Journal of Oilseed Brassica, 13 (1) : 37-40, January 2022

Growth and yield response of transplanted mustard (*Brassica juncea* L.) under different planting schedule in north Gujarat agroclimatic region

Mehul Patel, AL Jat* and JK Malav

Castor-Mustard Research Station, SD Agricultural University, Sardarkrushinagar, Gujarat 385506, India
**Corresponding author: aanandiagro508@gmail.com*
(Received: 25 September 2021; Revised: 23 December 2021; Accepted: 24 December 2021)

Abstract

A field experiment was conducted on transplanted Indian mustard during *rabi* season of 2020-21 at Sardarkrushinagar, Gujrat in loamy sand soil. The experiment consisted twelve treatment combinations, with four planting geometry *viz.*, 45 cm × 30 cm, 45 cm × 45 cm, 60 cm × 30 cm and 60 cm × 45 cm accommodate in main plots and three dates of transplanting *viz.*, 31st October, 10th November and 20th November taken in subplots were undertaken in split-plot design with three replications. Significantly higher plant height at 30 & 60 DAT (94 & 180 cm), leaf area index at 30 & 60 DAT (0.87 & 2.03) and oil yield (893 kg/ha) were recorded with mustard transplanted at 45 cm × 30 cm and, whereas, higher number of secondary branches per plant (26.3) and number of siliquae per plant (718) were recorded at 60 cm × 45 cm. Mustard transplanted at 45 cm × 30 cm spacing recorded significantly higher seed yield (2187 kg/ha) which was remained statistically at par with spacing 45 cm × 45 cm (2070 kg/ha). Crop transplanted on 10th November significantly out yielded (2143 kg/ha) over the 20th November (1829 kg/ha) but remained statistically at par with 31st October (1996 kg/ha) in terms of seed yield.

Keywords: *Date of transplanting, mustard, spacing, system of mustard intensification*

Introduction

Brassica juncea, commonly known as Indian mustard, brown mustard, leaf mustard, oriental mustard and vegetable mustard, is a species of mustard plant. Mustard plays an important role in the oilseed economy of the country. The estimated area, production and yield of rapeseed-mustard in the world was 36.59 million hectares (m ha), 72.37 million tonnes and 1980 kg/ha respectively, during 2018-19. Globally, India accounts for 19.8% and 9.8% of the total acreage and production of the crop (Anonymous, 2019). Vegetable oil has one of the highest shares (40%) of the production of all agricultural commodities globally. India is the largest importer of edible oils ($10.5 billion) in the world followed by China & USA (Choudhary *et al.*, 2021). India's share of world edible vegetable oil imports is about 15% (FAO, 2019; Choudhary *et al.*, 2021). Currently the area, production and productivity of rapeseed-mustard in Gujarat is about 1.72 lakh ha, 3.33 lakh tonnes and 1932 kg/ha, respectively (Anonymous, 2019-20). Kumari *et al.* (2012) reported that late sown mustard has the shorter growing period due to the high temperature during the reproductive phase which led to concomitant reduction in yield. Among the agronomic factors known to augment the mustard production are spacing and planting time which plays a pivotal role in enhancing the production. Spacing is a non-monetary input, but it plays a vital role by changing the magnitude of competition. The competitive ability of a rapeseed-mustard plant depends greatly upon the density of plants per unit area and soil fertility status (Shekhawat *et al.*, 2012). Transplanted crop has the exact plant population with mathematical precision, and there is also some time benefit after harvest of the *kharif* crops. Through transplanting, the full potentiality of individual plants can be realized and yield more than drilling of seeds. The late sowing of mustard cultivars resulted in yield losses and thus affected the supply-chain of the oil in the market. The forceful late sowing conditions of the crop are mainly because of delayed harvesting of *kharif* crops. Therefore, early crop establishment through transplanting technique could be a better alternative option to minimize the yield losses in mustard. The system of mustard intensification (SMI) also gives another opportunity for more productivity and profitability by adopting intercropping pea, lentil or chickpea with transplanted mustard which shall utilize the available resources like space, light and nutrients efficiently. In 2011-12, the Sir Dorabji Tata Trust (SDTT) extended support for this innovation effort, so that about 1600 farmers were able use SMI method for rapeseed cultivation. Keeping in view the potential of crop, in terms of better use of resources by single plant to realize identical yield, there is need to improve mustard productivity in India. Therefore, present investigation was conducted to find out the feasibility of Indian mustard establishment through transplanting technique with different planting schedule under North Gujarat Agroclimatic region.

