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Effect of varying fertilizer doses and crop geometry on productivity and nutrient uptake of late sown Indian mustard (*Brassica juncea* L.)

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ABSTRACT
A field experiment was conducted during rabi seasons of 2015-16 at Regional Research Station, Bawal (Rewari), CCS Haryana Agricultural University to study the effect of varying fertiliser doses and crop geometry on nutrient uptake and productivity of late sown Indian mustard (Brassica juncea L.). The experiment was laid out in split-split plot design with three replications involving four fertilizer dose viz. F 1 - 80 % RDF, F 2 - 85 % RDF, F 3 - RDF (Recommended dose of fertilizer i.e. 80 kg N + 30 kg P 2 O 5 + 20 kg K 2 O + 40 kg S per hectare) and F 4 - 115 % RDF as main plots, six crop geometry as sub plots viz. C 1 - 30 cm x 10 cm, C 2 - 25 cm x 15 cm, C 3 - 30 cm x 15 cm, C 4 - 25 cm x 20 cm, C 5 - 30 cm x 20 cm and C 6 - 25 cm x 25 cm. Finding showed that application of fertilizer up to 85% RDF in late sown Indian mustard enhanced the seed yield significantly. Though, the seed yield was not affected significantly by application of fertilizer above 85% RDF to 115% RDF. Hence, 85% RDF is recommended for obtaining higher seed yield. For obtaining higher nutrient uptake (N, P, K and S) in both seed and stover application of 115% RDF is recommended. Among different crop geometry, C 2 (25 cm x 15 cm) is recommended for production of significantly higher seed, straw and biological yield as well as for obtaining higher nutrient uptake.
Keywords: Indian Mustard, RDF, Stover application

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INTRODUCTION

Oilseeds crops are the most important determinant of agricultural economy, next to cereals. India is the world's second largest edible oil consumer after china, meeting more than 50 percent of its annual requirements through imports. Rapeseed-mustard (*Brassica spp.*) is one of the most valuable oilseed crops of the world as well as India. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the India's oilseed economy [9]. Rapeseed-mustard in the world is grown on an area of 33.64 million ha with a production and productivity of 62.84 million tones and 1856 kg/ha, respectively [4]. There was considerable increase in productivity of rapeseed- mustard from 405 kg/ha in 1966-67 to 1856 kg/ha in 2016-17. In India, rapeseed-mustard occupy 5.99 million ha area with production of 6.31 million tones and productivity of rapeseed-mustard in India1053 kg/ha is very less as compared to world's productivity 1856 kg/ha [2]. Rapeseed-mustard spared over India mainly distributed in states of Rajasthan, Haryana, Uttar Pradesh, and Madhya Pradesh. Demand of edible oil has increased with increasing population and improvement in the living standard of the people, resulting thereby in short supply of edible oils which is being met with imports of edible oil costing around Rs. 56,906 crores per annum. Thus, there is need to boost the oilseed production in India as well as Haryana.

Indian mustard (*Brassica juncea* L.) is an important *Rabi* oilseed crop of Haryana. Indian mustard (*Brassica juncea* L. Czern) belongs to family Cruciferae, genus *Brassica* and species *juncea* popularly known as rai and cultivated as a cold weather crop. Its seed contains 37 to 49 per cent edible oil [10]. Under late sown condition, productivity declines primarily due to the shortening of vegetative and reproductive phase. Late sown Indian mustard is exposed to high temperature coupled with high evaporative demand of the atmosphere during the reproductive phase (ripening and grain filling) which consequently results in forced maturity and ultimately low productivity. High temperature in *Brassica* caused flower abortion with appreciable loss in seed yield [1]. Higher doses of fertilizer coupled with narrow crop geometry (inter and intra plant spacing) depleted more soil moisture as compared to lower doses of fertilizer in association with wider plant spacing. Temperature can't be manipulated easily under field conditions but by modifying fertilizer doses and crop geometry of late sown Indian mustard, soil moisture loss may be adjusted to meet out the evaporative demand of the atmosphere during reproductive phase.

Uniform distribution of crop plants over an area results in efficient use of nutrients, moisture, and suppression of weeds leading to high yield. In wider row spacing, solar radiation falling within the rows gets wasted particularly during the early stages of crop growth, whereas in closer row spacing upper part of the crop canopy may be well above the light saturation capacity but the lower leaves remain starved of light and contribute negatively towards yield. The dense plant population reduces the yield due to reduction in the photo- synthetically active leaf area caused by mutual shading (Shekhawat *et al.*, 2012). The productivity of individual plant is limited under late sown conditions owing to poor growth and development. Hence, higher plant population may compensate for reduction in seed yield (Kumari *et al.,* 2012). Late planted crop has low productivity due to restricted vegetative growth therefore, selection of appropriate spacing and management of fertilizer doses under late sown condition play an important role in enhancing mustard productivity [11, 12, 13].

