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Arvind Singh
Vivekananda Global University, Jaipur, Rajasthan, India

Corresponding Author:
Arvind Singh
Vivekananda Global University, Jaipur, Rajasthan, India

Effect of nitrogen sources on yield and economics of mustard

Arvind Singh

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Abstract
A field experiment was conducted at Research farm, Vivekananda Global University, Jaipur during *Rabi* season¸ 2023-24 on loamy sand soil. The experiment comprises nine treatments of different nitrogen sources (100% RDN (80 kg N) through chemical fertilizers, 100% RDN through Vermicompost, 100% RDN through Biogas slurry, 100% RDN through Poultry Manure, 75% RDN through chemical fertilizers + 25% through Vermicompost, 75% RDN through chemical fertilizers + 25% through Biogas slurry, 75% RDN through chemical fertilizers + 25% through Poultry manure, 50% RDN through chemical fertilizers + 25% through Poultry manure + 25% through Vermicompost, 50% RDN through chemical fertilizers + 25% through Biogass slurry + 25% through Vermicompost, 50% RDN through chemical fertilizers + 25% through Poultry manure + 25% through Biogass slurry and 1/3 RDN through Each Vermicompost, Biogas Slurry and Poultry Manure) was laid out in randomized block design and replicated thrice. Results indicated that among the treatments applied as application of 75% RDN through chemical fertilizers + 25% through vermicompost recorded significantly higher seed (1783 kg ha^{-1}) and stalk (6345 kg ha^{-1}) yield, net return (Rs. 70032) and B:C ratio (3.27).

Keywords: Nitrogen sources, mustard, yield and economics

Introduction

Indian mustard (*Brassica juncea*) is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and West Bengal which occupied 82.22% area and 85.32% production (Anonymous, 2022) [1], out of which about 46.0% of total production contributed by Rajasthan state alone. Domestic production of edible oils meets only 50% of the total requirements, while rest is imported. Huge gap between the consumption and domestic production of edible oils can be filled up by increasing the area under oilseed crops like rapeseed and mustard, sunflower and soybean or increasing production per unit area.

In Rajasthan, crop brassicas are most important edible oilseed group of crops with predominance of Indian mustard followed by toria and yellow sarson. Rapeseed and mustard having area in 3.79 million hectare with 6.47 million tones production, however the average yield is about 1705 kg ha^{-1} in Rajasthan (Anonymous, 2023) [2]. It is one of the most important edible oils of northern and eastern parts of India and traditionally grown everywhere in the country due to their high adaptability in conventional farming systems. Among the vegetable oils, mustard oil is one of the major single sources of essential fatty acids particularly in northern Indian diet. Mustard seed is primarily used as a source of edible oil and protein meal while, it is also used as a condiment. The seeds when crushed yield around 33% oil and 67% protein meal. The per capita oil consumption increasing day by day is impaired by the growth rate of more than 3%. Hence there is no way, but to increase the oilseed production for getting self-sufficiency in edible oils. Use of chemical fertilizers in combination with organic manure is essentially required to improve the soil health (Prasad *et al*., 2010) [6]. Chemical fertilizers/organic manures alone cannot sustain the desired levels of crop production under continuous farming. Integrated nutrient management is very essential which is not only sustains high crop production over the years (Verma *et al*., 2010) [12] but also improves soil health and ensures safer environment. The nutrient supplied to crops through INM not only restoring the soil fertility but also sustain desired level of production over the years (Pal and Pathak, 2016) [3].

Adoption of integrated plant nutrient supply and management strategies for enhancing soil quality, input use efficiency and crop productivity is extremely important for food and nutritional security in Indian agriculture (Swarup, 2010) [10].

Methodology

Seed yield (kg ha^{-1})

After processing of harvested crops, plot wise seed yield were recorded in kg ha^{-1}.

Stover yield (kg ha-1)

The Stover yield was recorded plot wise by noting the difference between the weight of bundles (before threshing) and seed yield of the respective plots and then Stover yield in kg ha^{-1} was calculated.

Harvest index

Harvest index was computed by using the formula outlined by Singh and Stoskopf (1971) [9].

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100$$

Economics

The economics of treatments is the prime consideration before making any recommendation to the farmers for its adoption. Hence, to evaluate the effectiveness and profitability of the treatments, comprehensive economics in terms of net returns (₹ ha^{-1}) and B: C ratio was calculated so that the most effective and remunerative treatment could be recommended. The details of calculation with prevailing market rates of the inputs and produce are given in appendices at the end.

