RESEARCH COMMUNICATION

PERFORMANCE OF INDIAN MUSTARD (*BRASSICA JUNCEA* L.) GENOTYPES ON PLANT GEOMETRY

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Abstract: A field experiment was conducted during winter (*rabi*) season of 2015-16 at Banaras Hindu University, Varanasi to assess the effect of planting geometry on growth and yield of Indian mustard (*Brassica juncea* L.) genotypes. The treatments were comprised of three genotypes (NRCHB-101, Kranti and RGN-73) and four levels of planting geometry (30 cm x 10 cm, 30 x 20 cm, 45 cm x 15 cm and 45 cm x 30 cm). Mustard genotype 'RGN-73' showed its distinct superiority over 'Kranti' and 'NRCHB-101' and proved to be the most suitable genotype, and planting geometry of 45 cm x 15 cm was observed to be the optimum plant geometry as this treatment was superior over other corresponding treatments of plant geometries, *viz.,* 30 cm x 10 cm, 30 cm x 20 cm and 45 cm x 30 cm. This was corroborated from the similar significantly higher values of plant height, dry matter accumulation/plant, primary and secondary branches/plant, yields and other quality components recorded under the best treatments (genotype 'RGN-73' and geometry of 45 cm x 15 cm). The highest net profit could be realized with the plant geometry of 45 cm x 15 cm of Indian mustard genotype 'RGN-73'.

Keywords: Genotype, Plant Geometry, Indian mustard, Yield

INTRODUCTION

Oilseed *Brassicas* occupies prominent position in the country during winter season contributing nearly 23.5% and 24.2% to the total oilseed cropped area and production, respectively **(**GOI, 2014**)**. Indian mustard (*Brassica juncea* (L.) Czernj and Cosson) is an important winter (*rabi*) oilseeds crop of Rajasthan, Gujarat, Madhya Pradesh, Haryana, Uttar Pradesh, Bihar, West Bengal and Assam. India occupies third position in rapeseed-mustard production in the world after China and Canada. For increasing the productivity of mustard crop, the improved varieties which are capable of giving high yields should be cultivated. Production of any genotypes is greatly influenced by surrounding biosphere as well as non-monitory inputs like sowing distance, selection of seeds, sowing time etc. Planting geometry decided on the basis of plant ideotype which provide the condition for greater light interception during early crop growth stages. It is, therefore, imperative to define plant geometry to accommodate more number of plants per unit area. Planting geometry *i.e*. row to row and plant to plant distance plays a vital role in harnessing potential yield. Sub-optimal planting geometry, wider row and plant spacings leads to low population which in turn fails to compensate the yield obtained with optimum plant population, while narrower row and plant spacings increase the inter and intra-plant competition leading to poor growth, development and dry matter accumulation resulting in poor yield (Sharma, 1992). Thus, the optimal plant geometry for Indian mustard is required for obtaining maximum yield. Selection of appropriate genotype for the region is also one of the major concerns. Even before releasing the variety, a typical variety trial is conducted under different location to check the suitability, but only environment is not yield governing factor, it also affected by ecosystem as well as physico-chemical properties of soil. Therefore, considering the above factors, the present study was carried out to study the performance of Indian mustard genotypes on plant geometries.

MATERIAL AND METHOD

A field experiment was carried out during winter (*rabi*) season of 2014-15 at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi ($25^0 18'$ North latitude, $83^0 03'$ East longitude and at an altitude of 128.93 meters above the mean sea level). Mean minimum and maximum temperature during the crop season ranged from 5.8 to 22.1^{o}C and 17.1 to 39.2^{o}C, respectively. Rainfall of 188 mm was received during the crop growth period. The maximum rainfall of 61.2 mm was recorded in the month of April, 2015. Soil of the experimental field was sandy loam in texture free from salts, neutral in reaction (pH 7.4), low in organic carbon (0.39%), available nitrogen (147 kg/ha), medium in available phosphorus (21.5 kg/ha) and rich in available potassium (246.1 kg/ha). Twelve treatment combinations comprising three genotypes, *viz.*, NRCHB-101 (V_1), Kranti (V_2), RGN-73 (V_3) and four plant geometries *i.e.* G_1 (30 cm x 10 cm), G_2 (30 cm x 20 cm), G_3 (45 cm x 15 cm), and G_4 (45 cm x 30 cm) were tried in split-plot designed with three replications. Net plot size was 12.96 m^2 (3.6 m x 3.6 m). Genotypes were sown during the last week of

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October 2015. All other recommended package of practices was adopted for raising a good crop. Harvesting was done during last week of February 2016. Seed oil content was estimated by the conventional Soxhlet's method taking petroleum ether as a solvent (AOAC, 1995) where seed samples were kept in an oven at 70°C for removal of moisture after which the seeds were crushed in a pestle-mortar for extraction of oil. The oil content was expressed in per cent. Oil yield was calculated by multiplying seed yield and oil content in the seed. Economics of different treatment combinations were also worked out by taking account the cost of cultivation and sale value of produce.