Materials and Methods

The field experiment was conducted during *rabi* 2020-21 at Castor-Mustard Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat. Geographically, Sardarkrushinagar is situated at 24°19' North latitude and 72°19' East longitude with an elevation of 154.52 m above MSL and situated in the North Gujarat Agro-climatic region. Climate of this region is sub-tropical monsoon type and falls under semi-arid region. Soil of the experimental field was loamy sand in texture, low in organic carbon (0.28 %), low in available nitrogen (134.7 kg/ha), medium in available phosphorus (54.3 kg/ha) and medium in available potassium (272.3 kg/ha) having *p*H value of 7.4. The experiment consisted twelve treatment combinations with four different spacing *viz.*, S_1: 45 cm × 30 cm, S_2: 45 cm × 45 cm, S_3: 60 cm × 30 cm and S_4: 60 cm × 45 cm in main plots and three dates of transplanting *viz.*, D_1: 31st October, D_2: 10th November and D_3: 20th November in sub-plots of split-plot design and replicated thricely. The seedlings were raised on plastic pro-trays having 72 cups. The soil was mixed well with vermicompost and coco pit with the ratio of soil, vermicompost and coco pit on volume basic was 2:1:1. The seed were sown on that tray before 14-days of transplanting. The recommended dose of fertilizer for mustard crop was N_{50}, P_{50}, K_0 and S_{40} kg/ha. Full dose of phosphorus, sulphur and half dose of nitrogen fertilizers were drilled just before planting as a basal application through urea, DAP and bentonite sulphur and remaining half dose of nitrogen was applied at 25-30 DAT. First irrigation was given before transplanting of the crop. Remaining irrigations were given as per crop need. Total six irrigations were applied during the life period of mustard crop. Observation on plant height and leaf area index (LAI) was recorded from the net plot area at 30 and 60-days after transplanting (DAT). Leaf area was measured by leaf area meter (model-211) and leaf area index was calculated by formula:

$$\text{LAI} = \frac{\text{Total leaf area per plant}}{\text{Total land area occupied by plant}}$$

The oil content in seed was determined by FT-NIR (Fourier Transferable Near Infra-Red) technique (Model Bruker) as per standard procedure suggested by Tiwari *et al*., 1994. The data recorded for various parameters during the course of investigation were statistically analysed by a procedure appropriate to the design of experiment as described by Gomez and Gomez (1984). The significance of difference was tested by “F” test at 5 per cent level. The critical difference was calculated when the differences among treatments were found significant under “F” test.

Results and Discussion

Crop growth

Plant height at 30 and 60 DAT (94 and 180 cm), leaf area index at 30 and 60 DAT (0.87 and 2.03) of transplanted mustard were significantly higher with spacing of 45 cm × 30 cm, though it was remained statistically at par to spacing 45 cm × 45 cm and 60 cm × 30 cm in case of plant height (Table 1). This might be due to increased plant population in narrow crop geometry probably tended the plants to be taller for getting light in closer spacing. Singh *et al.* (2019) also reported the higher plant height with close spacing under transplanted mustard. Similar results on leaf area index were also reported by Kumar *et al*. 1997. Primary branches, days to 50 % flowering and days to physiological maturity of transplanted mustard were not influenced significantly due to different spacing. Significantly higher number of secondary branches per plant (26.3) was registered at 60 cm × 45 cm. Because of less plant population in wider crop geometry of 60 cm × 45 cm, plants could get adequate nutrient, moisture and space to produce higher branches. On the other hand, increased plant population density in narrow crop geometry of 45 cm × 30 cm, the shortage of space and light which led to higher competition for resources utilization *i.e.*, space, nutrient and moisture resulted ultimately increase in plant height and reduced the number of branches in plants. In lower densities under wider spacing crop and due to lesser competition within the plants and get sufficient light intensity as a potent source for increasing crop biomass, results in higher number of branches plant per plant (Mamun *et al*., 2014).

Plant height at 30 DAT (91 cm), leaf area index at 60 DAT (1.79) and number of secondary branches per plant (22.2) was higher of transplanted mustard on 10th November (Table 1). Plant height at 30 DAT was statistically at par to 20th November (87). Similar findings were also reported by Singh *et al.* (2019). Number of secondary branches per plant remained statistically at par with 31st October (21.2). Maximum days taken to 50% flower initiation (30.8 days) were recorded when mustard transplanted on 31st October and the minimum days taken to flower initiation was recorded when mustard transplanted on 10th November.

