth attributes, yield potential, and oil quality of mustard and encourages farmers to adopt the combined application of manures and fertilizers to decrease the dependence on inorganic fertilizers.

Keywords: Mustard seeds, FYM, N:P:K, Vermicompost, DAP, C:B Ratio, germination and seed yield.

INTRODUCTION

Oilseeds, the second largest agricultural commodity after cereals in India, play a significant role in India's agrarian economy, sharing 14% of the gross cropped area and accounting for nearly 1.5% of the gross national production and 8% of the value of all agricultural products. A range of oilseed crops viz. groundnut, rapeseed and mustard, soybean, sesame, sunflower, safflower and niger (edible) and linseed and castor (non-edible) are cultivated in the country (Hegde and Sudhakara, 2011). In *Brassica* sp. mustard is important edible oil next to groundnut. Its oil is used often for cooking and rapeseed mustard also valued for vegetable, condiments, fodder and medicinal purposes for remedy against stomach and skin disease etc.

Mustard [*Brassica juncea* L. (Czern & coss)] a member of *Brassicaceae* family and an important oil seed crop of the world. *Brassica juncea* (2n=36) is an amphidiploid species derived from interspecific cross between *Brassica nigra* (2n=18) and *B. rapa* (2n=20). *Brassica juncea* is a kind of cruciferae *brassica* annual herbaceous plant, which originated from spontaneous hybridization of the ancestors of B. rapa (AA, n=10) and B.nigra (BB, n=8) (Wang *et al.*, 2006). Mustard is an important Rabi season oilseed crop. Mustard seed is the world's second leading source of vegetable oil, after soybean. It is also the second most leading source of protein meal in the world after soybean. Population of India is increasing rapidly and consequently edible oil demand is also going up day by day. It is mainly grown in northern part of India, Rajasthan is the largest producing state followed by Uttar Pradesh (Sodani *et al.*, 2017).

Globally, India account for 21.7% and 10.7% of the total acreage and production. In India rapeseed and mustard is grown in an area of 5.76 M ha with

production and productivity of 6.8 MT and 1184 Kg/ha, respectively **(**Anonymous, 2016). Indian mustard [*Brassica juncea* L. (Czern & coss)] a member of *Brassicaceae* family and an important oil seed crop of the world. Indian mustard (*Brassica juncea* L.) commonly known as raya, rai or laha is an important oilseed crop. Among the *brassica* group of oilseed crops in India, it possesses a higher potential of production per unit area than other members of family crucifer. Mustard is an important Rabi season oilseed crop. Mustard is an economically important plant that has been well-known in India for centuries for its medicinal and nutritive values (Parikh and Khanna, 2014).

Mustard seeds (*Brassica juncea*) nutrition value per l00 gram. Energy 508 Kcal, Carbohydrates 28.09 g, Protein 26.08 g, Total Fat 36.24 g, Cholesterol 0 mg, Dietary Fiber 12.2 g, Vitamins Folates 162 meg, Niacin 4.733 mg, Pantothenic acid 0.810 mg, Pyridoxine 0.397 mg, Riboflavin 0.261 mg, Thiamin 0.805 mg, Vitamin A 31 IU, Vitamin C 7.1 mg, Vitamin E-y 19.82 mg, Vitamin K 5.4 meg, Electrolytes Sodium 13 mg, Potassium 738 mg, Minerals Calcium 266 mg, Copper 0.645 mg, Iron 9.21 mg, Magnesium 370 mg, Manganese 2.448 mg, Selenium 208.1 meg, Zinc 6.08 mg, Phyto-nutrients Carotene-B 18 meg, Crypto-xanthin-13 0 meg, Lutein-zeaxanthin 508 meg. (USDA National Nutrient data base, 2016).

The low productivity in oilseed is due to the reason that oilseed are grown mostly in marginal and rainfed areas. The main constraint in raising the productivity levels of oilseed in dry lands are inadequate soil moisture and poor fertility status of the soil. To overcome the adverse environmental conditions like low rainfall and low soil moisture which prevent the germination and establishment of seedlings, seed hardening is given as a pre-sowing treatment. Short term hydration of seeds before planting greatly benefits stand establishment but use of chemicals like potassium or sodium phosphate would give additional advantage. Seed priming/ hardening is a common practice followed to enhance seed performance with respect to rate and uniformity of germination (Hossain *et al.,* 2005).

The nutrient management is one of the most important agronomic factors that affect the Indian mustard reported by Hadiyal *et al.,* (2017). But application of all the needed fertilizer through chemical fertilizers had deleterious effect of soil fertility, unsustainable yields. While integration with organic manures and bio-fertilizers would be able to maintain soil fertility and sustain crop productivity. Organic manures are also enhance the activity of soil in improving the physical and nutritional system of soil and also enhance the activity of soil micro flora.

Paraye *et al.,* (2009) found that the application of 30 kg N + 5 t FYM ha^{-1} resulted in a higher seed yield of Indian mustard than 30, 60 and 90 kg N ha^{-1}. Further, they have reported that increase in seed yield due to the combined application of N and FYM might be attributed to the improvement in all yield attributes, particularly the number of siliquae per plant.