RESULT AND DISCUSSION

Among genotypes, variation in plant height and dry matter accumulation/plant were significant. Mustard genotype 'RGN-73' was recorded the highest plant height due to rapid initial growth habit, and the lowest plant height was recorded in 'Kranti' due to its slow initial growth habit (Table 1). Dry matter accumulation/plant was higher in 'RGN-73' compared to 'Kranti' and 'NRCHB-101' at all the growth stages except at 30 days after sowing (DAS). The results of present investigation are in agreement with the findings of Singh *et al.* (2008). Similar to plant height and dry matter accumulation/plant, the highest number of primary and secondary were recorded under 'RGN-73' at all the growth stages of the crop. Moreover, 'RGN-73' seems to have higher capacity to utilize photosynthates more efficiently for achieving maximum production of more number of branches and higher dry matter production.

Significantly taller plants and higher dry matter accumulation/plant were recorded with the plant geometry of 45 cm x 15 cm at all the growth stages of the crop except at 30 DAS (Table 1). Number of primary branches and secondary branches/plant were also significantly greater with 45 cm x 15 cm. Higher dry matter accumulation/plant was mainly attributed to higher plant height, number of primary and secondary branches/plant. These findings were in conformity with Kumari *et al.* (2011).

Data with respect to seed yield as affected by different genotypes and plant geometries (Table 2) revealed that seed and stover yield and biological yield of Indian mustard were significantly higher for 'RGN-73' and was superior to 'Kranti' and 'NRCHB-101'. Maximum seed yield was recorded with plant geometry of 45 cm x 15 cm, which was significantly superior to all other treatments of plant geometries. Contrary to seed yield, data pertaining to oil content in seed of mustard as influenced by different genotypes and plant geometry indicated similar values with some differences in total oil yield (Table 2). The interaction effect of genotypes and planting geometry on various parameters of mustard was found non-significant.

Table 1. Effect of plant geometry on growth parameters of Indian mustard genotype at different stages

Treatment	Plant height (cm)				Dry matter accumulation (g) /plant				Primary branches /plant				Secondary branches /plant		
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	60 DAS	90 DAS	At harvest
Genotype															
NRCHB-101	13.6	50.5	109.4	115.7	1.79	6.70	16.31	22.37	2.0	6.5	7.6	7.9	12.2	16.9	18.0
Kranti	13.1	50.0	108.1	114.3	1.33	6.19	18.89	22.02	2.0	6.5	7.6	7.9	12.2	16.8	18.0
RGN-73	15.7	56.3	121.8	128.8	1.88	7.59	20.66	24.73	2.1	7.5	8.8	9.2	14.1	19.8	20.7
SEm ±	0.3	1.2	2.9	3.0	0.04	0.18	0.56	0.65	0.1	0.2	0.2	0.2	0.4	0.5	0.5
CD (P=0.05)	1.1	3.8	8.4	8.9	NS	0.54	1.65	1.96	NS	0.6	0.6	0.7	1.0	1.4	1.5
Plant Geometry															
30 x 10	14.1	42.0	90.9	96.1	1.70	6.35	8.58	10.87	1.9	6.0	7.0	7.3	11.2	15.5	16.5
30 x 20	13.8	50.3	109.1	115.4	176	6.25	16.15	19.10	2.0	6.6	7.8	8.1	12.5	17.2	18.4
45 x 15	14.3	61.7	133.6	141.3	1.90	9.20	26.54	31.26	2.1	7.7	9.0	9.4	14.4	19.9	21.2
45 x 30	14.4	55.0	118.8	125.6	1.85	7.51	25.67	31.16	2.1	7.0	8.3	8.6	13.2	18.2	19.5
SEm±	0.4	1.5	3.3	3.5	0.05	0.21	0.65	0.76	0.1	0.2	0.3	0.3	0.4	0.6	0.6
CD(P =0.05)	NS	4.3	9.7	10.2	NS	0.62	1.92	2.25	NS	0.6	0.7	0.8	1.2	1.6	1.8

DAS: Days after sowing; NS: Non-Significant

Table 2. Effect of plant geometry on yields, oil content and oil yield of Indian mustard genotype

