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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON MUSTARD CROP (*BRASSICA JUNCEA* L.)

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ABSTRACT

The present investigation entitled "Effect of integrated nutrient management on mustard crop (*Brassica juncea* L.)" was conducted during *Rabi*-2021 at Research Farm, University College of Agriculture, Guru Kashi University, Talwandi Sabo, Punjab, India on an alluvial soil that was loamy sand in texture. The present experiment was laid out in Random Block Design (RBD) with 9 treatments viz. T_1 : 100% RDF (recommended dose of fertilizers) (60 kg nitrogen, 30 kg/ha phosphorus), T_2 : Farmyard manure (FYM) @ 10 t/ha, T_3 : Poultry manure (PM) @ 5 t/ha, T_4 : 75% RDF + 5 t/ha FYM, T_5 : 75% RDF + 2.5 t/ha PM, T_6 : 50% RDF + 5 t/ha FYM, T_7 : 50% RDF + 2.5 t/ha PM, T_4 : 25% RDF+ 5 t/ha FYM and T_9 : 25% RDF + 5 t/ha PM. Each treatment was replicated three times. There were different levels of manures and fertilizers applied under different treatments before sowing. Mustard crop was sown by hand driven seed drill on 14th November, 2021 and harvested manually on 21th March, 2022. The results and important research findings are recorded at different stages of crop and discussed in this trial. The different results of growth and yield attributes were recorded from all treatments at various stages of growth and development of plant. The result revealed treatments T_4 (75% RDF + 5 t/ha FYM) performed better in comparison to other treatments with respect to physiological parameters, growth and yield attributes. The economics gave maximum return in terms of net profit of 1,69,800 Rs./ha in treatment T_4. The B: C was highest (2.2) under treatment T_4 (75% RDF + 5 t/ha FYM) because of highest net returns.

***Keyword*:** Organic manures, fertilizers, growth attributes, seed yield, leaf area index and mustard.

Introduction

After soybean and palm oil, mustard (*Brassica juncea*) is the third-most significant edible oilseed crop in the world. India is the world's fourth-largest oilseed economy. Rapeseed and mustard account for 28.6 % of all oilseed production in India, with local production accounting for 12 % of global production.

The crop is the second-most significant source of edible oil in India after peanuts, contributing close to one-third of all oil produced there. On around 26 million hectares of land, oil seed farming is practiced in the nation. Oilseeds prepare up about 3 % of the gross national product and 13 % of the country's total cropped land in the Indian agricultural sector. (Anonymous, 2021)

Mostly temperate climates are used to grow mustard. As a cold-weather crop, it is also produced in several tropical and subtropical areas. It provides the majority of the production in the states of Uttar Pradesh, Punjab, Rajasthan, Madhya Pradesh, Bihar, Orissa, West Bengal, and Assam.

Because of multiple cropping and the introduction of high-yielding varieties, it has been noted that Indian soils are generally poor in nitrogen, phosphate, and sulphur. The rapid stand establishment and optimal yields depend on adequate quantities of nitrogen, phosphate, and potassium. The right management raised crop output while lowering fertilizer costs. In addition to increase productivity, the right combination of organic and inorganic fertilizers is crucial for maintaining soil health.

Farmyard manure enhances the soil's biological, chemical, and physical characteristics and boosts its water-holding capacity for optimal water utilization. Although in little amounts, it can provide the plant with all the nutrients it needs. The following elements are found in farm yard manure: (0.5 %) nitrogen, (0.25 % phosphorus), (0.5 %) potassium, (0.08 %) sodium, (0.02 %) sulphur, (0.004 %) zinc, (0.0003 %) copper, (0.007 %) manganese, and (0.45 %) iron, according to research (Singh 2014).

Poultry droppings have the highest nutritional levels of all animal manures. It contains significant amounts of micronutrients such as copper, zinc, and iron, as well as nitrogen (4.5 to 5.5 %), phosphorus (2.5 to 2.8 %), potassium (2.0 to 2.3 %), calcium (4.5 to 8.2 %), and magnesium (0.5 to 0.7 %). In addition to improving soil fertility and supplying primary, secondary, and micronutrients for crop productivity.