MATERIAL AND METHODS

A field experiment was conducted at Regional Research Station of Chaudhary Charan Singh Haryana Agricultural University, Bawal in r*abi* (winter) season of 2015-16 located at 28º4' N latitude and 76º35' E longitude at an altitude of 266 meters above mean sea level. The soil of experimental field was loamy sand in texture, alkaline pH (7.5), low in organic carbon (0.46%), low in available N (105.16 kg/ha) and medium available P_2O_5 (10 kg/ha), K_2O (205 kg/ha) and neutral in soil reaction. The average rainfall of Bawal varies from 300-500 mm and the total rains as well as its distribution are subjected to great variations. The experiment was laid out in split-split plot design with three replications involving four fertilizer dose viz. F1: 80 % RDF, F2: 85 % RDF, F3: RDF (Recommended dose of fertilizer *i.e.* 80 kg N + 30 kg P_2O_5 + 20 kg K_2O + 40 kg S per hectare), F4: 115 % RDF as main plots, six crop geometry as sub plots viz. C1: 30 cm x 10 cm, C2: 25 cm x 15 cm, C3: 30 cm x 15 cm, C4: 25 cm x 20 cm, C5: 30 cm x 20 cm and C6: 25 cm x 25 cm. The experimental site had been used over the years for continuous Clusterbean-Indian mustard cropping. Indian mustard variety RH 9801 available from Regional Research Station, Bawal was sowing of crop was done by using seed rates of 5.0, 4.0, 3.3, 3.0, 2.5 and 2.4 kg per ha in flat beds with the help of hand plough in rows as per treatments *i.e.* 30 cm x 10 cm, 25 cm x 15 cm, 30 cm x 15 cm, 25 cm x 20 cm, 30 cm x 20 cm and 25 cm x 25 cm (inter- row and intra-row plant spacing). Seed was sown at the depth of 4 to 5 cm. Pre-sowing irrigation was applied two cross harrowing followed by planking were given; and 2% methylparathion dust @ 25 kg/ha to control insect, before the last harrowing. Half doses of nitrogen and full basal dose of phosphorus, potassium and sulphur as per treatments were applied at sowing. The remaining half dose of nitrogen was applied after first irrigation. The source of nitrogen, phosphorus, potassium and sulphur were urea (46% N), Diammonium phosphate (18% N and 46% P_2O_5), murate of potash (60% K_2O) and gypsum (15% S). Gypsum was broadcasted before fertilizer application as per treatments, while urea, DAP and MOP were drilled by hand plough as per treatments at sowing. After germination, thinning was done 21 days after sowing in order to maintain required spacing of plants within the row as per treatment (30 cm x 10 cm, 25 cm x 15 cm, 30 cm x 15 cm, 25 cm x 20 cm, 30 cm x 20 cm and 25 cm x 25 cm) to established plant population of 3.33, 2.66, 2.22, 2.00, 1.66 and 1.60 lakh plants/hectare, respectively. Recommended package of practices was followed for all other operations. The data collected from the experiment subjected to statistically analyzed by the method of analysis of variance (ANOVA) as described by Panse and Sukhatme [7].

NPK & S uptake

Oven dried sample weighed 0.5 g for straw and seed was digested in diacid mixture of H_2SO_4 and $HClO_4$ in the ratio of 9:1 for NPK estimation. After digestion, a known volume was made with distilled water and filtered through Whatman's filter paper No. 42. Nitrogen content in digested plant material was determined by Nessler reagent method (Lindner 1944). Phosphorus and potassium content were determined by Vanadomolybdo phosphoric acid yellow color method [15] and flame photometric method [16]. Sulphur content was determined by Calcium chloride method [17].

