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Effect of Different Levels of Nitrogen, Phosphorous and Potassium on Growth, Yield Attributes and Yield of Indian Mustard (*Brassica juncea* (L.) Czern and Coss) in S-E Rajasthan

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A B S T R A C T

A field experiment was conducted at Agricultural Research Station, Kota during the *Rabi* seasons2019-20 to find out suitable nutrient management levels of nitrogen, phosphorous and potassium in irrigated condition of south- eastern Rajasthan. The treatments comprised three levels of nitrogen (80, 100 and 120 kg/ha), two levels of phosphorous (40 and 50 kg/ha) in main plot and three levels of potassium fertilizer (15, 30 and 45 kg/ha) in sub plot were laid out in split-plot design with 3 replication. Application of 120 kg N/ha had significance effect at harvest, over 80 kg N/ha, on plant height (224.5 cm), dry matter/meter row length(346.8 g), primary and secondary branches/plant (5.82 and 15.02), siliquae/plant (213.8), seeds/siliqua (15.94), length of siliqua (5.53 cm), 1000-seed weight (5.30 g), seed yield (2861 kg/ha) and stover yield (7016 kg/ha)however, 120 kg N/ha was remained on par with 100 kg N/ha. The application of 50 kg P_2O_5 had significant effect on dry matter accumulation per meter row length (329.64 g), height at 60 and 90 DAS (91.6 and 191.1 cm) primary and secondary branches/plant (5.45 and 14.66) siliquae/plant (204.3), seeds/siliqua (15.94), length of siliqua (5.43 cm), 1000-seed weight (5.19 g), seed yield (2830 kg/ha) and stover yield (6929 kg/ha).The application of 45 kg K_2O/ha was had significant effect as compared to 15 kg K_2O/ha, on plant height (210.5 cm) dry matter accumulation per meter row length (334.2 g), primary branches/plant (5.46),siliquae/plant (203.2), seeds/siliqua (16.03), length of siliqua (5.46 cm), 1000-seed weight (5.17 g) seed yield (2856 kg/ha) and stover yield (7050 kg/ha). However 45 kg K_2O/ha was found on par with 30 kg K_2O/ha. The application of 100 kg N with 50 kg P_2O_5 and 30 kg K_2O/ha was found beneficial for obtaining high seed yield in irrigated conditionsof south- eastern Rajasthan.

Introduction

Importance of oilseed in agriculture needs further attention, as they are valuable items of human nutrition and soil fertility. In India, rapeseed-mustard is grown over 5.96 million ha area with a production of 8.32 million tonnes at an average productivity of 1397

kg/ha (GOI, 2017-18). It is the most important rabi season oilseed crop of Rajasthan which is grown on 2.38mha with annual production of 3.95mt at an average productivity of 1656 kg/ha (Anonymous, 2019-20). The optimum sowing time of Indian mustard in south-eastern Presently in south-eastern Rajasthan Indian mustard (*Brassica juncea*) is being grown on *vertisols* under irrigated conditions after harvest of urdbean /soybean without considering nutrient management which is essential for harvesting good yield.

Imbalanced use of chemical fertilizers especially N,P&K not only lowers productivity but also adversely affects soil health by continuous. Decline in crop yield due to lack of K supply was reported even in K rich soils like Vertisols (Singh and Wanjari, 2012). Furthermore, the inadequate supply of K also limits the responses to applied N and P fertilizer. Nitrogen deficiency may decrease yield while, excess N availability reduces the oil quality. Under the present situation application of major nutrient elements NP&K is essential for increasing mustard yield and maintaining crop production at higher level in irrigated condition.

Considering these facts, the present study was therefore, undertaken to evaluate the effect of major nutrient N, P & K management for Indian mustard grown on *Vertisol* after harvest of urdbean in irrigated areas of south - east Rajasthan.

Materials and Methods

A field experiment was conducted at Agriculture Research Station, Kota (26º North latitude, 76º-6' East longitude and 260 m above mean sea level) during the *rabi* seasons of 2019-20 to study the effect of different levels of nitrogen, phosphorous and potassium nutrient management on growth, yield attributes, yield, quality and economics of Indian mustard grown after harvest of urdbean invertisols of south-east Rajasthan under irrigated condition. The experimental soil was clay loam in texture with a pH of 7.95, medium in organic carbon (0.54 %), available nitrogen (280 kg/ha), phosphorus (40.3 kg/ha) and high in potassium (400 kg/ha), zinc (0.92 mg/kg soil) and low in sulphur (8.85 kg/ha) contents. The experiment comprised of 18 treatments with three levels of nitrogen *viz.*, 80, 100 and 120 kg/ha, two levels of phosphorous fertilizer *viz.*, 40 and 50 kg/ha in main plots, and three levels of potassium fertilizer *viz.*, 15, 30 and 45 kg/ha in sub plots were assigned in sub-sub plots and laid out in split-plot design with 3 replication.