It has been discovered that using chemical fertilizer and organic manures together to provide and consume plant nutrients results in higher crop yields than applying either one separately. Utilizing the synergistic effects of organic manures, crop residues, and agricultural wastes with chemical fertilizers to increase balanced nutrient supplies and their use efficiency for farming productivity, sustainability, soil health, and environmental safety is known as integrated nutrient management.

The given the significance of this crop, attention must be paid to raising production levels to address the severe lack of edible oil in the nation. Regarding the impacts of integrated nutrient management on yield, productivity, and quality of mustard cv. Pioneer 45S46, very little research has been done in our country. The major goal of integrated nutrient management is to provide crops with a balanced supply of nutrients while maintaining and improving the health of the soil's fertility for long-term high productivity.

Keeping in view the previous work done and the present requirement to investigate the study with following objective:

- To study the effect of integrated nutrient management on growth, yield, productivity and profitability of mustard.

Materials and Methods

A field experiment was conducted at Department of Agriculture's Research Field at Guru Kashi University's University College of Agriculture in Talwandi Sabo, Bathinda (Punjab) during *Rabi*-2021. The experiment was laid out in randomized block design with three replication and nine treatments viz. T_1 : 100% RDF (recommended dose of fertilizers) (60 kg N, 30 kg P_2O_5/ha), T_2 : Farmyard manure (FYM) @ 10 t/ha, T_3 : Poultry manure (PM) @ 5 t/ha, T_4 : 75% RDF + 5 t/ha FYM, T_5 : 75% RDF + 2.5 t/ha PM, T_6 : 50% RDF + 5 t/ha FYM, T_7 : 50% RDF + 2.5 t/ha PM, T_4 : 25% RDF+ 5 t/ha FYM and T_9 : 25% RDF + 5 t/ha PM. The FYM and PM were applied two days before sowing as per treatments. The initial status of soil fertility was 215.8:14:202.1 kg NPK per ha with 0.26 % organic carbon. Full dose of nitrogen and phosphorus, as per treatments, were applied at the time of sowing. The data of plant height, number of leaves, fresh weight of plant, dry weight of plant, leaf area index, number of branches, number of silique/plant, length of silique, weight of silique, number of seeds/silique, 1000-seeds weight, biological yield, seed yield and stover yield were recorded by using standard procedure for mustard crop Gomez *et al.* (1984).

Results and Discussion

Growth Parameters

Plant height:

The significantly taller plant height of mustard was measured with application of 75% RDF + 5 t/ha FYM (T_4) being at par with application of 75% RDF + 2.5 t/ha PM (T_5) at all taken observation stages of the crop and at harvest (Table 1). The significantly higher plant height of mustard in T_4 might be due to rapid mineralization of organic manures and chemical fertilizer which might have supplied the nitrogen in early stages of the crop and presence of relatively readily available nutrient, growth promoting substances and other beneficial micro-organisms in farmyard manure, which are useful in nitrogen fixation, and other beneficial activities for nutrient availability in later stages of the mustard crop. The similar result was also reported by the various investigators viz. Tirpathi *et al.* (2010) and Thaneshwar *et al.* (2017).

Fresh weight of plant

The significantly higher fresh weight of plant was recorded with application of 75% RDF + 5 t/ha FYM (T_4) being at par with 75% RDF + 2.5 t/ha PM (T_5) all taken observation stages of the crop and at harvest (Table 2). The higher fresh weight of plant under T_4 might be due to application of organic manures and chemical fertilizers that have supplied the nitrogen in early stages of the crop, growth promoting substances and other beneficial micro-organisms which are useful in nitrogen fixation, and other beneficial activities for nutrient availability in later stages of the mustard crop. A similar result was also reported by Gour *et al.* (2017), Pal *et al.* (2008).