RESULTS

The result presented in Table 1 on seed yield indicated that increasing fertilizer doses application (70%, 85%, 100% and 115% RDF) in late sown Indian mustard significantly enhanced the seed yield but the difference was significant up to 85% RDF. Though, the differences amongst treatment *i.e.*, 85%, 100% and 115% RDF were found non-significant in respect to seed yield. Application of 115%, 100% and 85% RDF increased in the seed yield to the tune of 10.5%, 9.8% and 7.6% respectively over 70% RDF. Seed yield differed significantly under varying crop geometries (25 cm x 15 cm, 30 cm x 15 cm, 25 cm x 20 cm, 30 cm x 20 cm and 25 cm x25cm) respectively. Crop geometry (25 cm x 15 cm *i.e.* 2.66 lakh plants/ha) resulted into significantly higher seed yield over all other crop geometries under study. It produced 5.4%, 8.4%, 10.8%, 17.5% and 21.4% higher seed yield over crop geometry of 30 cm x 15 cm (2.22 lakh plants/ha), 30 cm x 10 cm (3.33 lakh plants/ha), 25 cm x 20 cm (2.00 lakh plants/ha), 30 cm x 20 cm (1.66 lakh plants/ha) and 25 cm x 25 cm (1.60 lakh plants/ha) respectively.

Stover yield increased with increasing doses of fertilizer *i.e.* 70%, 85%, 100% and 115% RDF. However, application of 85% RDF recorded significantly higher stover yield over 70% RDF, while the differences among 85%, 100% and 115% RDF were found statistically at par in Table 5. Stover yield under varying crop geometry differed significantly. Crop geometry (25 cm x 15 cm *i.e.*, 2.66 lakh plants/ha) resulted into significantly higher stover yield over all other crop geometries under study. Biological yield increased with successive increase in fertilizer doses from 70% to 115% RDF. However, application of 85% RDF recorded significantly higher biological yield over 70% RDF, while the difference among 85%, 100% and 115% RDF were found to be non-significant. Biological yield differed significantly under varying crop geometry (30 cm x 10 cm, 25 cm x 15 cm, 30 cm x 15 cm, 25 cm x 20 cm, 30 cm x 20 cm and 25 cm x 25 cm), respectively. Crop geometry of 25 cm x 15 cm (2.66 lakh plants/ha) produced significantly higher biological yield over all other crop geometries *i.e.*, 30 cm x 15 cm, 25 cm x 20 cm, 30 cm x 20 cm and 25 cm x 25 cm, respectively. Harvest index was not significantly influenced by different fertilizer doses in Table 5, though 85% RDF had higher harvest index (25.3 %) followed by 100% RDF (25.1%), 115% RDF (25.1 %), respectively. Similarly, varying crop geometry did not bring significant increase in harvest index. However crop geometry of 25 cm x 15 cm recorded highest harvest index (25.2 %).

Table 1: Effect of various treatments on Seed, Stover, biological yield and harvest index of late sown Indian mustard taken after Clusterbean

Treatments	Seed yield (Kg/ha)	Stover yield (Kg/ha)	Biological yield (Kg/ha)	Harvest Index (%)
Fertilizer doses				
70% RDF	1240	3831	5071	24.4
85% RDF	1334	3936	5270	25.3
100% RDF	1362	4059	5421	25.1
115% RDF	1370	4071	5451	25.1
SEm	20	20	39	0.18
CD at 5%	70	69	139	NS
Crop geometry				
30 cm x 10 cm	1348	4128	5477	24.5
25 cm x 15 cm	1461	4326	5787	25.2
30 cm x 15 cm	1386	4146	5533	25.0
25 cm x 20 cm	1318	3928	5246	25.1
30cm x 20 cm	1243	3752	4995	24.8
25 cm x 25 cm	1203	3582	4785	25.0
SEm	21	23	44	0.21
CD at 5%	61	65	126	NS

Table 2: Effect of various treatments on NPKS uptake in seed of late sown Indian mustard taken after Clusterbean

Treatments	N uptake (Kg/ha)	P uptake(Kg/ha)	K uptake(Kg/ha)	S uptake (Kg/ha)
Fertilizer doses				
70% RDF	35.44	8.65	9.64	16.23
85% RDF	38.97	9.73	10.93	17.75
100% RDF	39.83	10.05	11.42	18.36
115% RDF	40.23	10.26	11.61	18.62
SEm	0.52	0.11	0.15	0.26
CD at 5%	1.85	0.39	0.54	0.93
Crop geometry				
30 cm x 10 cm	38.01	9.16	10.30	17.35
25 cm x 15 cm	41.88	10.34	11.68	19.25
30 cm x 15 cm	40.29	10.03	11.35	18.51
25 cm x 20 cm	38.44	9.80	11.12	17.87
30cm x 20 cm	36.88	9.40	10.59	16.96
25 cm x 25 cm	36.20	9.31	10.39	16.50
SEm	0.65	0.19	0.20	0.26
CD at 5%	1.87	0.53	0.57	0.92

Results revealed that nutrient uptake (N, P, K and S) in stover increased with successive increase in fertilizer doses 70% to 115% RDF. Application of 85% RDF recorded significantly higher values of nutrient uptake (N, P, K and S) in stover over 70% RDF, but at par with the 85% and 100% RDF. Nutrient uptake (N, P, K and S) in stover of late sown Indian mustard differed significantly under varying crop geometry. Crop geometry (25 cm x 15 cm *i.e.*, 2.66 lakh plants/ha) had higher nutrient uptake (N, P, K and S) in stover over all other crop geometries (30 cm x 15 cm, 25 cm x 20 cm, 30cm x 20 cm and 25 cm x25cm).

