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Phenological and Growth Responses of Indian Mustard (*Brassica juncea* L.) Genotypes to Different Sowing Dates

Ajeev Kumar[1*], Manohar Lal[1], Praveen Kumar[2], Rajkumar[1] and Jitender Kumar[1]

[1]Department of Botany and Plant Physiology, [2]Department of Chemistry and Biochemistry, CCS HAU, Hisar-125004, Haryana, India

**Corresponding author*

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A B S T R A C T

The experiment was conducted with 6 genotypes of Indian mustard (*Brassica juncea* L.) *viz.*, RH-0116, RH-725, RH-923, RH-1019, RH-1077, RH-1301 for three dates of sowing i.e. 23 September, 16 October and 21 November in the field in randomized block design during rabi season of 2015-16 at Oil Seed Section, Chaudhary Charan Singh Haryana Agricultural University, Hisar to observe the effect of sowing dates on phenology and growth of Indian mustard genotypes. The days to emergence of seedlings and 50 % flowering were minimum in 16 October and maximum values in 21 November sowing. Among genotypes, RH-725 took minimum days to emergence of seedlings and 50 % flowering while RH-1019 took maximum days. The plant height, CGR and RGR were maximum in 23 September and minimum in 21 November sowing at 120 days after sowing (DAS). The genotype RH-0116 had highest values and RH-1019 had lowest values of all the growth parameters.

Introduction

Rapeseed-mustard (*Brassica spp.*) is one of the most important oilseed crops of the world where India is ranking third in area and production in the world (DRMR, 2015). Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the India's oilseed economy (Shekhawat *et al.,* 2012). Its seed contains 37 to 49 percent edible oil (Singh *et al.,* 2009). Demand of edible oil has increased with increasing population and improvement in the living standard of the people, resulting thereby in short supply of edible oils which is being met with imports of edible oil worth 44,000 crores per annum. Thus, there is need to boost the oilseed production through area expansion and productivity enhancement.

Indian mustard (*Brassica juncea* L. Czern) belongs to family Cruciferae, genus *Brassica* and species *juncea* popularly known as rai. Mustard is cultivated mostly under temperate climate. It is also cultivated in certain tropical and subtropical region as a cold weather crop. In India, rapeseed-mustard occupy 5.99 million ha area with production and productivity of 6.31 million tones and 1053 kg/ha respectively (India stat 2014-15). Indian

mustard (*Brassica juncea* L.) is an important *rabi* crop of Haryana. In Haryana, rapeseed and mustard is one of the major growing crop occupying 0.56 million ha of area, with production and productivity of 0.699 million tones and 1248 kg/ha respectively (India stat 2014-15). Indian mustard is sown late due to delay in harvesting of rainy season crops like cluster bean, cotton and rice (Kumar *et al.,* 2013). Under late sown condition, productivity declines primarily due to the shortening of vegetative and reproductive phase. Late sown Indian mustard is exposed to high temperature coupled with high evaporative demand of the atmosphere, during the reproductive phase which consequently results in forced maturity, increased senescence and low productivity (Porter, 2005).

The rise in temperature, even by a single degree beyond the threshold level is considered as heat stress in the plants (Hasanuzzaman *et al.,* 2013, Wahid *et al.,* 2007). The global mean surface air temperature increased by 0.5°C in the twentieth century and is expected to increase a further 1.5–4.5°C by the late twenty-first century (IPCC, 2012).Climate change has increased the intensity of heat stress and heat stress due to increased temperature is an agricultural problem in many areas in the world as well as in India (Beck *et al.,* 2007).

Heat stress affects plant growth throughout its ontogeny, though heat-threshold level varies considerably at different developmental stages. For instance, during seed germination, high temperature may slow down or totally inhibit germination (Wahid *et al.,* 2007). There is a specific time for the sowing of particular variety of a crop on specific area (Robertson *et al.,* 2004; Uzun *et al.,* 2009). The accurate time of sowing and high yielding cultivars can boost the growth and yield of the crop (Salmasi *et al.,* 2006).

Materials and Methods

The experiment was conducted at research area of Oil Seed Section, in the Department of Genetics and Plant Breeding of Chaudhary Charan Singh Haryana Agricultural University, Hisar during *Rabi* 2015-16.Geographically the experimental field was located at 29º.10' N latitude and 75º.46 longitude at an elevation of 215.2 meters above the mean sea level. The average rainfall varies from 300-500 mm and about 80-90 per cent of the total rains are received from South-West monsoon during the month of July to September. The minimum temperature in this area reaches upto 0.5 ºC in December and January and the maximum temperature in the area reaches upto 48 ºC during May or June.