A field experiment conducted during rabi seasons of 2004-05 and 2005-06 (Singh *et al.,* 2008) and found that application of 100% recommended dose of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} + seed treatment with Azotobacter @ 10g kg" 1 seed increased the seed weight (36.02%) and seed yield (50.1 %) over recommended dose of fertilizers. They also reported that integrated use of recommended fertilizers with organic and biological sources of nutrients significantly increased the plant height, branches per plant, number of siliquae per plant and seed weight per plant and seed yield of mustard.

Application of vermicompost and farm yard manure improves soil health by improving nutrient availability, water holding capacity (WHC), soil physical properties and microbial activity. Bio-fertilizers have the potential to solubilize/mobilize major nutrients such as nitrogen and phosphorus in addition to micro nutrients and thus act as nutrient flow regulator in nature (Meena *et al.,* (2013).

Research gap: Mustard crop showed have high erucic acid and low yield potentiality on farmers field, because of applying improper balance of inorganic fertilizers. So, increase yield potentiality by applying combination of organic and inorganic fertilizers rather than only inorganic (chemical) fertilizers. This research is useful for farmers to adopt the combined application of manures and fertilizers to decrease the dependence on inorganic fertilizers and increase growth and yield of mustard seed. This innovative and new researches on eco-region suited fertilizer treatment identification, improved crop and soil management, on agro-meteorology and crop modeling are suggested as priorities for future research to uplift the productivity and reduce yield gaps of mustard crops in Prayagraj district of Uttar Pradesh.

Hence, the present study was planned to determine the Effect of organic and inorganic fertilizers on growth, yield and yield attributing traits of Mustard cv.-Pusa Mustard 21.

MATERIAL AND METHODS

The present investigation was carried using genetically pure seeds of Mustard (variety: Pusa Mustard 21). The experiment was conducted in Field Experimentation Centre, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). After cleaning and grading, the seeds were place in field and apply organic and inorganic treatments.

Preparation of solutions: Full Dose of fertilizers (100% RDF):

FYM – 10 ton/ha
Vermicompost – 5 ton/ha
N: P: K – 40:50:50 kg/ha

Half Dose of fertilizers (50% RDF):-

FYM – 5 ton/ha
Vermicompost – 2.5 ton/ha
N: P: K – 20:25:25 kg/ha

Quarter Dose of fertilizers (25% RDF):-

FYM – 2.5 ton/ha
Vermicompost – 1.25 ton/ha
N: P: K – 10:12.5:12.5 kg/ha

For the preparation of solution of DAP, 10 gram DAP were taken in a beaker. The chemical were added in 1000 ml. of distilled water with constant stirring. The volume of solution will finally constitute to one litter, and then it became 1% stock solution of DAP chemical. The flasks containing chemicals were covered with muslin cloth to avoid any contamination. The chemical poured in knapsack sprayer and spraying on plants.

Design: Randomized Block Design (RBD) Panse and Sukhatme, (1967) with three replications. Observations on Field viz., Field emergence, Plant height, and yielding attributes were worked out and the data were statistically analyzed using ANOVA.

Field Experiment:

Field emergence (%): One hundred seeds from each treatment in three replications were used for field emergence studies. The seeds were sown in well prepared at 3 cm deep. The field emergence count was taken on the 4^{th}, $7^{th,}$ and 10^{th} day after sowing, and the emergence percentage was calculated taking into account the number of seedlings that emerged three centimeters above the soil surface (Kotowski, 1926).

Field emergence (%) =

$$\frac{\text{No. of seedling emerged on 4th, 7th \& 10th day}}{\text{Total no. of seeds sown}} \times 100$$

Plant height (cm): It was measured from ground level to the base of the topmost fully opened leaf at the physiological (harvest) stage. The average height of five plants was recorded in centimeters.

Number of branches per plant: The total numbers of branches from five randomly selected plants were counted manually from each treatment.

Days to 50% flowering: It will measure from DAS to half flowering, in which observe select five plants in a plot and check flowering status when 50 % flower open in field.

Days to maturity: The days taken from sowing to the end of pod maturity in each of the treatment were recorded and mean number of days to maturity were calculated.

Number of siliquae per plant: The total numbers of siliquae (inflorescence) from five randomly selected plants were counted manually from each treatment.

Number of seeds per siliquae: The total numbers of seeds per siliquae from five randomly selected plants were counted manually from each treatment.

Seed yield per plant (g): The seed weights of five randomly select plants were recorded for each plot.

Seed yield per plot (g): The seed weights of total plants were recorded for each plot.

Biological yield/plot (g): The biological yield refers to the total dry matter accumulation of a plant system. The biological yield of total plants was recorded for each plot.