Uniform application of FYM with treatment doses of NP&K were supplied through urea, dia-ammonium phosphate, muriate of potash, respectively. Full dose of P_2O_5, K_2O and halfN were applied as basal at planting and half dose of N was top-dressed at 40 days after planting of the crop as per treatments. 5 kg/ha seed of variety 'DRMRIJ 31' was used. The gross plot size for each treatment was 6 m x 3.6 m and net plot size was 5 m x 2.7 m. All the recommended agronomic practices were done throughout the crop season. The average annual rainfalls received during cropping period of one year were 190 mm. The crop was harvested manually at physiological maturity stage as per treatments. Initial and post-harvest soil samples were collected from 0-15 cm depth, dried processed and analyzed for oxidizable organic carbon, N, P, K and S using standard procedures. Growth, yield attributes, seed yield, quality parameter and nutrient uptake were workout as per standard statistical procedure and using formulae. Gross and net returns were calculated based on the seed and straw yield and prevailing market prices of mustard in respective seasons. The benefit: cost ratio was calculated by dividing the net

returns from the total cost of cultivation. The data were statistically analyzed and the results of pooled analysis are presented.

Results and Discussion

Effect of Nitrogen

Growth and yield attributes of Indian mustard were significantly influenced due to application of graded levels of Nitrogen fertilization contributed to a great extent in influencing the seed yield of mustard on account of its pronounced effect on the growth and yield attributes of the plant, at various stages of the crop growth. Application of 120 kg N/ha registered higher growth and yield attributing characters (Table 1)*viz*on plant height (224.5 cm), dry matter/meter row length (346.8 g), primary and secondary branches/plant (5.82 and 15.02), siliquae/plant (213.8), seeds/siliqua (15.94), length of siliqua (5.53 cm), 1000-seed weight (5.30 g). However there was no statistical difference between 100 and 120 kg N/ha.

These growth and yield parameters increased significantly with increasing levels of nitrogen upto 100 kg N/ha. Probably 120 kg N/ha ensured the availability of other nutrient and favourable condition for growth of mustard plant. Nitrogen increase in size of cell, which expressed morphologically increased in plant height, leaf area and branches/plant.

Nitrogen provide deep green colour to leaves due to better chlorophyll synthesis which increase the effective area of photosynthesis and resulting in higher dry matter. These results are in conformity with finding of Singh and Kumar, (2014)

The application of 100 kg produced significantly higher (Table 2) seed yield and stover yield as compared to 80 kg N/ha however, it was found at pat with 120 kg N/ha. The maximum seed and stover yield were recorded with the application of 120 kg N/ha. The increase in yield of mustard due to nitrogen application may be because of the fact that nitrogen played an important role in synthesis of chlorophyll and amino acids, which constitute building of protein blocks.

Nitrogen influenced the seed yield through a source-sink relationship and in addition to higher production of photosynthates it leads to increased translocation to reproductive parts. Nitrogen being a most important plant nutrient needed for growth and development of plant and is known to increase the yield of Brassica species (Singh *et al.,* 2002).

Effects of phosphorous

Application of 50 kg P_2O_5/ha recorded significantly the highest plant height at 60 and 90 DAS (Table 1) (91.6 and 191.1 cm) except at harvest, dry matter accumulation at all growth stages, primary and secondary branches/plant (5.45 and 14.66) siliquae/plant (204.3), seeds/siliqua (15.94), length of siliqua (5.43 cm), 1000-seed weight (5.19 g).

The seed yield (Table 2) (2830 kg/ha) and stover yield (6929 kg/ha) of mustard increased significantly due to application of 50 kg P_2O_5/ha over its lower level of phosphorus. The per cent increase in seed yield 8.22 was with 50 kg P_2O_5/ha level of phosphorus over 40 kg P_2O_5/ha level whereas the corresponding value for increase in stover yield was 4.50 per cent.

The supply of phosphorus to plant might have accelerated cell division and enlargement, carbohydrate, fat metabolism and respiration in plant. These results are in agreement with the findings of Rana *et al.,* (2005) in mustard; Sune *et al.,* (2006) in linseed; and Dhage *et al.,* (2014) in soybean.