The experimental soil having 57.93 % sand, 26.03 % silt and 16.04 % clay particles, EC = 0.20 dSm^{-1} at 25°C, pH = 8.0, Organic carbon = 0.30 %, Nitrogen = 143.4 kg ha^{-1}, Phosphorus = 17 kg ha^{-1}, Potassium = 172 kg ha^{-1}**.** The crop was planted in rows spaced 45cm with 30 cm plant to plant distance. The genotypes of mustard were RH-0116, RH-725, RH-923, RH-1019, RH-1077, RH-1301. The experimental treatments were 3 sowing dates viz. D1=23rd September, D2=16thOctober, D3= 21st November. The experimental design was Randomized Complete Block Design (RCBD) with three replications having plot size 1.5m × 5.0 m. Data were collected on days to emergence of seedlings, days to 50 % flowering, plant height, crop growth rate (CGR) and relative growth rate (RGR).

Days to seed germination were recorded in all plots when all the seeds germinated into seedlings (At 100 % germination). Days to 50 per cent flowering were recorded in all plots when at least one flower on main raceme of about 50 per cent plants was flowered. The height was measured from the base of the plant to the tip of the main stem of randomly

tagged plants and mean values were calculated and the values of CGR and RGR were calculated by using the formulas given by Reddy and Reddy, 2009 after achieving constant dry weight of the plants in the oven at 65 ºC. Plant height, CGR and RGR were recorded at 120 days after sowing and all the collected data were statistically analyzed by the OPSTAT software at the Computer Centre, Department of Statistics, CCS HAU, Hisar.

Results and Discussion

The effect of different sowing dates significantly affected on days to emergence of seedlings, days to 50 % flowering, plant height, CGR and RGR are presented in the Table 1. The more number of days (7.4) were taken to emergence of seedlings by crop sown on November 21 and least number of days (5.4) was taken to emergence of seedlings by crop sown on October 16 when considered irrespective of genotypes.

This might be due to the reason that the low temperature at the time of 21 November sowing might have inhibited the activity of seed that resulted into the poor germination while on 16 October sowing the prevailing temperature was optimum for seed activity or seed germination in *Brassica juncea* so least number of days were taken to emergence of seedlings by crop sown on October 16.

Similar results due to different sowing dates has also been reported earlier in the literature (Kumar *et al.,* (2001); Robertson and Holland (2004); Chauhan *et al.,* (2009); Azharudheen *et al.,* (2013). Among all six genotypes, RH-725 took least number of days to emergence of seedlings (5.8) and maximum number of days (6.6) was taken to emergence of seedlings by RH-1019 when considered irrespective of sowing dates. This is because of variation in different genotypes in their genetic makeup which is well reported in the literature (Kumar *et al.,* (2001); Alam *et al.,* (2014); Solanki and Mundra (2015).

The more number of days (51.1) were taken to 50 % flowering by crop sown November 21 and least number of days (43.9) were taken to 50 % flowering by crop sown on October 16 when considered irrespective of genotypes. This might be due to the reason that the favourable temperature prevailing on 16 October sown crop might have resulted into timely flowering while on 21 November sowing the low temperature might have extended the vegetative phase that resulted into delayed flowering in 21 November sown crop. Similar results due to different sowing dates have also been reported earlier in the literature (Khayat *et al.,* (2015) in canola; Alam *et al.,* (2014), Solanki and Mundra (2015) in *Brassica juncea*; Akhter *et al.,* (2014) in *Brassica rapa*). Among all six genotypes, RH-725 took least number of days (46.7) to 50 % flowering followed by RH-0116 (47.1) and maximum number of days was taken to 50 % flowering by RH-1019 (49.5) when considered irrespective of sowing dates. This is because of variation in different genotypes in their genetic makeup which is well reported in the literature (Alam *et al.,* (2014); Solanki and Mundra (2015).

At 120 DAS maximum plant height was observed in genotype RH-0116 (191.8 cm) whereas minimum plant height was observed in genotype RH-1019 (185.3 cm) when considered irrespective of sowing dates. This is because of variation in different genotypes in their genetic makeup which is well reported in the literature (Singh *et al.,* (2014); Solanki and Mundra (2015). The minimum plant height (174.3 cm) was observed in plants sown on 21 November and maximum plant height (201.5 cm) was observed on 23 September sown crop when considered irrespective of genotypes.