Net returns = Gross returns – Total cost of cultivation

$$\text{B: C ratio} = \frac{\text{Gross returns (₹ ha}^{-1})}{\text{Cost of cultivation (₹ ha}^{-1})}$$

Statistical analysis

In order to test the significance of variation in experimental data obtained for various treatment effects, the data were statistically analyzed as described by Fisher (1950). The critical differences were calculated to assess the significance of treatment mean wherever the F' test was found significant at 5 per cent level of probability. To elucidate the nature and magnitude of treatment effects, summary tables along with SEm$\pm$ and CD (P=0.05) were prepared and are given in the text of the chapter. Experimental results and their analyses of variance are given in Appendices at the end.

The following formula were used for standard error, critical difference and coefficient of variance estimations:

a) $SEm\pm = \sqrt{EMS/r}$

b) $C.D. = SEm\pm \times \sqrt{2} \times t\%$ at 22D.F.

c) $C.V.\ (\%) = \frac{\sqrt{EMS}}{\text{Grand mean}} \times 100$

Grand mean

Where,

r = Number of replications

t = Number of treatments

D.F. = Degree of freedom

SEm± = Standard error of mean

EMS = Error mean squares

C.D. = Critical difference

C.V. = Coefficient of variance

Results and Discussion

The seed and stover yield differed significantly due to addition of different combinations of nitrogen sources. Seed and stover yield of mustard was ranged between 1043 to 1783 and 3746 to 6345 kg ha^{-1} with different treatments and the highest yield was obtained in T_5 (75%RDN through chemical fertilizers + 25% through Vermicompost). The increase in yield under all treatment combination was significantly higher as compared to chemical fertilizers use presented in table 4.5. Amongst the treatments, T_5 seems more effective than other treatments in respect to yield. This improvement in yield is might be due to improvement of soil pH, physicochemical properties of soil due to application of vermicompost and poultry manures and instant availability of nutrients from inorganic fertilizers. The balanced nutrient management practices contributed to a great extent influencing the seed yield of mustard. The yield enhancement obtained in present study were also in agreement with the finding of Piri *et al.* (2012) [4] who stated that may be due to the effect of availability of micronutrients in increasing growth attributes. The beneficial effect of combined application of FYM and liming improving the physicochemical condition of the acid soil for achieving higher seed yield of mustard has been reported by Saha *et al*. (2010) [7] and Pooniyan *et al*. (2022) [5].

The highest net return of Rs. 70032 ha^{-1}was obtained from T_5 (75%RDN through chemical fertilizers + 25% through vermicompost) which found at par with the application of T_1 (100% RDN through chemical fertilizers), T_6 (75% RDN through chemical fertilizers + 25% through Biogas slurry) and T_7 (75% RDN through chemical fertilizers + 25% through Poultry manure). While, highest B: C ratio was recorded with the application of T_1 (100% RDN (80 kg N) through chemical fertilizers) which was statistically similar to T_5 (75%RDN through chemical fertilizers + 25% through vermicompost). The lowest B: C ratio was obtained in T_3 where cost effective biogas slurry input was applied. The prevailing market price of mustard seed at that period could not compensate the cost of production to reach the net benefit at required level. These results are in agreement with those of Singh *et al*. (2014) [8] and Tripathi *et al*. (2011) [11].

Table 1: Effect of different sources of nitrogen on yield and economics of mustard

Treatments	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Net return	B: C
100% RDN (80 kg N) through chemical fertilizers	1674	5740	67632	3.27
100% RDN through Vermicompost	1297	4709	31130	1.69
100% RDN through Biogas slurry	1043	3746	15125	1.33
100% RDN through Poultry Manure	1376	5126	35707	1.80
75% RDN through chemical fertilizers + 25% through Vermicompost	1783	6345	70032	3.08

75% RDN through chemical fertilizers + 25% through Biogas slurry	1711	5844	62984	2.74
75% RDN through chemical fertilizers + 25% through Poultry manure	1745	5925	67339	3.00
50% RDN through chemical fertilizers + 25% through Poultry manure + 25% through Vermicompost	1624	5601	56777	2.52
50% RDN through chemical fertilizers + 25% through Biogass slurry + 25% through Vermicompost	1579	5540	51328	2.28
50% RDN through chemical fertilizers + 25% through Poultry manure + 25% through Biogass slurry	1506	5463	48366	2.21
1/3 RDN through Each Vermicompost, Biogas Slurry and Poultry Manure	1431	5294	34859	1.72
SEm±	66	160	3565	0.09
C.D (P=0.05)	195	472	10517	0.26

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