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Response of Indian mustard (*Brassica juncea*) to sowing date and row spacing in mid-hills of Sikkim under rainfed conditions

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) seasons of 1999–2000 and 2000–2001 to study the response of Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson] to sowing date and row spacing. Sowing on 25 September and 5 October recorded significantly higher number of branches, seeds/siliquae, siliquae/plant, 1,000-seed weight and seed yield than that on 15 October, 25 October and 4 November. Seed yield decreased progressively with delay in planting. However, seed yield was significantly influenced by different row spacing. Significantly higher seed yield/ha was recorded with 30 and 45 cm row spacing than 60 cm row spacing. A row spacing of 45 cm was found suitable for crop sown on 25 September and 5 October, while 30 cm was optimum for Indian mustard sown beyond 5 October. Oil content (%) was significantly influenced by sowing date but remained unaffected due to variation in row spacing.

Key words : Indian mustard, Rainfed, Sowing date, Spacing, Yield, Yield attributes

Indian mustard is the second important oilseed crop in India, next to groundnut. In Sikkim hills, it is an important winter (*rabi*) oilseed crop grown as rainfed and occupies about 55% of total oilseed area, but its productivity per unit area is low (744.9 kg/ha) compared to that of national average of 950 kg/ha. Adoption of suitable crop-management practices are important factors for improving crop productivity. Sowing time has a profound effect on growth and yield of mustard (Pawar *et al.*, 1976). Sowing date and spacing, the 2 foremost non-monetary inputs of production can be manipulated to increase the crop productivity. Since information on sowing date and row spacing of Indian mustard in mid-hills of Sikkim is meagre, an experiment

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was conducted to determine the response of Indian mustard to sowing date and row spacing in mid-hills of Sikkim.

MATERIALS AND METHODS

The field experiment was conducted during the winter (*rabi*) seasons of 1999–2000 and 2000–2001 at ICAR Research Complex for N.E.H. Region, Sikkim Centre, Tadong, Gangtok, under rainfed condition. The soil was loamy, low in available nitrogen (203.8 kg/ha), medium in phosphorus (12.4 kg/ha) and high in potassium (233.6 kg/ha), with pH 5.8. The experiment was laid out in randomized block design with 3 replications. The treatments comprised 5 dates of sowing (25 September, 5 October, 15 October, 25 October and 4 November) and 3 row spacings (30, 45 and 60 cm). Indian mustard variety 'Pusa Bold' was grown with recommended dose of fertilizers (80, 60 and 40 kg N, P and K/ha) by maintaining plant spacing of 10 cm by thinning. Half dose of nitrogen and full dose of phosphorus and potassium were applied basal and remaining half dose of N was top-dressed at flowering stage. Application of lime @ 2.0 tonnes/ha was also done in soil 15 days before sowing of crop for amelioration of soil pH. The observations on growth and yield attributes were recorded on the basis of 5 random plants. Observations on soil temperature and soil moisture were recorded during sowing and at 30, 60, 90 and 120 days after sowing (DAS) with the help of soil- thermometer and soil moisture-meter respectively. The mean maximum temperature was 25.7 ± 1.55, 24.8 ± 1.72, 22.2 ±2.03, 18.5 ± 2.1, 16.2 ± 2.27, 17.6 ± 1.96, 21.5 ± 1.69°C and mean minimum temperature was 18.3 ± 1.71, 15.7 ±1.94, 11.9 ± 2.53, 9.2 ± 2.91, 7.2 ± 2.03, 7.5 ± 1.85 and 10.2 ± 1.24°C during September, October, November, December, January, February and March respectively.

