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Effect of Sowing Time and Planting Geometry on Yield and Economics of Mustard (*Brassica juncea*)

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ABSTRACT: Due to changing climatic condition such as the shift in onset and withdrawal of monsoon, shift in temperature where the lowest temperature that usually occurs during the middle of December has somehow shifted further. As a result, the desired cooler temperature does not coincide with the flowering period under conventional sowing time. So the time of sowing of mustard has to be adjusted to coincide the time of flowering with the occurrence of lower temperature of the season. A field experiment was conducted at Agronomy Farm, College of Agriculture, Nagpur (Maharashtra), India during *rabi* season of 2020- 21. Mustard *var.* TAM-108-1 was grown on clayey soil, medium in available nitrogen, low in phosphorous and very high in potassium having pH 7.7. The experiment was laid out in Factorial Randomized Block Design with 12 treatment combinations replicated three times. The treatments consist of three sowing dates [First week of November (S_1), Second week of November (S_2) and Third week of November (S_3)] with four planting geometries [30 × 10 cm (G_1), 30 × 15 cm (G_2), 45 × 10 cm (G_3) and 45 × 15 cm (G_4)]. Sowing in first week of November recorded highest yield, yield attributes and economics. Planting geometry of 45 × 10 cm also recorded highest values.

Keywords: Mustard, Sowing time, Planting geometry, Economics.

INTRODUCTION

Productivity of mustard in India (1499 kg ha^{-1}) is quite low compared to other rapeseed mustard producing countries like Germany (3811 kg ha^{-1}), France (3240 kg ha^{-1}), China (1834 kg ha^{-1}) and Canada (1769 kg ha^{-1}) as well as the world average of 1849 kg ha^{-1} (Singh and Bansal, 2020). To improve the productivity of mustard in India and to compensate with other parts of the world, on regional level, a thorough reconsideration of the existing agronomic package of practice is essential, among which sowing time and planting geometry are the important elements. These elements are the most important non-monetary inputs to get a good yield and can be altered to improve the productivity of mustard (Lakra *et al.*, 2018). Delayed sowing leads to poor growth, early onset of flowering, reduction in length of flowering period and seed set as the crops are subjected to unfavorable environmental conditions causing reduction in seed yield (Devi and Sharma, 2017). Sowing at the optimum time gives higher growth and seed yield whereas early or late sowing results in reduction of yield (Meena *et al*., 2017).

For better growth and development of mustard, maintaining proper spacing plays an important role in securing good yield (Mondal *et al*., 1999). 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 (Shekhawat *et al*., 2012). The optimum planting geometry of mustard varies from place to place as the efficiency of different spacing varies. The general recommendation of mustard planting geometry in India is 30 × 10 cm and 45 × 10 cm for varieties and hybrids, respectively (Bhanu *et al*., 2019). But in places where mustard is not grown traditionally, to find out the optimum planting geometry could be a great challenge and improper spacing could lead to reduction in yield attributes and seed yield (Nautiyal *et al*., 2020). Therefore, the present investigation was carried out to study the appropriate sowing time with optimum planting geometry for Indian mustard in Vidarbha region of Maharashtra.

MATERIALS AND METHODS

A field experiment was conducted at Agronomy Farm, College of Agriculture, Nagpur during *rabi* season of 2020- 21 to study the effect of sowing time and planting geometry on yield and economics of mustard (*Brassica juncea*) *var.* TAM-108-1. The experimental soil was clayey in texture with 0.50% organic carbon content with medium in available nitrogen (260.30 kg ha^{-1}), low in available phosphorous (18.25 kg ha^{-1}) and very high in available potassium (370.85 kg ha^{-1}) having pH 7.7. The experiment was laid out in Factorial Randomized Block Design with 12 treatment combinations replicated three times. The treatment consist of three sowing dates [First week of November (S_1), Second

week of November (S_2) and Third week of November (S_3)] with four planting geometries [30 × 10 cm (G_1), 30 × 15 cm (G_2), 45 × 10 cm (G_3) and 45 × 15 cm (G_4)]. Sowing was done and spacing was maintained as per the treatments. Uniform dose of 50:40:0 kg NPK ha^{-1} was applied to all the treatment. Nitrogen was applied in two equal splits at the time of sowing and 30 DAS. No detrimental incidence of insect pest and diseases were observed during the crop growth.

RESULTS AND DISCUSSION

A. Yield and Yield Attributes

Effect of sowing time: Among the three sowing dates, first week of November (S_1) recorded highest yield attributing characters *viz.* number of siliquae per plant, number of seeds per siliqua, length of siliqua, seed yield per plant and straw yield per plant. Highest seed and straw yield (kg ha^{-1}) were also recorded in first week of November sowing (S_1). Data observed in first week of November (S_1) were at par with second week of November (S_2). However, delayed sowing in third week of November (S_3) recorded significantly lowest value in every aspect. Favorable weather condition that prevailed during the crop growth period of timely sown crop (S_1) might have improved development of the crop that might increase the yield attributes *viz.* number of siliquae per plant, number of seeds per siliqua and length of siliqua. Hence, higher seed yield produced in first week of November sowing might be due to improved yield attributing characters. However, reduction in yield attributes, seed and straw temperature during early vegetative phase. This might have retarded development of the crop, yield with delayed sowing might be due to less favorable weather conditions such as cool consequently affecting the yield.

