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Yield and Yield Attributes of Hybrid Mustard as Affected by Crop Geometry and Varieties

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A B S T R A C T

A field experiment was carried out in the CR Farm of Gayeshpur, BCKV, Nadia, West Bengal, India during *rabi* season of 2015-16 and 2016-17 to find out suitable hybrid variety and optimum spacing for different hybrids. Three hybrid varieties of mustard *viz.* Kesari 5111(V_1), Kesari 5222(V_2) and Kesari Gold(V_3) were taken as treatments in the main plot, whereas, four spacing - 30cm × 10cm (S_1), 30cm × 20cm (S_2), 40cm × 20cm (S_3) and 40cm × 30cm (S_4) were imposed as subplot treatment. The experiment was conducted in split plot design with 3 replications and repeated in *rabi* seasons for two consecutive years (2015-16 and 2016-17). The results of the experiment revealed that the maximum seed yield was recorded in Kesari Gold (1746 and 2153 kg ha^{-1} respectively in 1st and 2nd year) followed by Kesari 5111. Regarding plant geometry significantly higher yield was noticed in 30 cm × 20 cm (1689 $kgha^{-1}$ and 2244 kg ha^{-1} respectively in 1st and 2nd year). Crop geometry 40 cm × 30 cm observed superior with respect of number of primary branches/plant and seeds/siliqua, but it was not reflected on seed yield due to less number of plants per unit area. The hybrid varieties of mustard are highly suitable in Gangetic plains of West Bengal due to their higher yields. Slightly wider spacing (30 cm × 20 cm) is suitable for hybrids because of their bigger canopy.

Introduction

Indian mustard (*Brassica juncea* L.) belonging to family *Cruciferae* is one of the most important winter oilseed crops, occupies a prominent place among oilseed crop being next to groundnut in importance. Presently rapeseed mustard sown area in India is 6.36 mha, with a production of 8.03 mt. The average productivity is 1262 $kgha^{-1}$ (Directorate of Economics and Statistics, Department of Agriculture and Cooperation, 2012-13), which needs to be enhanced upto 2562 $kgha^{-1}$ by 2030 for ensuring edible oil for self-reliance (DRMR, 2011). Indian mustard is a fairly high remunerative crop with a major source of high quality edible oil and for increasing the productivity of mustard crop the improved varieties which are capable of giving high yields like hybrid varieties need to be cultivated. Selection of varieties depends mainly on the several factors eg. method of sowing, crop rotation, pest and disease management, irrigation facilities, climatic conditions etc. Planting geometry i.e row spacing is one of the very important

practices for mustard production (Mondal *et al.,* 1999). Suboptimal planting geometry, wider rows and plant spacing lead to low population which in turn fail to compensate the yield obtained in optimum plant stand while narrower row and plant spacing increase the inter and intra-plant competition leading to poor growth and development and dry matter accumulation resulting in poor yield. Improved varieties of mustard or hybrid are capable of higher yields when grown under optimum row spacing and fertility level. Decreasing crop yield in improper spacing has been reported by many workers (McDonald *et al.,* 1983). The improper row spacing of mustard decreased seed yield through synchronization of silique filling period with high temperature, the decreased in assimilates production, drought stress occurrence, shortened silique filling period and acceleration of plant maturity (Mendham *et al.,* 1995). Hence an attempt was made to study the effect of varieties and sowing method on yield attributes and yield of hybrid mustard under Gangetic alluvial soil of West Bengal.