Table.1 Effect of sowing dates on phenology and growth of Indian mustard genotypes

Treatments	Days to emergence	Days to 50 % flowering	Plant height (cm)	Crop growth rate(g $m^{-2}day^{-1}$)	Relative growth rate (g g^{-1} day^{-1})
Dates of sowing					
23 September	6.0	49.2	201.5	3.59	0.001
16 October	5.4	43.9	190.0	3.53	0.001
21 November	7.4	51.1	174.3	2.57	0.001
CD at 5 %	0.5	0.7	1.4	0.15	N.S
Genotypes					
RH-0116	6.0	47.1	193.5	4.94	0.002
RH-725	5.8	46.7	193.4	4.64	0.002
RH-923	6.4	48.9	187.1	2.33	0.001
RH-1019	6.6	49.5	185.3	1.67	0.001
RH-1077	6.5	48.2	187.3	2.64	0.001
RH-1301	6.5	48.1	186.6	2.47	0.001
CD at 5 %	0.2	1.0	1.9	0.21	N.S

This is due to reason that the high temperature at 23 September sown crop might have accelerated the plant growth resulting into increased plant height while the low temperature on 21 November sown crop might have reduces the plant height. Similar results due to different sowing dates has also been reported in the literature (Abdul *et al.*, (2013) in canola; Akhter *et al.*, (2014) in *Brassica rapa*; Kumari *et al.*, (2013); Singh *et al.*, (2014) in *Brassica juncea*.

At 120 DAS maximum crop growth rate was observed in genotype RH-0116 (4.94 g $m^{-2}day^{-1}$) whereas minimum crop growth rate was observed in genotype RH-1019 (1.67 g $m^{-2}day^{-1}$) when considered irrespective of sowing dates. This is because of variation in different genotypes in their genetic makeup which is well reported in the literature (Muhal and Solanki (2014); Alam *et al.*, (2014). The minimum crop growth rate (2.57 g m^{-2} day^{-1}) was observed in plants sown on 21 November and maximum crop growth rate (3.59 g m^{-2} day^{-1}) was observed on 23 September sown crop when considered irrespective of genotypes. This might be due to the reason that the high temperature at 23 September

sown crop might have accelerated the plant growth rate which might have resulting into increased plant growth rate and might be due to temperature gradient i.e. low temperature at vegetative phase and high temperature at reproductive phase in 21 November sown crop might have resulted into decreased plant growth rate. Similar results due to sowing dates has also been reported earlier in the literature (Muhal and Solanki (2014) in *Brassica juncea*; Alam *et al.,* (2014) in *Brassica napus*; Khayat *et al.,* (2015) in canola). At 120 DAS there was no significant difference of relative growth rate in different dates of sowing and genotypes.

From the results it may be concluded that under agroclimatic condition of Hisar maximum phenological traits of *Brassica juncea* cultivars including days to emergence of seedlings and days to 50 % flowering can be obtained if these cultivars were sown on October 16. However plant height, crop growth rate and relative growth rate were maximum if these cultivars were sown on 23 September. The genotype RH-725 proved to be best among all studied genotypes in terms of all phenological traits while RH-0116 proved to best in terms of plant height, crop growth rate and relative growth rate.

References

Abdul Sattar, Cheema, M.A., Wahid, M.A., Saleem, M.F., Ghaffari, M.A., Hussain, S. and Arshad, M.S. (2013) Effect of sowing time on seed yield and oil contents of canola varieties. *Journal of Global Innovation in Agricultural and Social Science*, 1(1): 1-4.

Akhter, S., Singh, L., Saxena, A., Lone, B., Singh, P. and Qayoom, S. (2014) Effect of temporal and varietal variability on growth and developmental parameters of brown sarson (*Brassica rapa* l. var. *oleifera)* under temperate kashmir condition. *Journal of Agriculture research,* 1(2): 122-126.

Alam, M.J., Ahmed, K.S., Mollah, M. R. A., Tareq, M.Z. and Alam, J. (2014) Effect of planting dates on the yield of mustard seed. *International Journal of Applied Science & Biotechnology*, 3(4): 651-654.

Azharudheen, T. P. M., Yadava, D. K., Singh, N., Vasudev, S., Prabhu, K. V. (2013) Screening of Indian mustard (*Brassica juncea* L. Czern & Coss.) germplasm for seedling thermo-tolerance using a new screening protocol. *African Journal of Agriculture Research*. 8: 4755-4760.

Beck, E. H., Fettig, S., Knake, C., Hartig, K., and Bhattarai, T. (2007) Specific and unspecific responses of plants to cold and drought stress. *Journal of Biosciences* 32: 501–510.