Table 3: Effect of various treatments on NPKS uptake in Stover of late sown Indian mustard taken after Clusterbean

Treatments	N uptake (Kg/ha)	P uptake (Kg/ha)	K uptake (Kg/ha)	S uptake (Kg/ha)
Fertilizer doses				
70% RDF	30.23	6.75	8.92	14.34
85% RDF	32.35	7.56	10.22	15.57
100% RDF	32.92	8.00	10.81	16.04
115% RDF	33.65	8.50	11.34	16.61
SEm	0.19	0.19	0.10	0.14
CD at 5%	0.69	0.68	0.37	0.52
Crop geometry				
30 cm x 10 cm	31.79	6.45	9.16	15.12
25 cm x 15 cm	35.10	8.10	11.06	16.88
30 cm x 15 cm	33.80	8.09	10.83	16.42
25 cm x 20 cm	31.86	7.93	10.42	15.40
30cm x 20 cm	31.19	7.83	10.37	15.16
25 cm x 25 cm	29.99	7.80	10.04	14.84
SEm	0.36	0.32	0.31	0.28
CD at 5%	1.06	0.92	0.89	0.82

DISCUSSION

Application of 115%, 100% and 85% RDF increased in the seed yield to the tune of 10.5%, 9.8% and 7.6% respectively over 70% RDF. This can be attributed to increase in fertilizer doses which improved LAI and might have resulted in higher production of photosynthates and their translocation to sink (yield attributes), which results to the better yield attributes *viz.* number of siliquae/plant, number of seeds/siliqua, 1000 seed weight and seed yield/plant. Whereas, Seed yield have positive relation with the yield attributes. The increase in seed yield and its attributes with increase in fertilizer doses have also been observed by Singh *et al.* [12]. Lower seed yield/ha under very close spacing of 30 cm x 10 cm (3.33 lakh plants/ha) might be ascribed to poorly developed yield attributes *i.e.* number of siliquae/plant, number of seeds/siliqua, 1000 seed weight and seed yield/plant as a result of overcrowding of plants. Corroborative finding have also been reported by Geetha *et al.* [5]. Application of fertilizer doses affected a significant increase in stover and biological yield upto 115% RDF and harvest index upto 85% RDF, though an increasing trend was evident in both the highest fertilizer doses except in case of harvest index where increase was only 85% RDF. This is due to fact that increased in fertilizer doses resulted in an increase in plant height, number of primary branches, dry matter accumulation per plant and LAI (Table 6, 7, 8, 9 and 10), respectively which ultimately resulted into increase in stover and biological yield. Increasing fertilizer doses may increase the seed yield in greater proportion as compared to stover yield and resulted thereby an increased in harvest indices value. Corroborative finding have also been reported by Trivedi *et al.* [13].

Crop geometry (25 cm x 15 cm *i.e.* 2.66 lakh plants/ha) resulted into significantly higher stover yield over all other crop geometries. Closer spacing because of much higher number of plants per unit area resulted in higher stover as well as biological yield. . Crop geometry of 25 cm x 15 cm recorded highest harvest index (25.2 %). This is due to higher seed yield per hectare, resulted higher HI. Similar results were observed by Kumari *et al.* [6].

Nutrient uptake (N, P, K and S) in seed increased with successive increase in fertilizer doses 70%, 85%, 100% and 115% RDF. This is due to more availability of nutrients under higher rate of fertilizer dose, resulted higher absorption and improved the concentration of nutrient in plants. However, application of 85% RDF recorded significantly higher values of nutrient uptake (N, P, K and S) in seed over 70% RDF, but the differences among 85%, 100% and 115% RDF were found to be non-significant. This might be attributed that the fertilizer doses not only effect the concentration of nutrients but also resulted in higher dry matter accumulation. It seemed that the seed and stover yield were more deciding factors for uptake of these nutrients. The results are in consonance with those of Dabi *et al.* [3]. Nutrient uptake (N, P, K and S) in seed and stover of Indian mustard differed significantly under varying crop geometry. Crop geometry (25 cm x 15 cm *i.e.* 2.66 lakh plants/ha) had higher nutrient uptake (N, P, K and S) in seed and stover over other crop geometries (30 cm x 15 cm, 25 cm x 20 cm, 30 cm x 20 cm and 25 cm x 25 cm), respectively. It seemed that the seed and stover yield were more deciding factors for uptake of these nutrients. The present findings are in accordance with those of Kumari *et al.* [6] and Rajput [8].