Materials and Methods

A field experiment was conducted at Regional Research station, New Alluvial Zone, Bidhan Chandra KrishiViswavidyalaya, Gayeshpur, Nadia. The experimental site is situated at 23º8'N latitude and 88 º E longitudes having an average altitude of 9.75m above mean sea level. The soil of the experimental site was Gangetic alluvial with sandy clay loam texture, good water holding capacity, well drained and moderate fertility status. The experimental site located in sub-humid, sub-tropical zone and lies in Indo-Gangetic alluvial agro-ecological zone. The average annual rainfall ranged from 1300 to 1450mm and major portion of rainfall is generally received during the month of June to middle of October. The mean monthly temperature ranged from 9ºC to 36ºC. During the crop growing period maximum temperature varied from 31.9ºC to 31.3ºC (2015-16), 29.7ºC to 28ºC (2016-17) and minimum temperature varied between 21.8ºC to 18.8ºC (2015-16), 20.5 to 17.7ºC (2016-17). The mean maximum relative humidity was highest in the month of November (93.3% in 2015 and 93.4% in 2016), whereas the mean minimum relative humidity was in March (47.5% in 2016 and 45.6% in 2017). Three mustard hybrid variety namely V1- Kesari 5111, V2- Kesari 5222, V3- Kesari Gold as main plot treatment and S1- 30 cm x 10 cm, S2- 30 cm x 20 cm, S3- 40 cm x 20 cm, S4- 40 cm x 30 cm as sub-plot treatment were included in the experiment. Land was prepared by 4 ploughing followed by planking after each ploughing. The land was made free from weeds and stubble of previous crop. After proper levelling the whole experimental field was divided into 3 equal blocks. Then each of the blocks were divided into 3 main-plots and ultimately each of the main-plot were again split into 4 equal sub-plots. Mustard crop was sown in line with the help of tyne as per treatment. The crop was fertilized with a uniform amount of nitrogene, phosphorus and potassium at the rate of 80, 40 and 40 kg/ha respectively. The 50% dose of N and full dose of P_2O_5 and K_2O were applied as basal. The rest amount of nitrogen was applied in two splits with the equal amount at 21 DAS and at 42 DAS. Five plants were randomly selected from each plot and tagged. The total no. of primary branches produced per plant counted at harvest from five tagged plants in all treatments. The mean of five plants were represented as the no. of primary branch per plant. Total no. of siliqua per plant was recorded from five tagged plants. Mean of five plants was recorded as the no. of siliqua produced per plant. Randomly 5 siliqua were chosen from siliqua of 5 tagged plants and seeds were counted in each siliqua and their mean was recorded as number of

seeds/siliqua. The weight of thousand grains (g) was recorded from the grain samples drawn from the produce obtained from each of net plot. Yield was determined from the well dried seeds collected from net plot area excluding the border effect each plot. Then the mean yield was converted into kg/ha. Biological yield from net plot was calculated and expressed as kg/ha. Stover yield of each net plot was recorded after complete sun drying and expressed in kg/ha. Biological yield from net plot was calculated and expressed as kg/ha. Biological yield was obtained by summing seed yield and stover yield from net plot.

Results and Discussion

The no. of primary branches per plant, no. of siliqua/plant, no. of seeds/siliqua and test weight are important yield attributing character for Indian mustard. Effect of varieties and crop geometry on yield component has been presented in Table 1. No. of primary branches were significantly influenced by varieties in 1st year and maximum no. were recorded by Kesari Gold (7). Crop geometry significantly influenced the no. of primary branches. Maximum no. of primary branches (7.78) was obtained at 40 cm x 30 cm spacing during 1st year and in 2nd year S3 recorded higher no. of primary branches (6.31) which is at par with S4. Number of siliqua/ plant and no. of seeds/siliqua were significantly influenced by varieties. Kesari Gold recorded maximum no. (367.93 and 306.90 respectively in 1st and 2nd year) and S4 spacing i.e. 40 cm x 30 cm recorded maximum no. of siliqua/plant. Singh *et al.,* (2001) conducted an experiment in Jodhpur and observed that number of siliqua/plant recorded higher in cultivar Pusa Bold (257) compared to cultivar TS9 (198). In interaction (Table 2) maximum number of siliqua /plant was recorded by V3 (Kesari Gold) along with spacing S3 spacing (496.00). Wider spacing favours higher number of siliqua/plant. Difference of siliqua number among different varieties may be due to genetic character. Somondal *et al.,* (2012) recorded different number of siliqua/plant by different mustard varieties.

Maximum no. of seeds/siliqua were obtained in Kesari 5111 (14.58) in 1st year and Kesari Gold (16.46) in 2nd year. Crop geometry significantly influences the no. of seeds/siliqua in 2nd year. Maximum no. was found at 40 cm x 30 cm spacing. It has been observed that varieties significantly influence the test weight. Highest test weight was found in Kesari Gold (6.78) in 1st year and in 2nd year Kesari 5111 (5.36) recorded highest test weight, which is at par with V3 i.e. Kesari Gold. Crop geometry did not show any significant effect on test weight. Yield contributing characters were highest in V3-Kesar Gold and lowest in V2 – Kesari 5222. Although interaction effect did not show any significant effect on yield attributing characters except for no. of siliqua/ plant in the first year. The findings are in line with Mamun (2005) who stated that yield contributing characters are higher in HYV of mustard.