Harvest index (%): For grain crops, the harvest index (HI) is the ratio of harvested grain to total shoot dry matter, and this can be used as a measure of reproductive efficiency. The HI of five randomly select plants was recorded for each plot.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

RESULT AND DISCUSSION

According to the results, all studied traits were affected by the treatments and there was a completely significant difference between control (untreated) and treated seeds in Table 1 and 2. The B:C ratio dedicated in Table 3.

Analysis of variance: The analysis of variance for growth and seed yield characters was presented in Table 1. Analysis of variance revealed that the differences among thirteen treatments were significant for growth and yield, *viz.*, field emergence percentage, plant height, number of branches per plant, days to 50% flowering, days to maturity, number of siliquae per plant, number of seeds per siliquae, seed yield per plant, seed yield per plot, biological yield, harvest index and oil yield.

Mean performance: Mean value is defined by the ratio of the sum of the observations to the total number of observations. On other hand, the range is the simplest measurement in mathematical calculation and simple to understand. It avoids variation of overall data and depends only on extreme values. The data presented in Table 1 and 2 shows the mean performance of 13 treatments for 12 growths, yield, and yielding attributes. The grand mean for all the traits is also depicted in Table 1 and 2.

Table 1: Analysis of variance for 11 growths and yield attributes in mustard.

Sr. No.	Characters	Mean sum of square		
		Replications (df=2)	Treatments (df=12)	Error (df=24)
1.	Field emergence percentage	8.10	20.69*	4.77
2.	Plant height at 90 DAS (cm)	0.27	322.95*	4.45
3.	Number of branches per plant	0.21	1.52*	0.08
4.	Days to 50% flowering	1.62	7.67*	1.20
5.	Days to maturity	1.72	21.41*	2.30
6.	Number of siliquae per plant	7.58	132.65*	14.41
7.	Number of seeds per siliquae	0.04	4.04*	0.16
8.	Seed yield per plant (g)	0.07	0.60*	0.02
9.	Seed yield per plot (g)	3.17	152.38*	19.06
10.	Biological yield (g)	362.95	988.19*	452.24
11.	Harvest index (%)	8.26	8.48*	3.44

* Significant at 5% level of significance.

Integrated nutrient management with FYM + Vermicompost + 100% N:P:K recorded maximum percentage of field emergence (93.00%) was recorded by and it was followed by Vermicompost 5 t/ha + 100% N:P:K (91.67%) and FYM + Vermicompost + 50% N:P:K (90.33%) where found to be lowest in control (84.67%). The interaction effect of different fertilizer treatments on field emergence percentage was found to be significant and similar finding observed by Shukla *et al.,* (2002); Chaturvedi *et al.,* (1988); Bhat *et al.,* (2005).

Maximum height of plant (143.40 cm) was recorded by FYM + Vermicompost + 100% N:P:K and it was followed by FYM + Vermicompost + 50% N:P:K (141.65 cm) and Vermicompost 5 t/ha + 100% N:P:K (139.59 cm) where unprimed was of lowest plant height (111.12 cm). The interaction effect of different fertilizer treatments on plant height was found to be significant and similar finding observed by Singh *et al.,* (2011); Selvam and Bheemaiah (2001); Imkongtoshi and Gohain (2009); Jaleel *et al.,* (2007).

Number of branches per plant (5.63) was recorded highest in Vermicompost 5 t/ha + 100% N:P:K and it was followed by FYM + Vermicompost + 100% N:P:K (5.50) and FYM + Vermicompost + 50% N:P:K (5.37) were found to be lowest in control (3.50). The interaction effect of different fertilizer treatments on number of branches per plant was found to be significant and similar finding observed by Thakur *et al.,* (2009); Latha and Nadanassababady, (2003); Chand, (2007).

Days to 50% flowering (39.00) was recorded minimum by FYM + Vermicompost + 100% N:P:K and it was followed by Vermicompost 5 t/ha + 100% N:P:K (40.00) and Vermicompost 5 t/ha (40.67) where found to be maximum in control (44.67).The interaction effect of different fertilizer treatments on days to 50% flowering was found to be significant and similar finding observed by Kandpal, (2001); Rajkhowa *et al.,* (2002); Jaishankar and Wahah (2005); Singh *et al.,* (2008).

The direct benefits of seed priming in all crops included: faster emergence, better, more and uniform stands, less need to re-sow, more vigorous plants, better drought tolerance, earlier flowering, earlier harvest and higher grain yield. The indirect benefits reported were: earlier sowing of crops, earlier harvesting of crops and increased willingness to use of fertilizer because of reduce risk of crop failure. Park *et al*., (1997) reported that priming aged seeds of soybean resulted in good germination and stand establishment in the field trials.

Days to maturity (122.00) was recorded minimum by FYM + Vermicompost + 100% N:P:K and it was followed by Vermicompost 5 t/ha + 100% N:P:K (123.67) and FYM + Vermicompost + 50% N:P:K (124.33) where found to be maximum in control (130.33). The interaction effect of different fertilizer treatments on days to maturity was found to be significant and similar finding observed by Bhat *et al.,* (2007); Mandal and Sinha (2002); Latha; Nadanassababady, (2003).