Dry weight of plant

The significantly higher dry weight of plant was recorded with application of 75% RDF + 5 t/ha FYM (T_4) being at par with 75% recommended dose of fertilizers + 2.5 t/ha PM (T_5) all taken observation stages of the crop and at harvest (Table 3). The higher dry weight of plant under T_4 involving organic manures and chemical fertilizers might have supplied the nitrogen in early stages of the crop, growth promoting substances and other beneficial activities for nutrient availability in later stages of the mustard crop. A number of research workers have observed increases in these attributes in mustard crop viz. Sahoo *et al.* (2018) and Singh *et al.* (2014).

Leaf area index

The significantly higher leaf area index of plant was recorded with application of 75% RDF + 5 t/ha of FYM (T_4) being at par with 75% RDF + 2.5 t/ha of PM (T_5) at 30 DAS and 60 DAS (Table 4). The leaf area index of plant under T_4 was higher due application organic manures and chemical fertilizers that have supplied the nitrogen in early stages of the crop, growth promoting substances and other beneficial activities for nutrient availability in later stages of plant.

Yield parameters

Number of silique/plant, length of silique, weight of silique, number of seeds per silique and test weight

The significantly highest number of silique/plant, length of silique, weight of silique, and test weight of mustard seeds was recorded (Table 5). The significantly highest with application of 75% RDF + 5 t/ha of FYM (T_4) being at par with 75% RDF + 2.5 t/ha of PM (T_5). However, number of seeds per silique significantly highest with application of 75% RDF + 5 t/ha of FYM (T_4) being at par with 75% RDF + 2.5 t/ha of poultry manure (T_5) and 100% RDF (T_1). The significantly higher yield attribute of mustard crop with T_4 might be due to application of adequate quantities of organic manures and chemical fertilizers that supply balanced proportions of plant nutrients throughout the growth stages of the crop, which further increased the yield attributes and yield of mustard crop. These results are in conformity with Singh *et al.* (2011), who stated that, supply of adequate amount of nutrient particularly nitrogen at active growth stages of the crop leads to significant increase in yield attributes of crop.

Seed, stover yield, Harvest index

The seed and stover of mustard crop significantly higher was recorded (Table 6) with application of 75% RDF + 5 t/ha of FYM (T_4) being at par with 75% RDF + 2.5 t/ha of PM (T_5). The significantly increase in grain and stover of mustard crop due to significantly higher plant height, dry matter accumulation, leaf area index, number of silique, length of silique and number of seeds per silique etc. which

all these growth and yield attributing characters contributed to final yield of the mustard crop. Singh *et al.* (2018) recorded that the significantly higher seed and stover yield of mustard with application of soil test based fertilizer application through 75% chemical fertilizer + 25% organic manure than rest other treatments. They resulted that, the greater availability of photosynthesis and nutrients to developing reproductive structures of the plant increased all the yield attributes, which ultimately useful for improvement of the final yield of mustard crop. It also indicated that the sink capacity of a plant depends mainly on vegetative growth that is positively affected by application of nitrogen fertilizers and supply of photosynthesis having a vital role for the formation of yield components of plant.

Economics of mustard crop

The cost of cultivation was statistically lower (T_1) (63.1). The T_2 (102.1) treatment's greatest cost of cultivation was caused by the application of a lot of farmyard manure, labour costs, and costs for transportation and manure application, respectively. The lowest cost of cultivation in T_1 (100% RDF (60 kg N, 30 kg P_2O_5/ha)) treatment was attributed to the low cost of chemical fertilizers (urea, single superphoshate), as well as the fact that there were applied in a small quantities chemical fertilizers used in comparison to organic manures. As a result, the labour and transportation costs were declined (Singh *et al*. (2014)). The gross returns were significantly greater with T_4. However, Under T_9 statistically inferior gross returns have been observed. The net returns significantly greater with T_4 but lower net returns have been recorded under T_9. Considerably higher B: C ratio was recorded with T_4 but statistically inferior benefit-cost ratio due to the high cultivation costs associated with T_2 and T_3. A number of investigators have observed increases in B: C of mustard crop viz. Tripathi *et al*. (2010) and Kumar *et al*. (2018)