Seed yield (kg/ha) as affected by varieties and crop geometry have been presented in (Table 3). A perusal of data showed that different crop geometry influenced significantly to the seed yield. Among the varieties highest seed yield (1746 kg/ha and 2153kg/ha respectively 1st and 2nd year) was recorded by Kesari Gold which was significantly higher than Kesari 5111 (V1) and Kesari 5222(V2). The minimum seed yield (1358 kg/ha and 1623 kg/ha respectively 1st and 2nd year) was recorded in V2 variety i.e Kesari 5222. Maximum seed yield (1689 kg/ha and 2244 kg/ha respectively in 1st and 2nd year) was recorded when the crop was shown on 30 cm x 20 cm, which was superior over other spacing.

Table.1 Effect of varieties and spacing on yield component of hybrid mustard

Treatments	No. of primary branches/plant		No. of siliqua/plant		No. of seeds/siliqua		Test weight(g)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
V1	6.58	6.32	289.47	256.43	14.58	14.87	4.30	5.36
V2	6.08	5.47	295.83	186.95	13.67	13.25	6.34	5.07
V3	7.00	5.97	367.93	306.90	12.08	16.46	6.78	5.25
S.Em(±)	**0.17**	**0.24**	**17.91**	**20.80**	**0.25**	**0.25**	**0.01**	**0.05**
CD at 5%	**0.68**	**NS**	**70.31**	**81.64**	**1.00**	**1.00**	**0.05**	**0.18**
S1	5.22	5.22	180.87	146.06	12.67	13.64	5.77	5.17
S2	6.56	5.89	335.44	266.28	13.33	14.69	5.77	5.21
S3	6.67	6.31	329.00	280.89	13.89	16.09	5.81	5.27
S4	7.78	6.24	425.67	307.14	13.89	15.01	5.87	5.27
S.Em(±)	**0.26**	**0.21**	**25.94**	**14.91**	**0.47**	**0.41**	**0.01**	**0.02**
CD	**0.77**	**0.62**	**77.07**	**44.28**	**NS**	**1.23**	**NS**	**NS**

Table.2 Interaction effect of varieties and spacing on yield component of hybrid mustard

Treatments	No. of primary branches/plant		No. of siliqua/plant		No. of seeds/siliqua		Test weight	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
V1S1	5.67	5.67	153.20	153.20	15.00	15.00	4.27	5.30
V1S2	6.67	6.53	325.67	235.73	14.33	14.27	4.27	5.31
V1S3	6.00	6.60	238.33	316.07	14.67	15.53	4.31	5.40
V1S4	8.00	6.47	440.67	320.73	14.33	14.67	4.34	5.45
V2S1	4.33	4.33	221.00	89.07	11.33	11.33	6.29	5.00
V2S2	6.00	5.67	330.00	222.87	14.00	13.40	6.30	5.05
V2S3	6.67	6.20	252.67	216.93	14.67	15.33	6.33	5.17
V2S4	7.33	5.67	379.67	218.93	14.67	12.93	6.44	5.07
V3S1	5.67	5.67	168.40	195.92	11.67	14.58	6.74	5.21
V3S2	7.00	5.47	350.67	340.25	11.67	16.42	6.75	5.27
V3S3	7.33	6.13	496.00	309.67	12.33	17.42	6.80	5.24
V3S4	8.00	6.60	456.67	381.75	12.67	17.42	6.83	5.30
SEm(±)	**0.45**	**0.36**	**44.94**	**25.82**	**0.82**	**0.71**	**0.02**	**0.04**
CD at 5%	**NS**	**NS**	**133.50**	**NS**	**NS**	**NS**	**NS**	**NS**

Table.3 Effects of varieties and spacing on seed yield, stover yield and harvest index of hybrid mustard

Treatments	Seed yield(kg/ha)		Stover yield(kg/ha)		Harvest index (%)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
V1	1532	1816	4361	3372	25.97	29.61
V2	1358	1623	6301	4842	19.83	22.45
V3	1746	2153	6417	4769	18.20	26.11
S.Em (±)	55.47	98.04	275	259.42	0.53	2.31
CD at 5%	217.73	384.84	1081	1018.30	2.07	9.06
S1	1349	1705	5822	4383	19.16	27.88
S2	1689	2244	5989	5148	22.07	23.35
S3	1641	1886	6029	4183	21.74	27.24
S4	1502	1620	4931	3598	22.36	25.76
S.Em(±)	68.28	96.99	239	252.5	0.56	1.60
CD at 5%	202.84	288.15	711	750.2	1.65	4.76

