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Growth and Yield of Mustard (*Brassica juncea*) as Influenced by Different Sowing Dates and Spacing

P.C. Lalruatfeli[1]*, A.A. Choudhary[2] and N.R. Mairan[3]

[1]P.G. Student, Agronomy Section, College of Agriculture, Nagpur, (Maharashtra), India.
[2]Associate Professor, Agronomy Section, College of Agriculture, Nagpur, (Maharashtra), India.
[3]Senior Research Assistant, Agronomy Section, College of Agriculture, Nagpur, (Maharashtra), India.

(Corresponding author: P.C. Lalruatfeli)*
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ABSTRACT: Sowing dates and spacing plays an important role in producing a good yield in mustard. Since optimum sowing time and spacing varies in different region according to the climatic conditions, there is a need to find the optimum time of sowing and spacing for a particular area. The present investigation entitled "Growth and Yield of Mustard (*Brassica juncea*) as influenced by different sowing dates and spacing" was carried out at College of Agriculture, Nagpur with 12 treatment combinations replicated thrice. Sowing in first week of November recorded significantly higher plant height, number of branches plant^{-1}, dry matter plant^{-1}, Absolute Growth Rate (AGR) and Relative Growth Rate (RGR) than sowing done in second and third week of November. It also recorded highest seed and straw yield (kg ha^{-1}) and yield decreased progressively with delayed sowing. Crop spacing of 45 × 10 cm also recorded highest growth attributes, growth rates as well as seed and straw yield over spacing's of 30 × 10 cm, 30 × 15 cm and 45 × 15 cm. Sowing in first week of November as well as spacing of 45 × 10 cm was found to optimum for mustard *var.* TAM-108-1.

Keywords: Mustard, sowing dates, spacing, growth attributes, yield.

INTRODUCTION

Mustard crop is sensitive to photoperiod and temperature. Better agronomic practices can lead to increased production (Sandhu *et al*., 2012). Response of growth and yield of rapeseed-mustard depends upon the temperature coinciding during each phenological stage (Gouri *et al*., 2005) which depends on the sowing time of crop. Sowing time is a one of the most important inputs to get a good yield as optimum temperature is crucial at the time of flowering (Devi and Sharma, 2017; Pattam *et al*., 2017). It is also the main factor that decides the environmental conditions that likely to encounter during the growing period of the crop. Late sown crops are subjected to heat stress which further affects the ontogeny, although heat-threshold level differs at different stages of the crop (Kumar *et al*., 2018). Sowing at the optimum time gives higher growth and seed yield whereas untimely sowing results in reduction of yield (Meena *et al*., 2017).

Competition among the crops arises due to large number of crops per unit area. Optimum spacing might vary from region to region. The general recommendation of mustard spacing in India is 30 × 10 cm and 45 × 10 cm for varieties and hybrids, respectively (Bhanu *et al*., 2019). In Maharashtra, spacing of 45 ╪ 10 or 45 × 15 cm is recommended. Also, for better growth and development of mustard, maintaining proper spacing plays an important role in securing good yield. Closer plant spacing with higher plant population has higher competition among the ants for nutrients and moisture. Whereas too much wider spacing might not have taken full advantages of the nutrients and allow weeds to grow leading to poor yield (Dewangan *et al*., 2012). Since the considered factors *i.e.* sowing time and spacing are the two leading non-monetary inputs that can be altered to get a good yield (Lakra *et al*., 2018). The present investigation is carried out to study on impact of sowing dates and spacing on growth and yield of Mustard in Vidarbha region of Maharashtra.

MATERIALS AND METHODS

A field experiment was conducted at College of Agriculture, Nagpur with the objective to study the effect of sowing dates and spacing on growth and yield of mustard along with growth rate *viz.* Absolute Growth Rate and Relative Growth Rate at different growth period. The experiment was conducted in Factorial Randomized Block Design (FRBD) with 12 treatments and three replications. It consist of three sowing dates *viz*., First week of November (S_1), Second week of November (S_2) and Third week of November (S_3) with four planting geometries *viz*., 30 × 10 cm (G_1), 30 × 15 cm (G_2), 45 × 10 cm (G_3) and 45 × 15 cm (G_4). Mustard *var*. TAM-108-1 was sown and spacing's were maintained according to treatments. The experimental site is located at 20°10′N latitudes and 79°19′E longitudes at 321 meter above the mean sea level.

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. Records were taken at specified intervals.

Absolute Growth Rate (AGR) was calculated with the help of dry matter $plant^{-1}$ using the following formula:

$$AGR = \frac{W_2 - W_1}{t_2 - t_1} (g\ day^{-1})$$

where, W_1 and W_2 are weight of dry matter at t_1 and t_2, respectively.

Relative Growth Rate (RGR) was calculated based on the following formula:

$$RGR = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1} (g\ g^{-1}\ day^{-1})$$

where, W_1 and W_2 are weight of dry matter at t_1 and t_2, respectively.

RESULTS AND DISCUSSION

Growth Attributes and growth rate:

Effect of sowing dates. Sowing in first week of November recorded highest plant height, dry matter $plant^{-1}$ and number of branches $plant^{-1}$ which was at par with second week of November sowing except in dry matter accumulation. It took the most number of days to attain 50% flowering whereas third week of November took least number of days to attain 50% flowering. Third week of November sowing also recorded significantly lowest growth attributes. As mustard is a photo and thermal sensitive crop, the earlier sown crops might have been benefited by medium to higher atmospheric temperature during the vegetative phase with longer reproductive phase that might have resulted in better growth. Bhuiyan *et al.,* (2008); Patel *et al.*, (2017) also reported similar results.

Table 1: Growth attributes as influenced by various treatment.