Table 1: Effect of integrated nutrient management on plant height of mustard crop

Treatments	Plant height (in cm)		
	30 DAS	60 DAS	Harvesting
T_1 :100% RDF	62.5	151.6	157.8
T_2 :10 t/ha FYM	60.4	150.6	155.9
T_3 : 5 t/ha PM	61.3	150.9	155.2
T_4 : 75% RDF + 5 t/ha FYM	64.1	154.6	161.8
T_5 : 75% RDF + 2.5 t/ha PM	63.1	153.5	158.2
T_6 : 50% RDF + 5 t/ha FYM	59.2	149.6	156.1
T_7 : 50% RDF + 2.5 t/ha PM	59.3	148.9	155.4
T_8 : 25% RDF + 5 t/ha FYM	57.9	147.9	154.2
T_9 : 25% RDF + 2.5 t/ha PM	58.4	147.2	153.4
SEm ±	0.68	1.80	0.75
C.D.	1.46	3.85	1.61

Table 2: Effect of integrated nutrient management on fresh weight of plant of mustard crop

Treatments	Fresh weight of plant (g)		
	30 DAS	60 DAS	Harvesting
T_1 : 100% RDF	0.15	0.25	0.29
T_2 :10 t/ha FYM	0.14	0.24	0.28
T_3 : 5 t/ha PM	0.14	0.23	0.29
T_4 : 75% RDF + 5 t/ha FYM	0.17	0.29	0.32
T_5 : 75% RDF + 2.5 t/ha PM	0.16	0.28	0.31
T_6 : 50% RDF + 5 t/ha FYM	0.12	0.23	0.27
T_7 : 50% RDF + 2.5 t/ha PM	0.13	0.22	0.26
T_8 : 25% RDF + 5 t/ha FYM	0.11	0.21	0.25
T_9 : 25% RDF + 2.5 t/ha PM	0.11	0.21	0.25
SEm ±	0.004	0.003	0.005
C.D.	0.01	0.02	0.01

Table 3 : Effect of integrated nutrient management on dry weight of plant of mustard crop

Treatments	Dry weight of plant (g)		
	30 DAS	60 DAS	Harvesting
T_1 : 100% RDF	0.13	0.22	0.27
T_2 : 10 t/ha FYM	0.12	0.22	0.26
T_3 : 5 t/ha PM	0.12	0.21	0.26
T_4 : 75% RDF + 5 t/ha FYM	0.15	0.24	0.29
T_5 : 75% RDF + 2.5 t/ha PM	0.14	0.23	0.28
T_6 : 50% RDF + 5 t/ha FYM	0.12	0.20	0.25
T_7 : 50% RDF + 2.5 t/ha PM	0.11	0.19	0.23
T_8 : 25% RDF + 5 t/ha FYM	0.11	0.19	0.23
T_9 : 25% RDF + 2.5 t/ha PM	0.10	0.18	0.22
SEm ±	0.004	0.04	0.005
C.D.	0.01	0.01	0.01

Table 4 : Effect of integrated nutrient management on leaf area index of mustard crop

Treatments	Leaf area index	
	30 DAS	60 DAS
T_1 :100% RDF	0.76	0.83
T_2 :10 t/ha FYM	0.75	0.83
T_3 : 5 t/ha PM	0.74	0.83
T_4 : 75% RDF + 5 t/ha FYM	0.85	0.96
T_5 : 75% RDF + 2.5 t/ha PM	0.82	0.92
T_6 : 50% RDF + 5 t/ha FYM	0.73	0.85
T_7 : 50% RDF + 2.5 t/ha PM	0.72	0.77
T_8 : 25% RDF + 5 t/ha FYM	0.67	0.76
T_9 : 25% RDF + 2.5 t/ha PM	0.66	0.72
SEm ±	0.02	0.03
C.D.	0.04	0.08

Table 5 : Effect of integrated nutrient management on number of silique/plant, length of silique, weight of silique, and test weight of mustard crop