The total rainfall received during crop season of first and second experimental years was 504.8 and 498.3 mm respectively. During 1999–2000, crop received 93.1 mm rainfall in the last week of September and 320, 35, 7, 31.6, 21.5 and 116.8 mm rainfall during October, November, December, January, February and March respectively. During 2000–2001, the crop received 86.2, 298, 40.1, 16, 30.4, 19.8 and 111.5 mm rainfall during the last week of September, October, November, December, January, February and March respectively. Based on the mean value of both years, it was found that crop sown on 25 September and 5 October received 407 and 312 mm rainfall up to 50% flowering stage, while crop sown on 15 October, 25 October and 4 November received 145, 42 and 29 mm rainfall, respectively, up to 50% flowering stage. The thermal index at the time of sowing was 21.1 ± 0.8, 20.7±1.1, 20.2 ± 1.6, 19.8 ± 1.8 and 17.6 ± 1.9°C and the soil temperature at sowing time was 27.8, 27.0, 25.2, 23.3 and 19.5° C during first, second, third, fourth and last date of sowing respectively.

RESULTS AND DISCUSSION

Growth attributes

Plant height of 'Pusa Bold' Indian mustard varied due to difference in sowing date. Crop sown on 25 September and 5 October, produced taller plants which were

at par with each other but significantly taller than later-sown crops (Table 1). Plant height decreased with progressive delay in sowing from 5 October to 4 November. Number of secondary branches/plant also showed the same trend due to variation in date of sowing.

Plant height of crop sown at 30, 45 and 60 cm did not differ significantly. However, row spacing influenced the number of secondary branches/plant. Secondary branches/plant increased with successive increase in row spacing. The secondary branches/plant of 45 and 60 cm spaced crop were at par with each other but significantly higher than that of 30 cm spaced crop. Singh *et al.* (1989) also reported similar findings.

Yield attributes

The number of siliquae/plant, seeds/siliqua and 1,000-seed weight are the

Table 1. Effect of date of sowing and row spacing on growth, yield attributes, yield and oil content of Indian mustard (pooled data of 1999–2000 and 2000–2001)

Treatment	Plant height (cm)	Secondary branches/ plant	Siliquae/ plant	Seeds/ siliqua	1,000-seed weight (g)	Seed yield (kg/ha)	Oil content (%)	Oil yield (kg/ha)
Date of sowing								
25 Sep.	158.1	9.9	275.6	11.1	5.3	1,882	33.0	619
5 Oct.	161.4	9.5	279.4	11.1	5.2	1,800	32.6	583
15 Oct.	149.0	8.1	259.3	9.8	4.9	1361	31.0	425
25 Oct.	137.8	7.2	242.4	8.6	4.7	938	30.4	284
4 Nov.	125.8	6.1	223.8	7.6	4.4	668	29.3	197
CD (P=0.05)	8.1	1.2	13.4	0.5	0.1	166	0.4	47
Row spacing								
30 cm	144.1	7.2	238.1	8.8	4.8	1563	31.1	490
45 cm	148.5	8.3	256.7	9.5	4.9	1479	31.3	468
60 cm	151.8	9.1	273.6	10.6	4.9	947	31.4	306
CD (P=0.05)	NS	0.9	10.4	0.4	NS	129	NS	36

Table 2. Interaction effect of sowing date and row spacing on seed yield of Indian mustard during 2000–2001

Interaction	Date of sowing (D)					
	25 Sep.	5 Oct.	15 Oct.	25 Oct.	4 Nov.	Mean
Row spacing(s)						
30 cm	1,968	2,056	1,704	1,266	976	1,594
45 cm	2,366	2,201	1,461	997	707	1,546
60 cm	1,485	1,399	995	620	424	985
Mean	1,940	1,885	1,387	961	702	
CD (P=0.05)						
D × S			269			

important seed yield attributes of Indian mustard. All these attributes were significantly influenced due to sowing dates. Crop sown on 25 September produced yield attributes similar to that sown on 5 October, but further delay in sowing adversely affected the yield attributes (Table 1). This may be due to variation in prevailing weather conditions.

Earlier-sown crop (25 September and 5 October) faced favourable soil-moisture condition and relatively warmer temperature during vegetative phase and conducive temperature during 50% flowering and pod-formation stage, while later-sown crop (15 October, 25 October and 4 November) faced low temperature at the time of emergence as well as at 50% flowering stage. As a result late-sown mustard germinated late and grew slowly during early growth period consequently shortened the reproductive phase (Table 2) and adversely affected the plant growth and development. Pal *et al.* (1985) also reported declining trend in yield attributes with delay in sowing.