Table.1 Effect of nitrogen, phosphorous and potassium on plant height and dry matter accumulation at 60, 90 DAS and at harvest of Indian mustard

Treatments	At 60 DAS		At 90 DAS		At harvest			
Nitrogen (kg/ha)	**Plant height (cm)**	**Dry matter/ m row length**	**Plant height (cm)**	**Dry matter/ row length**	**Plant height (cm)**	**Dry matter/ m row length**	**Primary Branches/plant**	**Secondary Branches/plant**
80	79.0	136.5	169.7	226.0	193.1	295.4	4.38	12.28
100	87.5	153.6	188.4	252.1	202.4	332.5	5.24	14.42
120	99.8	155.7	196.8	259.6	224.5	346.8	5.82	15.02
SEm ±	0.67	3.50	3.08	1.16	2.65	5.53	0.18	0.43
CD (P=0.05)	2.62	13.74	12.09	4.54	10.41	21.72	0.72	1.67
Phosphorous (kg/ha)								
40	85.9	144.6	178.82	241.1	206.0	320.09	4.84	13.15
50	91.6	152.5	191.19	250.4	207.3	329.64	5.45	14.66
SEm ±	1.63	2.21	3.33	2.21	1.49	2.48	0.06	0.22
CD (P=0.05)	5.62	7.63	11.51	7.66	NS	8.59	0.22	0.75
Potassium (kg/ha)								
15	84.7	145.00	181.7	239.0	201.7	317.3	4.83	13.43
30	88.9	150.22	183.7	246.5	208.0	323.1	5.15	13.99
45	92.7	150.59	189.7	252.1	210.2	334.2	5.46	14.29
SEm ±	1.12	3.08	2.33	2.58	1.93	4.49	0.13	0.25
CD (P=0.05)	3.28	NS	NS	7.54	5.63	13.09	0.39	NS

Table.2 Effect of nitrogen, phosphorous and potassium on silique/plant, seeds/plant, siliqua length, 1000-seed weight, seed and stover yield, of India mustad

Treatment	Siliquae/ plant	Seeds/ siliqua	Siliqua length (cm)	1000 seed weight (g)	Seed yield (kg/ha)	Stover Yield (Kg/ha)
Nitrogen (kg/ha)						
80	173.3	14.88	5.04	4.70	2544	6433
100	201.3	15.71	5.33	5.12	2764	7009
120	213.8	15.94	5.53	5.30	2861	7016
SEm ±	7.31	0.19	0.07	0.10	40.45	51.27
CD (P=0.05)	28.69	0.73	0.29	0.40	158.80	201.27
CV (%)	15.81	5.11	5.93	8.64	6.30	3.19
Phosphorus (kg/ha)						
40	187.9	15.08	5.18	4.93	2615	6710
50	204.3	15.94	5.43	5.19	2830	6929
SEm ±	1.78	0.22	0.06	0.03	51.97	18.81
CD (P=0.05)	6.15	0.76	0.22	0.12	179.81	65.09
CV (%)	4.71	7.36	6.31	3.42	9.92	1.43
Potassium (kg/ha)						
15	187.2	14.94	5.11	4.85	2557	6634
30	197.9	15.56	5.36	5.16	2756	6774
45	203.2	16.03	5.46	5.17	2856	7050
SEm ±	4.31	0.25	0.05	0.07	57.50	50.23
CD (P=0.05)	12.58	0.74	0.14	0.21	167.82	146.58
CV (%)	9.33	6.89	3.79	6.04	8.96	3.12

Effect of Potassium

Among potassium levels, application of 30 kg K_2O/ha was found significantly superior with respect to plant height at 60 DAS (Table 1), dry matter accumulation per meter row length at harvest, primary branches/plant, number of siliquae/plant (197.3), seeds/siliqua (15.56), length of siliqua (5.46 cm), 1000-seed weight (5.17 g), seed yield (2756 kg/ha), biological yield (9877 kg/ha) and found at par with 45 kg K_2O/ha (Table 2). Whereas, secondary branches/plant and stover yield could not influenced significant by potassium levels. The maximum number siliquae/plant and number of seeds/siliqua in case of 60 kg K_2O/ha which could be attributed to favourable soil environments like better availability as well as absorption of water and nutrients due to balanced application of potassium that promoted vegetative and reproductive growth processes of the crop The increase in oil content confirmed the findings of Misras (2003) in mustard.

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