Number of siliquae per plant (61.73) was observed highest in fertilizer treatments with FYM + Vermicompost + 100% N:P:K and it was followed by Vermicompost 5 t/ha + 100% N:P:K (59.27) and FYM + Vermicompost + 50% N:P:K (56.40) where found to be lowest in control (41.00). The interaction effect of different fertilizer treatments on number of siliquae per plant was found to be significant and similar finding observed by Kumar *et al.,* (2001); Tigga *et al.,* (2004); Nazir *et al.,* (2011); Chaturvedi *et al.,* (1988).

Table 2: Mean performance of mustard for 4 germination and growth parameters (pre-harvest).

Sr. No.	Treatments	Field Emergence percentage	Plant height at 90 DAS (cm)	Number of branches per plant	Days to 50% flowering
1.	T_0	84.67	111.12	3.50	44.67
2.	T_1	85.33	112.04	3.70	44.00
3.	T_2	87.00	114.28	4.37	42.33
4.	T_3	89.00	117.60	3.83	41.33
5.	T_4	86.33	121.67	4.13	43.00
6.	T_5	86.00	123.15	4.03	42.67
7.	T_6	91.67	127.59	5.63	40.00
8	T_7	88.33	125.34	4.80	42.00
9.	T_8	90.33	127.65	5.37	41.00
10.	T_9	93.00	130.40	5.50	39.00
11.	T_{10}	88.00	129.02	4.63	42.00
12.	T_{11}	89.67	126.52	4.83	40.67
13.	T_{12}	85.00	117.79	5.17	43.33
Grand Mean		88.03		121.85	42.00
C.D. (5%)		3.68		2.76	1.85
SE (m)		1.26		0.89	0.63
SE (d)		1.78		1.26	0.89
C.V.		2.48		1.04	2.61

Number of seeds per siliquae (12.37) was observed highest in fertilizer treatments with FYM + Vermicompost + 50% N:P:K and it was followed by FYM + Vermicompost + 100% N:P:K (12.23) and Vermicompost 5 t/ha + 100% N:P:K (12.10) where found to be lowest in control (8.70).

The interaction effect of different fertilizer treatments on number of seeds per siliquae was found to be significant and similar finding observed by Yadav, (2005); Akbari *et al.,* (2010); Chaudhary *et al.,* (2008); Tripathi *et al.,* (2010).

Observed maximum seed yield per plant (2.77 g) was Vermicompost + 100% N:P:K and it was followed by Vermicompost 5 t/ha + 100% N:P:K (2.60 gm) and FYM + Vermicompost + 50% N:P:K (2.48 gm) where unprimed was of lowest seed yield per plant (1.36 g). Seed yield per plot (56.58 g) was found to be highest in fertilizer treatments with FYM + Vermicompost + 100% N:P:K and it was followed by Vermicompost 5 t/ha + 100% N:P:K (52.45 gm) and FYM + Vermicompost + 50% N:P:K (47.28 gm) where lowest in control (33.45 g). Seed treatment is a useful practice for healthy plant growth. The combination of fertilizer treatments accelerated the crop performance by enhancing seed yield and oil yield in which best perform FYM + Vermicompost + 100% N:P:K. The interaction effect of different fertilizer treatments on seed yield was found to be significant and similar finding observed by Premi *et al.,* (2005); Singh and Singh, (2006); Dixit *et al.,* (2008); Kashved *et al.,* (2010) and Hadiyal *et al., (*2017).

Biological yield (226.58 g) was observed highest in fertilizer treatments with FYM + Vermicompost + 100% N:P:K and it was followed by Vermicompost 5 t/ha + 100% N:P:K (225.87 gm) and FYM + Vermicompost + 50% N:P:K (210.04 gm) where found to be lowest in control (175.75 g). The interaction effect of different fertilizer treatments on biological yield was found to be significant and similar finding observed by Ramesh *et al.,* (2009); Shankar *et al.,* (2002); Premi *et al.,* (2005) and Munda *et al.,* (2008).

Maximum harvest index (25.06%) was observed in fertilizer treatments with FYM + Vermicompost + 100% N:P:K and it was followed by Vermicompost 5 t/ha + 100% N:P:K (23.17%) and FYM + Vermicompost + 50% N:P:K (22.58%) where unprimed was of lowest harvest index (19.05%). INM enhance germination due to their metabolic reaction, timely germination and uniform seedling indicates higher yield and seed yield always correlated with harvest index. The interaction effect of different fertilizer treatments on harvest index was found to be significant and similar finding observed by Singh and Pal, (2011); Nagdive *et al.,* (2007); Hegde *et al.,* (2011) and Shankar *et al.,* (2002).

Maximum Oil yield (1.98) was observed in fertilizer treatments with FYM + Vermicompost + 100% N:P:K and it was followed by Vermicompost 5 t/ha + 100% N:P:K (1.96) and FYM + Vermicompost + 50% N:P:K (1.89) where unprimed was of lowest oil yield (1.05). The interaction effect of different fertilizer treatments on harvest index was found to be significant and similar finding observed by Rao, (2003); Kashved *et al.,* (2010); Hegde *et al.,* (2011); Law-Ogbomo and Egharevba (2009).