Table 1: Effect of planting geometry and date of transplanting on growth parameters of transplanted mustard

Treatments	Plant height (cm)		Leaf area index		No. of branches/plant		Days to 50% flowering	Days to physiological maturity
	30 DAT	60 DAT	30 DAT	60 DAT	Primary	Secondary		
Planting geometry								
45cm × 30cm	94	180	0.87	2.03	4.2	16.6	28.3	104
45cm × 45cm	84	171	0.62	1.62	4.5	21.2	28.1	104
60cm × 30cm	86	169	0.74	1.71	4.3	20.3	28.0	103
60cm × 45cm	81	153	0.47	1.30	4.8	26.3	28.2	104
SEm±	2.4	5.0	0.02	0.05	0.14	0.85	0.73	1.8
CD (P=0.05)	8.4	17.2	0.07	0.16	NS	2.95	NS	NS
Date of transplanting								
31st October	81	166	0.66	1.59	4.5	21.2	30.6	105
10th November	91	170	0.68	1.79	4.6	22.2	26.8	105
20th November	87	168	0.68	1.62	4.3	19.9	27.1	102
SEm±	2.0	4.2	0.02	0.04	0.10	0.56	0.47	1.0
CD (P=0.05)	5.9	NS	NS	0.11	NS	1.67	1.39	NS

Number of primary branches, leaf area at 30 DAT and days to physiological maturity were not influenced significantly due to different date of transplanting.

Yield performance

The crop transplanted at 60 cm × 45 cm produced significantly higher number of siliquae per plant (718) as compared to rest of spacing (Table 2). This might be due to less plant's population per unit area in case of crop geometry 60 cm × 45 cm, the plants could get adequate nutrients, moisture and space to produce more number of branches and number of siliquae with higher dry biomass production. Whereas, due to more plant population in case of crop geometry 45 cm × 30 cm, the shortage of space and higher competition for space, nutrients and moisture reduced the number of branches and siliquae number with dry biomass production in siliquae these results are in close conformity with the findings of Singh and Dhillon (1991). Transplanting of mustard seedlings at 45 cm × 30 cm produced the higher seed yield (2187 kg/ha) and stover yield (5518 kg/ha) being significantly superior over other spacing and remained statistically at par to spacing 45 cm × 45 cm and 60 cm × 30 cm, while stover yield remained statistically at par with spacing 45 cm × 45 cm (Table 2). The growth characters and yield attributes *viz.*, the number of branches and siliquae per plant were higher under wider spacing as compared to the closer spacing. The decreased in seed yield with crop geometry of 60 cm × 45 cm was mainly due to less plant population per unit area. On the other hand, crop geometries of 45 cm × 30 cm and 45 cm × 45 cm, accommodate higher plant population per unit

Table 2: Effect of planting geometry and date of transplanting on yield attributes, yield and oil content of transplanted mustard

Treatment	No. of siliquae/plant	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Oil content (%)	Oil yield (kg/ha)
Planting geometry						
45cm × 30cm	478	2187	5518	28.3	40.8	893
45cm × 45cm	605	2070	4940	29.7	40.0	829
60cm × 30cm	570.	1954	4884	28.7	40.0	778
60cm × 45cm	718	1746	4410	28.9	39.4	685
SEm±	23.8	78.9	203.2	1.2	1.7	39.0
CD (P=0.05)	82.4	273.1	703.2	NS	NS	135.1
Date of transplanting						
31st October	594	1996	4806	29.6	39.9	800
10th November	624	2143	5508	27.9	40.2	860
20th November	561	1829	4500	29.1	40.0	730
SEm±	14.6	59.2	172.8	0.9	0.9	28.5
CD (P=0.05)	43.7	177.5	518.1	NS	NS	85.5

area resulted into higher seed yield. These results are in close vicinity with findings of Singh *et al*. (2019) and Sahar *et al*. (2012).

Among the different date of transplanting, mustard transplanted on 10th November recorded significantly more number of siliquae (624) as compared to earlier and later date of transplanting (Table 2). Adverse effect of low temperature on flowering, siliqua setting and seed development in rapeseed-mustard have also been reported by Adak *et al.* (2011); Biswas *et al.* (2011) and Kumari *et al*. (2012). Seed yield (2143 kg/ha) and stover yield (5508 kg/ha) were recorded significantly higher under 10th November and seed yield was remained statistically at par with 31st October transplanting. Mustard was adversely affected due to high temperature in earlier transplanting, so in early transplanted plant could get a transplanting shock and take some time to recover. The later planting usually causes a decline in growth, leaf area and shortening of reproductive phase due to faster maturation (forced maturity) due to high temperature in late transplanting which led to more aphid and powdery mildew incidence at later stage thus decreasing yield (Mondal *et al*., 2011). The results revealed that harvest index was found non-significant due to the different spacing and date of transplanting (Table 2).