Table.4 Interaction Effects of varieties and spacing on seed yield, harvest index, and productivity of rapeseed and mustard

Treatments	Seed yield(kg/ha)		Stover yield(kg/ha)		Harvest Index (%)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
V1S1	1456	1763	4370	4050	25.00	25.00
V1S2	1758	2075	5000	4287	25.97	26.65
V1S3	1534	1856	4337	2732	25.84	36.11
V1S4	1380	1570	3736	2418	27.06	30.70
V2S1	1133	1604	6770	5966	16.38	21.32
V2S2	1401	1825	6117	5041	21.33	23.12
V2S3	1481	1560	6742	4677	20.81	22.82
V2S4	1416	1505	5574	3686	20.79	22.54
V3S1	1457	1748	6326	3133	16.09	37.33
V3S2	1907	2834	6849	6115	18.93	20.29
V3S3	1909	2243	7007	5140	18.57	22.78
V3S4	1711	1786	5485	4689	19.23	24.04
S.Em(±)	118.26	168.00	414.76	437.43	0.96	2.77
CD at 5%	NS	NS	NS	1299.52	NS	3.92

The minimum seed yield (1503 kg/ha) was obtained when sowing was done at 30 cm x 10 cm. The seed yield was significantly affected by different varieties. As discussed earlier, the different hybrids have different yield potential, which is the reason for yield variation among different varieties. In contrast to the traditional OP varieties hybrids have bigger canopy structure and to explore optimum yield potential this hybrids needs wider spacing in comparison to OP varieties.. Rana and Pachauri (2001) observed that the

seed yield recorded higher with 30 cm ×10 cm spacing (1670 kg/ha) as compared to 45 cm ×15 cm spacing (1280 kg/ha).

Stover yield (kg/ha) as affected by varieties and crop geometry have been presented in (Table 3). The stover yield (kg/ha) was significantly affected by different varieties. Highest stover yield (6417 kg/ha) was recorded by Kesari Gold in1st year and in 2nd year it was recorded by Kesari 5222 (4842 kg/ha), which was at par with Kesari Gold. A perusal of data showed that different crop geometry influenced significantly to the stover yield. Maximum stover yield of (6029 kg/ha) was recorded when the crop was shown on 40 cm x 20 cm during 1st year and in 2nd year highest stover yield (5148 kg/ha) was recorded at 30 cm x 20 cm. In interaction table (Table 4) highest stover yield (6115 g/ha) was found when Kesari Gold was sown at 30 cm x 20 cm spacing. Mirza Hasanuzzaman and Md. Fazlul Karim (2007) conducted a field experiment in Bangladesh and reported that 30 cm row spacing produced highest stover yield (2933kg/ha).

Harvest index (%) as affected by varieties and crop geometry have been presented in (Table 3). Maximum harvest index (25.97 % and 29.61 % respectively 1st and 2nd year) was recorded by Kesari 5111. Among the 3 hybrids Kesari 5111 recorded relatively less stover yield in comparison to its seed yield and ultimately showed higher harvest index. A perusal of data showed that different crop geometry influenced significantly to the yield. Maximum harvest index (22.36 %) was recorded when the crop was shown on 40 cm x 30 cm in 1st year, whereas during 2nd year 30 cm x 10 cm attained (27.88 %) higher value. The harvest index (%) was significantly affected by different varieties. In interaction table (Table 4) highest harvest index was found when Kesari Gold was sown at 30 cm x 10 cm spacing. Mirza Hasanuzzaman and Md. FazlulKarim (2007) conducted a field experiment and reported that 30 cm row spacing produced highest harvest index (36.20%).

Form the above results, it may be concluded that the variety Kesari Gold performed better followed by Kesari 5111 and then Kesari 5222. Seed yield and yield attributing characters of hybrid mustard was significantly affected by planting geometry. Wider spacing (30cm x 20cm/ 40cm x 20cm) is essential for hybrid mustard cultivation. This management approach would be easy for farmers to implement because it would mean replacing their old varieties with new hybrid ones.

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