B:C Ratio: Selling price of Mustard (Seed yield) = 4650₹/ q

According to following table: The economy of different treatment concerned, the treatment (vermicompost @5 t/ha) provides highest net profit of ₹51660.00with cost benefit ratio is 1: 1.76 however, the minimum net profit of ₹43055.00was recorded in the treatment FYM + Vermicompost + 50% N:P:K with cost benefit ratio is 1:1.08.

Table 3: Mean performance of mustard for 8 yield and yielding attributes (post-harvest).

Sr. No.	Treatments	Days to maturity	Number of siliquae per plant	Number of seeds per siliquae	Seed yield per plant (g)	Seed yield per plot (g)	Biological yield (g)	Harvest index (%)	Oil yield (Q/ha)
1.	T_0	130.33	41.00	8.70	1.36	33.45	175.75	19.05	1.05
2.	T_1	130.00	42.13	9.83	1.49	34.66	176.16	19.78	1.13
3.	T_2	129.33	46.03	10.87	2.07	38.70	185.09	21.00	1.52
4.	T_3	127.00	45.00	10.20	1.54	35.06	183.34	19.21	1.16
5.	T_4	129.67	43.77	9.17	1.65	36.17	175.80	20.54	1.24
6.	T_5	129.00	46.93	10.57	1.79	37.04	182.53	20.32	1.59
7.	T_6	123.67	59.27	12.10	2.60	52.45	225.87	23.17	1.96
8.	T_7	128.00	49.03	11.27	2.14	41.20	193.56	21.30	1.33
9.	T_8	124.33	56.40	12.37	2.48	47.28	210.04	22.58	1.89
10.	T_9	122.00	61.73	12.23	2.77	56.58	226.58	25.06	1.98
11.	T_{10}	127.67	50.20	11.07	2.23	42.36	194.79	21.99	1.70
12.	T_{11}	126.33	55.13	11.50	1.95	39.72	182.87	21.83	1.57
13.	T_{12}	125.00	52.63	11.73	2.35	45.46	207.64	22.07	1.76
Grand Mean		127.10	49.94	10.89	2.03	41.55	193.85	21.38	1.53
C.D. (5%)		2.56	6.40	0.68	0.26	7.36	35.84	3.12	0.04
SE (m)		0.88	2.19	0.23	0.09	2.52	12.28	1.07	0.01
SE (d)		1.24	3.10	0.33	0.13	3.56	17.36	1.51	0.02
C.V.		1.19	7.60	3.68	7.64	10.51	10.97	8.67	1.43

Table 4: Effect of different cost benefit ratio (C: B) of Different Treatment Combination with Mustard crop.

Treatment	Yield (q ha^{-1})	Yield (₹/ q)	Gross return (₹ ha^{-1})	Total cost of cultivation (₹ ha^{-1})	Net profit (₹ ha^{-1})	Cost benefit ratio (C:B)
T_0	15.4	4650.00	71610	22504.23	49105.7	1:2.18
T_1	15.6	4650.00	72540	29482.5	43057.5	1:1.46
T_2	15.8	4650.00	73470	29715	43755	1:1.47
T_3	16.3	4650.00	75795	30180	45615	1:1.51
T_4	16.7	4650.00	77655	29482.5	48172.5	1:1.63
T_5	16.9	4650.00	78585	29715	48870	1:1.64
T_6	17.1	4650.00	79515	30180	49335	1:1:63
T_7	17.6	4650.00	81840	39482.5	42357.5	1:1.07
T_8	17.8	4650.00	82770	39715	43055	1:1.08
T_9	18.9	4650.00	87885	40180	47705	1:1.18
T_{10}	17.2	4650.00	79980	29250	50730	1:1.73
T_{11}	17.4	4650.00	80910	29250	51660	1:1.76
T_{12}	15.2	4650.00	70680	19490	51190	1:2.62