Oil content and oil yield

Oil content was found statistically unaffected due to different spacing. Even though, marginally higher oil content (40.8 %) was recorded at 45 cm × 30 cm (Table 2). Significantly higher oil yield (893 kg/ha) was observed with the spacing of 45 cm × 30 cm and its remained statistically at par to spacing 45 cm × 45 cm and 60 cm × 30 cm. Oil content was significantly not influenced by different date of transplanting. Oil yield (860 kg/ha) was significantly higher under 10th November and it was remained statistically at par with 31st October.

Conclusion

It can be concluded that growth, seed yield contributing parameters of transplanted mustard were positively influenced due to planting geometry and planting time. Hence, 14-days old seedlings of mustard should be transplanted on 10th November at the spacing of 45 cm × 30 cm for securing higher seed yield and oil yield under loamy sand soil of north Gujarat.

References

Adak T, Bhaskar N and Chakravarty NVK. 2011. Response of *Brassica* to micro environment modification under semi-arid agro ecosystem. *Indian J Agric Sci* **81**: 744-50.

Anonymous 2019. United States Department of Agriculture.

Anonymous 2019-20. Annual Report. Directorate of Agriculture, Govt. of Gujarat, Gandhinagar.

Biswas C, Singh R and Vijaya PK. 2011. Dynamics of white rust disease in mustard (*B. juncea*) in relation to date of sowing and weather parameters. *Indian J Agric Sci* **81**: 1187-90.

Choudhary RL, Langadi AK, Jat RS, Anupama, Singh HV, Meena MD, Dotaniya ML, Meena MK, Premi OP and Rai PK. 2021. Mitigating the moisture stress in Indian mustard (*B. juncea*) through polymer. *J Oilseed Brassica* **12**: 21–27.

FAO 2019. Oilseeds and Oilseed products. OECD-FAO Agricultural Outlook 2019-2028/FAO 2019, p-47.

Gomez KA and Gomez AA. 1984. Statistical Procedures for Agricultural Research (2nd ED, 1984). *John Wiley and Sons Interscience Publication*, New York, USA.

Kumar S, Singh J and Dhingra KK. 1997. Leaf area index with solar radiation interception and yield Indian mustard (*B. juncea*) as influenced by plant population and nitrogen. *Indian J Agric Sci* **42**: 348–51.

Kumari A, Singh RP, and Yeshpal. 2012. Productivity, nutrient uptake and economics of mustard hybrid (*B.juncea*) under different planting time and row spacing. *Indian J Agron* **57**: 61-67.

Mamun F, Ali MH, Chowdhaury IF, Hasanuzzaman M and Matin MA. 2014. Performance of rapeseed and mustard varieties grown under different plant density. *Scientia Agric* **8**: 70-75.

Mondal MRI, Begum F and Saiyed IM. 2011. Effect of planting dates on seed and oil yield of rapeseed (*B. campestrie*) genotype BCYS-03. SAARC *J Agric* **9**: 85-93.

Sahar K, Delkhosh B, Hossein A, Rad S and Zandi P. 2012. The effect of different rates of nitrogen and plant density on qualitative and quantitative traits of Indian mustard. *Adv Environ Biology* **6**: 145-52.

Shekhawat K, Rathore SS, Premi OP, Kandpal BK and Chauhan JS. 2012. Advances in agronomic management of Indian mustard (*B. juncea*): An overview. *Int J Agron* doi:10.1155/2012/408284

Singh HV, Choudhary RL, Meena MD, Dotaniya ML, Meena MK, Jat RS, Premi OP and Rai PK. 2019. Productivity enhancement of Indian mustard (*Brassica juncea*) through innovative crop establishment technique. *Indian J Agric Sci* **89**: 1669-73.

Singh T and Dhillon SS. 1991. Response of toria (*B. napus*) to sowing date and row spacing in south-western Punjab. *Indian J Agron* **36**: 6-14.

Tiwari PN, Gambhit PN and Rajan TS. 1994. Rapid and non-destructive determination of oil in oilseeds. *J Oil Chem Sci* **51**: 1049.