The pooled data of yield attributes showed that wider-spaced crop (60 cm) produced significantly more siliquae/plant and seeds/siliqua than 30 and 45 cm spaced crop. Consistent increase in yield attributes with successive widening of row spacing from 30 cm to 60 cm may be due to lesser competition for resources among plants. Butter and Aulakh (1999) also made similar observations. Emergence period of seeds of mustard at different row spacings were same, however 60 cm spaced crop took more number of days to attain 50% flowering and maturity than of 30 and 45 cm spaced crop. Kumar (1992) also observed reduction in branch formation and declining trend in maturity period with an increase in plant density.

Seed and oil yield

The crop sown on 25 September gave grain yield similar to that sown on 5

Table 3. Duration of Indian mustard as influenced by dates of sowing and row spacing (pooled data of 1999–2000 and 2000–2001)

Treatment	Emergence period (days)	50% flowering (days)	80% maturity (days)
Date of sowing			
25 Sep.	6–7	52.7	153.2
5 Oct.	6–7	53.1	154.8
15 Oct.	6–7	64.6	149.1
25 Oct.	7–8	70.0	147.3
4 Nov.	8–10	70.3	144.6
CD (P=0.05)		0.5	0.9
Row spacing			
30 cm	6–7	58.7	145.8
45 cm	6–7	61.4	150.6
60 cm	6–7	66.3	153.0
CD (P=0.05)		0.4	0.7

October but significantly higher by 521, 944 and 1,214 kg/ha than delayed sowing of 15 October, 25 October and 4 November respectively (Table 1). The higher grain yield with early sowing could be attributed to its beneficial influence on yield attributes because the crop had longer growth period and favourable soil moisture and temperature during crop-growth period. The decline in yield in later-sown crops might be due to shorter duration of reproductive phase and longer vegetative phase which allowed less time for siliqua formation and development of seeds. Pal *et al.* (1985) and Kumar and Singh (1989) also recorded similar results. Oil yield and oil content of 25 September and 5 October-sown crops were significantly higher than 15, 25 October and 4 November sown crops (Table 1). Ghosh and Chatterjee (1988) also found that delay in sowing of mustard from third week of October to first week of November reduced the oil content by 2.9%.

Data of pooled analysis showed that seed yield was significantly influenced by row spacing. Seed yield increased by 616 and 532 kg/ha when spacing was reduced to 30 cm and 45 cm from 60 cm respectively. Instead of higher number of yield attributes in widely spaced crop (60 cm), it yielded lesser as compared to 30 and 45 cm spaced crop due to lesser plant population per unit area. Singh *et al.* (1989) also reported that row spacings of 30 cm and 45 cm were equally effective for seed yield of Indian mustard. Oil content in seeds did not differ significantly due to different row spacing. These results are in conformity with those of Sharma *et al.* (1997). However, oil yield differed significantly with difference in row spacing. Highest oil yield (490 kg/ha) was recorded under 30 cm row spacing, being at par with 45 cm row spacing and significantly higher over 60 cm row spacing. This was mainly owing to higher seed yield under 30 cm row spacing.

Interaction effect

The interaction effects of date of sowing and row spacing was significant during 2000–2001 (Table 2). The highest seed yield was registered in the first date of sowing, i.e. 25 September under 45 cm row spacing, which was on a par with second date of sowing, i.e. 5 October, with similar spacing but significantly superior to all other treatments. Crop sown at 60 cm spacing on 25 September and 5 October yielded at par with crop sown at 45 cm on 15 October and 30 cm spaced crop sown on 25 October. Likewise, yield given by Indian mustard sown on 15 October with 60 cm spacing was at par with that of 25 October with 45 cm row spacing and 4 November with 30 cm spacing. Further, yield of crop sown on 25 October at 60 cm spacing was at par with the yield of 4 November with 45 cm spacing.

It was concluded that for achieving higher seed and oil yields, the optimum sowing dates range from 25 September to 5 October. A row spacing of 45 cm is optimum for earlier-sown crop (25 September and 5 October), while 30 cm spacing for later sown crops.

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