SUMMARY

Field emergence, plant height, yield and yielding attributes Significant differences in all the field observations were observed due to environmental effect on different treatment of mustard. Significantly maximum percentage of field emergence (93.00%) was recorded by T_9 – FYM + Vermicompost + 100% N:P:K and it was followed by T_6 – Vermicompost 5 t/ha + 100% N:P:K (91.67%) and found to be lowest in T_0 – Control (84.67%). Plant height observed highest in T_9 – FYM + Vermicompost + 100% N:P:K (143.40 cm)followed by T_8 – FYM + Vermicompost + 50% N:P:K (141.65 cm) and found to be lowest in T_0 – Control (111.12 cm).Number of branches per plant observed highest in T_6 – Vermicompost 5 t/ha + 100% N:P:K (5.63) followed by T_9 – FYM + Vermicompost + 100% N:P:K (5.50) and found to be lowest in T_0 – Control (3.50). Days to 50% flowering observed highest in T_9 – FYM + Vermicompost + 100% N:P:K (39.00) followed by T_6 – Vermicompost 5 t/ha + 100% N:P:K (40.00) and found to be lowest in T_0 – Control (44.67). Days to maturity observed highest in T_9 – FYM + Vermicompost + 100% N:P:K(122) followed by T_6 – Vermicompost 5 T/ha + 100% N:P:K (123.67) and found to be lowest in T_0 – Control (130.33).Number of siliquae per plant observed highest in T_9 – FYM + Vermicompost + 100% N:P:K (61.73) followed by T_6 – Vermicompost 5 t/ha + 100% N:P:K (59.27) and found to be lowest in T_0 – Control (41.00). Number of seeds per siliquae observed highest in T_8 – FYM + Vermicompost + 50% N:P:K (12.37) followed by T_9 – FYM + Vermicompost + 100% N:P:K (12.23) and found to be lowest in T_0 – Control (8.70). Seed yield per plant observed highest in T_9 – FYM + Vermicompost + 100% N:P:K (2.77 gm) followed by T_6 – Vermicompost 5 t/ha + 100% N:P:K (2.60 gm) and found to be lowest in T_0 – Control (1.36 gm). Seed yield per plot observed highest in T_9 – FYM + Vermicompost + 100% N:P:K (56.58 gm) followed by T_6 – Vermicompost 5 t/ha + 100% N:P:K (52.45 gm) and found to be lowest in T_0 – Control (33.45 gm).
Biological yield observed highest in T_9 – FYM + Vermicompost + 100% N:P:K (226.58 gm) followed by T_6 – Vermicompost 5 T/ha + 100% N:P:K (225.87 gm) and found to be lowest in T_0 – Control (175.75 gm). Harvest index observed highest in T_9 – FYM + Vermicompost + 100% N:P:K (25.06%) followed by T_6 – Vermicompost 5 t/ha + 100% N:P:K (23.17%) and found to be lowest in T_0 – Control (19.05%).Oil yield observed highest in T_9 – FYM + Vermicompost + 100% N:P:K (1.98) followed by T_6 – Vermicompost 5 t/ha + 100% N:P:K (1.96) and found to be lowest in T_0 – Control (1.05).

CONCLUSION

Integrated Nutrient Management is the process to maintain the soil fertility and plant nutrient supply at an optimum level through optimization by the benefits of all possible sources of nutrients like inorganic, organic and bio-fertilizers. The only chemical fertilizer application is influential elements for yield and quality of mustard seed. So, the amelioration of soil condition and increase yield potentiality by applying combination of organic and inorganic fertilizers rather than only inorganic (chemical) fertilizers.It is concluded from the present study that the seeds of mustard variety Pusa Mustard 21 treating with FYM + Vermicompost + 100% N:P:K enhanced the Field emergence percentage, Plant height (cm), Numbers of branhes per plant, Numbers of siliqua per plant, Number of seeds per siliqua, Seed yield per plant (gm), Seed yield per plot (gm), Biological Yield per plot (gm) and Harvest index followed by Vermicompost 5 t/ha + 100% N:P:K and FYM + Vermicompost + 50% N:P:K as compared to control (untreated) seeds.
The cost of cultivation of Mustard (*Brassica juncea* L.) Var. Pusa mustard-21 per hectare, Gross Return, Net Profit and Benefit Cost Ratio has also been worked out. All the parameters of cost of cultivation found to be highest in Vermjcompost @ 5t/ha, given are as: Total Cost of Cultivation (₹ha^{-1}) was 51660.00 the Total

Gross Return (₹ha^{-1}) was 52870.50 and Total Net Profit (₹ha^{-1}) was 33380.50, Total Benefit Cost Ratio was found 1: 1.08.

These conclusions are based on the results of six months investigation and therefore further investigation is needed to arrive at valid recommendations.This research elucidates the efficacy of different fertilizers' (organic and inorganic) application on growth attributes, yield potential, and oil quality of mustard and encourages farmers to adopt the combined application of manures and fertilizers to decrease the dependence on inorganic fertilizers.

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REFERENCES

Akbari, K. N., Sutaria, G. S., Vora, V. D., Hirpara, D. S., & Padmani, D. R. (2010). Response of oilseed crops to enriched vermicompost on Verticustochrept under rainfed conditions. An *Asian Journal of Soil Science, 5*: 172-174.

Anonymous (2016). Agriculture statistics at a glance, pp 124-125.

Bhat, M. A., Singh, R., & Dash, D. (2005). Effect of integrated nutrient management on uptake and use efficiency of nitrogen and sulphur in Indian mustard *(Brassica juncea* L.) on an Inceptisol. *Crop Res.* (Hisar), *30*(1): 23-25.

Bhat, M. A., Singh, R., & Kohli, A. (2007). Effect of integrated use of farmyard manure and fertilizer nitrogen with and without sulphur on yield and quality of Indian mustard (*Brassica juncea* L.). *Journal of the Indian Society of Soil Science*, *55*(2): 224-226.