Chauhan, J. S., Meena, M. L., Saini, M. K and Meena, D. R. (2009) Heat stress effects on morpho-physiological characters of Indian mustard (*Brassica juncea* L.). *16th Australian Research Assembly of Brassicas, Ballarat Victoria*. 91-97.

DRMR. 2015. Vision 2050. Directorate of Rapeseed-Mustard Research, Bharatpur, Rajasthan: 2.

Hasanuzzaman, M., Nahar, K., Alam, M. M., Roychowdhury, R. and Fujita, M. (2013) Physiological, biochemical, and molecular mechanisms of heat stress tolerance in plants. *International Journal of Molecular Sciences* 14: 9643-9684.

India Statistics 2014-15. (Indiastat.com).

IPCC. (2012) Managing the risks of extreme events and disasters to advance climate change adaptation. In C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G. K. Plattner, S. K. Allen, M. Tignor, & P. M. Midgley (Eds.), *A special report of working groups I and II of the intergovernmental panel on climate change* (p. 582). Cambridge: Cambridge University Press.

Khajepour, M.R., (2001) Principals and Essentials of crop Production. Jihad-University Press. Isfahan University, pp: 201.

Khayat, M., Rahnama, A., Lorzadeh, S. and Lack, S. (2015) Physiological Indices, Phenological Characteristics and Trait Evaluation of Canola Genotypes Response to Different Planting Dates The National Academy of Sciences, India 2016.

Kumar, A., Singh, D. P., Bikram, S., Yadav, Y. (2001) Effects of nitrogen application an partitioning of biomass, seed yield and harvest index in contrasting genotype of oilseed Brassicase. *Indian Journal of Agronomy* 46: 162–167.

Kumar, S., Sairam, R. K and Prabhu, K. V. (2013) Physiological traits for high temperature stress tolerance in *Brassica juncea*. *Indian Journal of Plant Physiology.*18: 89-93.

Kumari, A., R.P. Singh., Yespal. (2012) Productivity, nutrient uptake and economics of mustard hybrid *(Brassica juncea*) under different planting time and row spacing *Indian Journal of Agronomy* 57 (1): 61-67.

Porter, J. R. (2005) Rising temperatures are likely to reduce crop yields. *Nature,* 436: 174.

Reddy, T. Y. and Reddy, G. H. S. (2009) Principles of agronomy. Kalyani Publishers, Ludhiana. 4: 91.

Robertson, M. J, & Holland, J. F. (2004) Response of Indian mustard to sowing date in the grain belt of North-eastern Australia. *Australian Journal of Experimental Agriculture.* 44: 43–52

Robertson, M.J., Holland, J.F. and Bambach, R. (2004) Response of canola and Musterd to sowing date in the grain belt of north-eastern Ausrralia. *Australian Journal of Expperimental Agriculture* 44: 43-52.

Salmasi, S.Z., K.G. Golez and S. Moghbeli. (2006) Effect of sowing date and limited irrigation on the seed yield and quality of dill (*Anethum graveolens* L.). *Turkry Journal of Agriculture* 30: 281-286.

Shekhawat, K., Rathore, S. S., Premi, O. P., Kandpal, & Chauhan, J. S. (2012) Advances in agronomic management of Indian mustard (*Brassica juncea* (L.) Czernj. Cosson): An overview. *International Journal of Agriculture*. 2012: 1–14.

Singh, C., Singh, P. and Singh, R. (2009) Modern techniques of raising field crops. 2nd edition. Oxford and IBH publishing company private limited, New Delhi: 337.

Singh, M., S.S. Rathore and P. Raja. (2014)Physiological and Stress Studies of Different Rapeseed- Mustard Genotypes under Terminal Heat Stress. *International Journal of Genetic Engineering and Biotechnology*. 5(2): 133-142.

Solanki, N.S. and Mundra, S.L. (2015) Phenology and productivity of mustard (*Brassica juncea* L.) under varying sowing environment and irrigation levels. *Annals of Agriculture Research* 36 (3): 312-317.

Uzun, B., U. Zengin, S. Furat and O. Akdesir (2009) Sowing date effects on growth, flowering, seed yield and oil content of canola cultivars. *Asian Journal of Chemistry* 21: 1957-1965.

Wahid, A., & Close, T. J. (2007) Expression of dehydrins under heat stress and their relationship with water relations of sugarcane leaves. *Biologia Plantarum*. 51: 104–109.

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