Treatments	Number of silique/plant	Length of silique (cm)	Weight of silique (g)	Number of seeds/silique	Test weight (g)
T_1 : 100% RDF	218.6	5.7	5.9	18.2	4.4
T_2 : 10 t/ha FYM	211.8	5.5	5.7	17.9	4.6
T_3 : 5 t/ha PM	211.2	5.2	5.8	18.0	4.5
T_4 : 75% RDF + 5 t/ha FYM	225.6	6.2	6.6	19.0	4.9
T_5 : 75% RDF + 2.5 t/ha PM	222.5	5.9	6.1	18.5	4.8
T_6 : 50% RDF + 5 t/ha FYM	205.6	5.4	5.4	18.0	4.2
T_7 : 50% RDF + 2.5 t/ha PM	202.9	5.3	5.1	17.8	4.4
T_8 : 25% RDF + 5 t/ha FYM	200.8	5.1	5.2	17.3	3.9
T_9 : 25% RDF + 2.5 t/ha PM	198.4	5.1	4.9	17.4	3.8
SEm ±	3.23	0.18	0.24	0.43	0.13
C.D.	6.89	0.38	0.51	0.95	0.27

Table 6 : Effect of integrated nutrient management on seed, stover, biological yield and harvest index of mustard crop

Treatments	Seed yield (q/ha)	Stover yield (q/ha)	Biological yield (q/ha)	Harvest index %
T_1 : 100% RDF	30.3	81.2	114.9	26.4
T_2 :10 t/ha FYM	34.8	84.7	123.1	30.7
T_3 :5 t/ha PM	34.4	85.6	123.6	29.0
T_4 : 75% RDF + 5 t/ha FYM	38.7	88.6	128.1	31.9
T_5 : 75% RDF + 2.5 t/ha PM	36.8	87.4	125.3	30.9
T_6 : 50% RDF + 5 t/ha FYM	32.6	76.5	117.4	29.5
T_7 : 50% RDF + 2.5 t/ha PM	31.7	74.8	116.1	29.0
T_8 : 25% RDF + 5 t/ha FYM	29.7	73.4	115.4	27.4
T_9 : 25% RDF + 2.5 t/ha PM	29.3	72.6	115.1	27.1
SEm ±	0.94	0.87	1.57	-
C.D.	2.02	1.85	3.35	-

Table 7 : Effect of integrated nutrient management on economics of mustard crop (Total cost (1000/ha), Gross returns (1000/ha), Net returns (1000/ha) and B: C ratio)

Treatments	Cost of cultivation (1000/ha)	Gross returns (1000/ha)	Net returns (1000/ha)	B: C Ratio
T_1 :100% RDF	63.1	199.1	137.0	2.1
T_2 : FYM @ 10 t/ha	102.1	225.7	123.6	1.2
T_3 : PM @ 5 t/ha	101.3	223.5	122.2	1.2
T_4 : 75% RDF + 5 t/ha FYM	80.1	249.9	169.8	2.2
T_5 : 75% RDF + 2.5 t/ha PM	79.3	238.3	159.0	2.0
T_6 : 50% RDF + 5 t/ha FYM	77.0	210.9	133.0	1.7
T_7 : 50% RDF + 2.5 t/ha PM	75.8	205.2	129.4	1.7
T_8 : 25% RDF + 5 t/ha FYM	74.1	192.9	118.8	1.6
T_9 : 25% RDF + 2.5 t/ha PM	73.0	190.3	117.3	1.6
SEm ±	-	-	-	-
C.D.	-	-	-	-

Conclusions

The results indicated that among all the treatment where the application of 75% RDF + 5 t/ha farm yard manure (T_4) incorporated in the soil significantly enhanced the plant growth parameters, yield attributing characters and productivity of mustard crop in light textured alluvial soils of Punjab. Under different treatments T_4 performed better in comparison to other treatments with respect to physiological parameters, growth and yield traits. The economics gave maximum return in terms of net profit of 1,69,800 Rs./ha in treatment T_4. The B: C was highest under T_4 because of highest net returns of crop.

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