Treatments	Mean Plant height (cm)				Mean Dry matter $plant^{-1}$ (g)				No. of branches $plant^{-1}$	Days to 50% flowering	Yield (kg ha^{-1})	
	30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	At Harvest			Seed	Straw
A. Sowing Dates												
S_1- First week of November	19.4	146	154	157	4.87	20.1	27.3	29.7	3.41	51	1302	3656
S_2- Second week of November	19.0	142	150	153	4.68	18.9	25.3	27.4	3.33	49	1239	3613
S_3- Third week of November	19.4	128	135	135	4.48	16.8	21.2	21.5	2.78	45	970	3101
SE(m) ±	0.2	1.2	1.5	1.4	0.04	0.2	0.3	0.2	0.03	0.1	47	135
CD at 5%	**NS**	**3.5**	**4.5**	**4.2**	**NS**	**0.5**	**0.8**	**0.7**	**0.09**	**0.2**	**138**	**396**
B. Spacing												
G_1- 30 ×10 cm	19.1	131	137	138	4.43	16.9	22.4	23.6	2.82	47	1036	3164
G_2- 30 ×15 cm	18.0	132	139	141	4.51	17.8	23.0	24.5	2.94	48	1109	3343
G_3- 45 ×10 cm	20.1	147	156	158	4.96	20.3	26.8	28.6	3.51	49	1321	3745
G_4- 45 ×15 cm	19.7	145	153	155	4.81	19.5	26.2	28.1	3.41	48	1214	3575
SE(m) ±	0.2	1.6	2.0	1.9	0.06	0.2	0.4	0.3	0.04	0.1	54	156
CD at 5%	**NS**	**4.6**	**5.9**	**5.6**	**NS**	**0.7**	**1.0**	**0.9**	**0.13**	**0.3**	**159**	**457**
Interaction (S × G)												
SE(m) ±	0.7	4.8	6.1	5.7	0.17	0.69	1.04	0.9	0.13	0.3	94	270
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
G. M.	19.3	138.8	146.3	148.5	4.67	18.6	24.6	26.2	3.17	48	1170	3457

For growth rates, highest Absolute Growth Rate and Relative Growth Rate were observed with first week of November sowing as shown in Table 2. It was followed by second week of November sowing except for RGR during 90 DAS- Harvest as second week of November sowing recorded similar Relative Growth Rate as first week of November.

Table 2: Mean Absolute Growth Rate and Relative Growth Rate as influenced by various treatments.

Treatments	Mean Absolute Growth Rate (g day^{-1})				Mean Relative Growth Rate (g g^{-1} day^{-1})			
	0-30 DAS	30-60 DAS	60-90 DAS	90 DAS-Harvest	0-30 DAS	30-60 DAS	60-90 DAS	90 DAS-Harvest
A. Sowing Dates								
S_1- First week of November	0.16	0.51	0.24	0.15	0.023	0.021	0.0043	0.0024
S_2- Second week of November	0.15	0.47	0.21	0.14	0.022	0.020	0.0042	0.0024
S_3- Third week of November	0.14	0.41	0.15	0.11	0.021	0.019	0.0033	0.0023
B. Spacing								
G_1- 30 ×10 cm	0.14	0.41	0.17	0.11	0.021	0.019	0.0039	0.0021
G_2- 30 ×15 cm	0.15	0.44	0.18	0.11	0.021	0.020	0.0037	0.0021
G_3- 45 ×10 cm	0.17	0.51	0.22	0.18	0.023	0.021	0.0041	0.0029
G_4- 45 ×15 cm	0.16	0.49	0.21	0.15	0.020	0.020	0.0041	0.0023
G.M	0.15	0.46	0.20	0.14	0.020	0.020	0.0039	0.0024

Effect of Spacing. Spacing of 45 × 10 cm recorded highest plant height, number of branches plant^{-1} and dry matter plant^{-1} which was at par with 45 × 15 cm spacing. Significantly lower growth attributing characters were observed in closer spacing of 30 × 10 cm and 30 × 15 cm. Better growth observed under wider row spacing compared to closer spacing might be due to efficient use of light, soil moisture and nutrients under wider spacing. Results are in conformity with findings of Pandey *et al.,* (2015); Tyagi and Upadhyay, (2017).

Highest Absolute Growth Rate and Relative Growth Rate were observed in 45 × 10 cm spacing followed by 45 × 15 cm spacing. However, lowest AGR and RGR were observed in 30 × 10 cm spacing. Meitei *et al*., (2001) also reported decreased in RGR with decreased in spacing.

Seed and Straw Yield:

Effect of sowing dates. Highest seed and straw yield were obtained from sowing in first week of November which was statistically at par with second week of November. However, sowing in third week of November recorded significantly lowest seed and straw yield. Similar findings were also reported by Patel *et al.,* (2015); Ahmed *et al.,* (2019).

Effect of spacing. Highest seed yield was recorded with 45 × 10 cm spacing followed by 45 × 15 cm. In case of straw yield, highest value was obtained from 45 × 10 cm spacing which was at par with spacing of 45 × 15 cm and 30 × 15 cm. Closer spacing of 30 × 10 cm recorded significantly lowest seed and straw yield. The results are in conformity with report made by Mahan *et al.,* (2008); Yadav *et al.,* (2018).

CONCLUSION

It may be concluded that for mustard *var*. TAM-108-1, sowing in first week of November as well as spacing of 45 × 10 cm is optimum to get good growth and yield.

FUTURE SCOPE

1. Studies may provide information on optimum sowing time and spacing that will be beneficial for a particular region.
2. More studies should be conducted at different region to find out the suitable time of sowing and spacing for a particular area.

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Conflict of Interest. None.

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