Treatment	Grain yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Oil content (%)	Oil yield (kg/ha)
Genotype						
NRCHB-101	1382	4634	6016	22.97	39.36	544
Kranti	1365	4580	5945	22.96	39.44	538
RGN-73	1530	5161	6691	22.87	40.26	616
SEm±	37	159	166	0.73	1.20	30
CD(P = 0.05)	110	465	487	NS	NS	NS
Plant Geometry						
30 x 10	1143	3851	4994	22.89	38.86	444
30 x 20	1382	4620	6002	23.03	39.48	546

45 x 15	1702	5662	7364	23.11	40.55	690
45 x 30	1510	5032	6542	23.08	39.93	603
SEm±	44	182	192	0.84	1.40	35
CD(P = 0.05)	131	535	562	NS	NS	103

Table 3. Interaction effect of plant geometry on economics of Indian mustard genotype

Treatment	Gross return (`/ha)	Net return (`/ha)	B:C* ratio
V_1G_1	30,547	15,247	1.00
V_1G_2	37,970	22,670	1.48
V_1G_3	44,455	29,155	1.91
V_1G_4	42,775	27,475	1.80
V_2G_1	31,364	16,064	1.05
V_2G_2	36,666	21,366	1.40
V_2G_3	47,461	32,161	2.10
V_2G_4	38,396	23,096	1.51
V_3G_1	34,860	19,560	1.28
V_3G_2	39,157	23,857	1.56
V_3G_3	51,075	35,775	2.34
V_3G_4	45,844	30,544	2.00

*Cost of cultivation: `15,300/ha

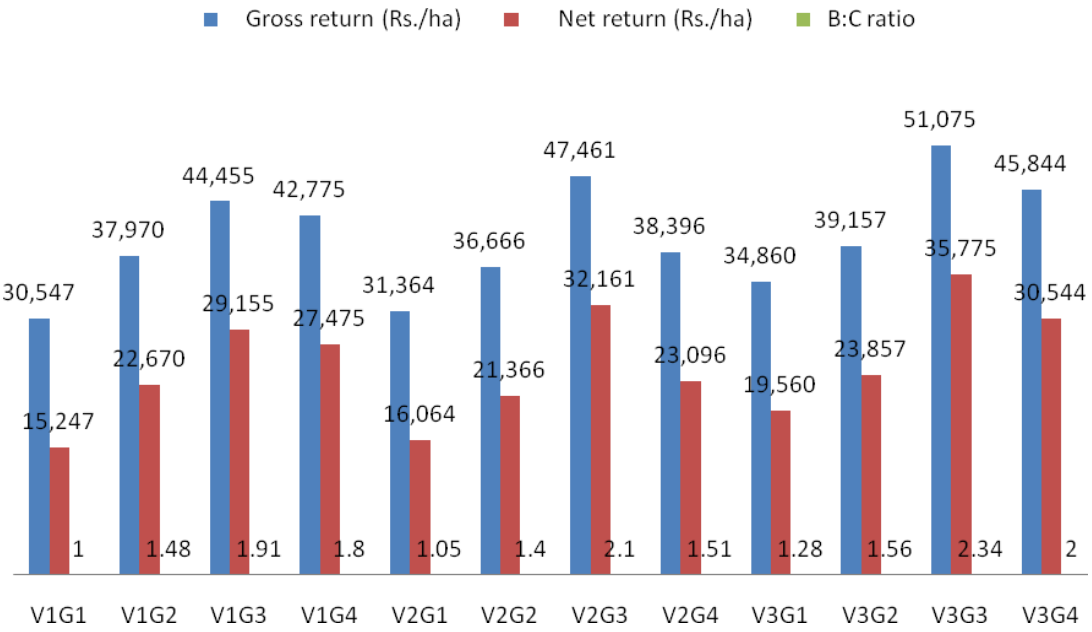

Fig. 1: Interaction effect of plant geometry on economics of Indian mustard genotype

On the basis of economics, it is evident from the data that maximum gross income (`51, 075/ha) as well as net return (`35, 775/ha) was obtained under the treatment combination of V_3G_3 ('RGN-73' and plant geometry 45 cm x 15cm). Similarly, the benefit: cost ratio in terms of net return per rupees invested indicated that maximum benefit: cost ratio (2.34) was recorded (Table 3) under the treatment combination of V_3G_3 ('RGN-73' and plant geometry 45 cm x 15 cm).

It can be inferred that mustard genotype 'RGN-73' proved to be most productive and remunerative genotype at plant geometry of 45 cm x 15 cm under the agro-ecological conditions of eastern Uttar Pradesh.

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