Chand, S. (2007). Effect of integrated nutrient management on yield and nutrient use efficiency in mustard (*Brassica juncea* L.). *SAARC Journal of Agriculture*, *5*(2), 93-100.

Chaturvedi, G. S. S. Singh, B. B. Prasad, R. Chauhan, Y. S., & Padmakar (1988). "Physiological analysis of yield in Indian mustrd (*Brassica juncea* L.) under irrigated condition". *Indian Journal of Plant Physiology, 31*(1): 38-44.

Chaudhary, H. P., Singh, Yogesh & Uttam, S. K. (2008). Effect of nutrient management and moisture conservation practices on growth and yield of rainfed mustard on eroded soils. *Indian Agriculturist, 52*(1/2): 53-56.

Dixit P. M., Elamathi, S., Kishor K. Z., & Neeta C. (2008). Effect of foliar application of nutrients and NAA in mungbean. *J. Food Legume, 21*: 277-278.

Parikh, H., & Khanna, A. (2014). Pharmacognosy and Phytochemical Analysis of *Brassica juncea* Seeds. *Pharmacognosy Journal*, *6*(5): 47-54.

Hadiyal J. G., Kachhadiya S. P., Ichchhuda P. K., & Kalsaria R. N. (2017). Response of Indian mustard (*Brassica juncea* L.) to different levels of organic manures and bio-fertilizers. *Journal of Pharmacognosy and Phytochemistry, 6*(4): 873-875.

Hegde, D. M., & Sudhakara, S. N. (2011). Nutrient management strategies for oilseed crops under rainfed condition. *Indian Journal of Fertilizers, 7*(4): 30-46.

Hossain, M. A., Arefin, M. K., Khan B. M., & Rahman M. A. (2005). Effects of Seed Treatments on Germination and Seedling Growth Attributes of Horitaki (*Terminaliachebula* Retz.) in the nursery. *Research Journal of Agriculture and Biological Sciences, 1*(2): 135-141.

Imkongtoshi & Gohain, T. (2009). Integrated nutrient management in soybean (*Glycine max* L.) under terrace cultivation of Nagaland. *Crop Res.* (Hisar). 38: (1/3): 39-42.

Jaishankar, S., & Wahab, K. (2005). Effect of integrated nutrient management on the growth, yield components and yield of sesame. *Sesame and safflower Newsletter, 20:* unpaginated.

Jaleel, C.A., Manivannan, P., Sankar, B., Kishorekumar, A., & Gopi, R. (2007). Water deficit stress mitigation by calcium chloride in *Catharanthus roseus*: Effects on oxidative stress, proline metabolism and indole alkaloid accumulation. Colloids Surf B 60: 110-116.

Kandpal, B. K. (2001). Integrated nutrient management in relation to growth, yield and quality of Brassica carinata A. Braun and its residual effect on succeeding rice. Ph.D Thesis, G.B.P.U.A & T, Pantnagar.

Kashved, S. M.; Raskar, B. S., & Tamboli, B. D. (2010). Effect of integrated nutrient management and irrigation regimes on productivity of mustard (*Brassica juncea* L.). *Journal of Maharashtra Agricultural Universities, 35*(3): 349-353.

Kotowski, F. (1926). Temperature re- Rep. for period April 1963-March lations to germination of vegetable 1964. Submitted to U.S.D.A. 100 p. seeds. Proc. *Amer. Sot. Hort. Sci., 23*: 176-184.

Kumar, S., Singh, B., & Rajput, A. L. (2001). Response of Indian mustard (*Brassica juncea*) to source and level of sulphur. *Indian Journal of Agronomy*, *46*(3): 528-532.

Latha, M. R., & Nadanassababady, T. (2003). Foliar nutrition in crops–A review. *Agricultural Reviews*, *24*(3), 229-234.

Law-Ogbomo K.E., & Egharevba R. K. A. (2009). Effects of planting density and NPK fertilizer application on yield and yield components of tomato (*Lycopersicon esculentum* Mill) in forest location. *World Journal of Agricultural Science, 5*(2): 152-158.

Mandal, K. G., & Sinha, A. C. (2002). Effect of integrated nutrient management on growth, yield, oil content and nutrient uptake of Indian mustard (*Brassica juncea)* in foothills soils of eastern India. *Indian J. Agron., 47*(1): 109-113.

Meena, D. S., Tetarwal, J. P., & Ram, B. (2013). Effect of chemical and bio-fertilizers on productivity, profitability and quality of Indian mustard (*Brassica juncea*) in Vertisols. *Indian journal of Agronomy*, *58*(1): 96-99.

Munda, G. C., Islam, M., Panda, B. B., & Patel, D. P. (2008). Performance of rice (*Oryza sativa* L.)-rapeseed (*Brassica campestris* L.) cropping sequence under system based nutrient management. *ORYZA-An International Journal on Rice*, *45*(1): 36-39.

Nazir, H., Mohammad M., & Rehana H. K. (2011). Response of nitrogen and phosphorus on growth and yield attributes of blackgram (*Vigna mungo* L.). *Res. J. Agric. Sci., 2*: 334-336.