Table 1: Yield and yield attributes of mustard as influenced by various treatments.

Treatments	Number of siliquae per plant	Number of seeds per siliqua	Length of siliqua (cm)	Seed yield per plant (g)	Straw yield per plant (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})
A. Sowing time							
S_1- First week of November	218	10.6	4.66	5.10	13.1	1302	3656
S_2- Second week of November	212	10.3	4.54	4.96	12.7	1239	3613
S_3- Third week of November	173	9.33	4.10	4.49	11.6	970	3101
SE(m) ±	2.2	0.10	0.04	0.14	0.3	47	135
CD at 5%	**6.4**	**0.30**	**0.13**	**0.44**	**0.9**	**138**	**396**
B. Planting Geometry							
G_1- 30 ×10 cm	170	9.29	4.16	4.46	11.7	1036	3164
G_2- 30 ×15 cm	175	9.61	4.28	4.63	12.1	1109	3343
G_3- 45 ×10 cm	233	10.9	4.71	5.20	13.3	1321	3745
G_4- 45 ×15 cm	225	10.6	4.66	5.11	12.7	1214	3575
SE(m) ±	2.9	0.14	0.05	0.17	0.4	54	156
CD at 5%	**8.5**	**0.40**	**0.16**	**0.50**	**1.1**	**159**	**457**
Interaction (S × G)							
SE(m) ±	8.7	0.41	0.13	0.29	0.6	94	270
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
G. M.	201	10.1	4.43	4.83	12.5	1170	3457

Patel *et al.* (2015) also reported reduction in number of siliquae per plant, seed, stover and biological yield with delayed sowing and the same results were reported by Prasad *et al.*, (2020).

Effect of planting geometry: Yield attributes *viz.* number of siliquae per plant, number of seeds per siliqua, length of siliqua, seed yield per plant and straw yield per plant were highest with 45 × 10 cm planting geometry (G_3) which was at par with 45 × 15 cm (G_4). Seed yield (kg ha^{-1}) was highest with planting geometry of 45 × 10 cm (G_3) which was also at par with 45 × 15 cm (G_4). In case of straw yield (kg ha^{-1}), highest record was obtained from 45 × 10 cm (G_3) which was statistically at par with 45 × 15 cm (G_4) and 30 × 15 cm (G_2) planting geometry. Closer planting geometry of 30 × 10 cm (G_1) recorded lowest values both in yield and yield attributes. With less number of plants per unit area, availability of enough growing space in wider row spacing might have enhanced the utility of available resources such as sunlight, moisture, nutrients, etc. Reduction in competition among the crop might have improved the yield and yield attributes. Singh *et al.*, (2016) also reported highest yield attributes and yield with 45 × 10 cm planting geometry and lowest with 30 × 10 cm. Similar results were also reported by Paraye *et al.*, (2009).

B. Economics

Effect of sowing time: Significantly highest gross and net monetary returns of Rs. 64,180 and 42,175 ha^{-1}, respectively were obtained from first week of November sowing (S_1) and was superior over other sowing dates. Highest B: C ratio of 2.92 was also observed with first week of November sowing over sowing in second and third week of November (2.78 and 2.19, respectively). These results corroborate the findings of Singh and Singh (2014); Singh *et al.*, (2018).

Table 2: Economics of mustard as influenced by various treatments.

Treatments	GMR (Rs. ha^{-1})	NMR (Rs. ha^{-1})	B:C Ratio
A. Sowing time			
S_1-First week of November	64180	42175	2.92
S_2- Second week of November	61219	39214	2.78
S_3-Third week of November	48194	26189	2.19
SE (m) ±	669	669	—
CD at 5%	**1963**	**1963**	—
B. Planting Geometry			
G_1- 30 ×10 cm	51358	29353	2.33
G_2- 30 ×15 cm	54896	32891	2.49
G_3- 45 ×10 cm	65166	43161	2.96
G_4- 45 × 15 cm	60036	38031	2.73
SE(m) ±	892	892	—
CD at 5%	**2617**	**2617**	—
Interaction (S × G)			
SE(m) ±	2678	2678	—
CD at 5%	**NS**	**NS**	—
G. M.	57864	35857	2.63

Effect of planting geometry: Among the planting geometries, 45 × 10 cm (G_3) recorded significantly highest gross and net monetary returns of Rs. 65166 and 43161 ha^{-1}, respectively. Highest B:C ratio of 2.96 was also recorded under this planting geometry. Similar result was also reported by Kumar *et al.*, (2018).

CONCLUSION

It may be concluded that among the sowing time, first week of November was found to be the optimum time of sowing mustard with significantly superior yield and yield attributes and economics over second week of November and third week of November. Among the planting geometries, 45 × 10 cm and 45 × 15 cm was found to be the optimum spacing for getting better growth and yield of mustard. Growing of mustard under closer spacing reduced the growth and yield of mustard.

FUTURE SCOPE

1. Studies in this area may provide information regarding optimum sowing time and planting geometry and thus may be utilized to improve the yield of mustard.
2. More studies should be conducted on a regional level in consideration with the changing climate conditions.
3. Especially in areas where mustard is not grown traditionally, studies in the areas may help the farmers to find out the optimum time of sowing and planting geometry to follow.

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Conflict of interest. None.

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