CONCLUSION

From present investigation, it can be concluded that Fertilizer doses 70%, 85%, 100% and 115% RDF (RDF 80 kg N + 30 kg P_2O_5 + 20 kg K_2O + 40 kg S per hectare) application in late sown Indian mustard significantly enhanced the seed yield but the difference was significant up to 85% RDF. Significantly higher seed, straw and biological yield were recorded at crop geometry (25 cm x 15 cm) over all other crop geometries significantly higher nutrient uptake (N, P, K and S) in seed and stover were observed at a crop geometry of 25 cm x 15 cm along with application of 115 % RDF.

REFERENCES

1. Alam, M.M., Begum, F. and Roy, P. (2014). Yield and yield attributes of rapeseed- mustard (*Brassica*) genotypes under late sown condition. *Bangladesh Journal Agrcultural Research,* 3**9(2)**: 311-336.
2. Anonymous. 2016. http,//www.indiastat.com/agriculture/2.
3. Dabi, B., Singh, J.K., Singh, R.K. and Vishwakarma, A. (2015). Quality and profitability of Indian mustard (*Brassica juncea*) as affected by nutrient- management practices under irrigated condition. *Indian Journal of Agronomy,* **60(1)**: 168-171.
4. FAO STAT. (2017). Prospects for Food, Nutrition, Agriculture and Major Commodity Groups. www.fao.org/ docrep/009/a0607e/a0607e00.htm.
5. Geetha, V.V., Balamurugan, P. and Subrahmaniyan, K. (2011). Assessment of population dynamics and mother crop nutrition on seed yield and quality in mustard CV.GM 2. *American Journal of Plant Nutrition and Fertilization Tehnology*, **1(1)**: 48-54.
6. Kumari, A., Singh, R.P. and Yashpal (2012). Productivity, nutrient uptake and economics of mustard hybrid (*Brassica juncea*) under different planting time and row spacing. *Indian Journal Agroonomy* **57:** 61-67.
7. Panse, U.G. and Sukhatme, P.V. (1967). Statistical methods for Agricultural Workers, ICAR, New Delhi.
8. Rajput, A.L. (2012). Effect of plant density, N levels and moisture conservation practices on the performance of Indian mustard (*Brassica juncea*) and available N status of soil. *Indian Journal of Agronomy,* **57(2)**: 171-175.
9. Shekhawat, K., Rathore, S. S., Premi, O.P., Kandpal, B. K. and Chauhan, J. S. 2012. Advances in agronomic management of Indian mustard (*Brassica juncea* L.), An overview. *International Journal of Agronomy*.
10. Singh, C., Singh, P. and Singh, R. 2009. Modern techniques of raising field crops. 2nd edition. Oxford and IBH publishing company private limited, New Delhi, 337.
11. Singh, R. Kumar, A. and Kumar, P. 2014. Performance of Indian mustard (*Brassica juncea* L.) in response to integrated nutrient management. *Journal of Agrisearch,* **1(1)**: 9-12.
12. Singh, S.K and Singh, G. 2002. Response of Indian mustard *(Brassica juncea*) varieties to nitrogen under varying sowing dates in eastern Uttar Pradesh. *Indian Journal of Agronomy,* **47**: 242-248.
13. Trivedi, S.K., Pachauri, R.K., Sharma, G., Joshi, B.S. and Rajput, B. 2013. Effect of moisture Regimes, NPK and zinc levels on growth, yield, quality, nutrient uptake and economics of mustard (*Brassica juncea)*. *Journal of Soils and Crops,* **23(1)**: 78-85.
14. Lindner R.C. (1944). Rapid analytical methods for some of the most common inorganic constituents of plant tissues. *Plant Physiology,* **19:** 76-89.
15. Koeing, R. and Johnson, C. (1942). Colorimetric determination of Phosphorus in biological materials. *Industrial and Engineering Chemistry Analytical Edition* **14 (2):** pp 155–156.
16. Jackson, M.L. (1973). Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi. pp. 214-221.
17. Chesnin, L.S. and Yien, C.H. (1950). Turbidimetric determination of available sulphates. *Procific Soil Science Society of America.* **14:** 149-51.

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