Panse, V. G., & Sukhatme, P. V. (1954). Statistical methods for agricultural workers. *Statistical methods for agricultural workers.*

Paraye, P. M., Kashyap, T. L., & Chaubey, A. K. (2009). Effect of nutrient management practices and row spacing on growth, yield attributes and yield of Indian mustard (*Brassica juncea* L.). *Environment and Ecology, 27*: (2), 589-591.

Premi, O. P., Sinsinwar, R. S., Kumar, M., & Kumar, A. (2005). Influence of organics and inorganics on yield and quality of Indian mustard, (*Brassica Juncea* (L.) Czern & Coss) in semi-arid region. *Rajastan J. Oilseeds. Res., 22*(1): 45-46.

Rajkhowa, D. J., Saikia, M., & Rajkhowa, K. M. (2002). Effect of vermicompost with and without fertilizer on Greengram. *Legume Research-An International Journal*, *25*(4): 295-296.

Ramesh, P., Panwar, N. R., Singh, A. B., & Ramana, S. (2009). Effect of organic nutrient management practices on the production potential nutrient uptake, soil quality, input use efficiency and economics of mustard (*Brassica juncea*). *Indian Journal of Agricultural Sciences, 79* (1): 40-44.

Rao, S. S. (2003). Nutrient balance and economics of integrated nutrient management in groundnut (*Arachis hypogeae* L.) mustard (*Brassia junceal*). *Madras Agriculture Journal, 90(*7-9): 465-471.

Sodani, R., Seema, R. K. S., Gupta, S., Gupta, N., Chauhan, K. S., & Chauhan, J. (2017). Performance of Yield and Yield Attributes of Ten Indian Mustard (*Brassica juncea* L.) Genotypes under Drought Stress. *International Journal of pure & Applied Bioscience*, *5*(3): 467-476.

Selvam, Panneer & Bheemaiah, G. (2001). Effect of integrated nutrient managetment practices on productivity, nutrient uptake and economics of sunflower intercropped wih Azadirachtaindica and Meliaazadirachta trees. *J. Oilseed Res., 22*: (1), 231-234.

Shankar, Gauri, Verma, L. P. & Singh, Room (2002). Effect of integrated nutrient management on yield and quality of Indian mustard *(Brassica juncea)* and properties of soil. *Indian J. Agric. Sci., 72*(9): 551-552.

Shukla, R. K., Kumar, A., Mahapatra, B. S. & Kandpal, B. (2002). Integrated nutrient management practices in relation to morphological and physiological determinants of seed yield in Indian mustard (*Brassica juncea*). *Indian J. Agric. Sci., 72* : 670-72.

Singh, A. B., Saha, J. K., & Ghosh, P. K. (2008). Effect of nutrient management practices on soybean *(Glycine max)* - chickpea *(Cicer arietinum)* cropping system for improving seed yield, quality and soil biological health under rainfed condition. *Indian J. Agric. Sci., 78*(6): 485-489.

Singh, R. P., Yesh, P., & Harpreet, S. (2011). Effect of organic and inorganic sources of nutrients on growth, yield and quality of Indian mustard (*Brassica juncea* L.) under late sown condition. *Pantnagar Journal of Research*, *9*(2): 308-310.

Singh, R., & Singh, S. K. (2006). Evaluation of yield and quality aspects of Indian mustard (*Brassica juncea* L. Czernj & Cosson) under integrated nutrient management. *Annals of Agricultural Research, 27*(3): 220-223.

Thakur, N. P., Kachroo D., Kour, M., Kumar P., Sharma R., & Khajuria, V. (2009). Long-term effect of integrated nutrient management on crop productivity and fertility of clay loam (Inseptisol) soil in continuous rotation of rice-wheat cropping system under sub-tropical ecosystem of Jammu region. Paper presented in *75th Annual convention of ISSS held at IISS, Bhopal* during Nov. 14-17.

Tigga, R., Joshi, B. S., Malaiya, Sanjeev & Shrivastava, G. K. (2004). Effect of intercropping and integrated nutrient management on growth and yield of mustard and chickpea. *Ann. Agric. Res., 25*(3): 453-455.

Tripathi, M. K., Chaturvedi, Sumit, Shukla, D. K., & Mahapatra, B. S. (2010).Yield performance and quality in Indian mustard (*Brassica juncea*) as affected by integrated nutrient management. *Indian J Agron., 5*(2): 138-142.

US Department of Agricultural Research Service, (2016). Nutrient Data Laboratory. USDA National Nutrient Database for standard Research, Released 28. Version Current.

Wang, J. L., He Y., & Zhang Y. Q. (2006). A study on origin, evolution and spread of Brassica in china. Zhongguo Nongxue Tongbao, *22*(8), 489-494.

Yadav, R. L. (2005). Effect of FYM, clay mixing and sulphur on mustard [*Brassica juncea* (L.) Czernj and Cosson] in Typic Ustipsamment. Ph.D., Thesis, Rajasthan Agricultural University, Campus, Jobner.

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