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Sowing time and crop geometry influences seed yield attributes and economics of Indian mustard (*Brassica juncea*) under irrigated conditions of Rajasthan

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Abstract

An experiment was conducted on sandy loam soil to study the effect of time of sowing and crop geometry on yield attributes, seed yield and the economics of Indian mustard (*Brassica juncea* L) cultivar RH-749 under irrigated condition of Rajasthan. Results revealed that crop sown on October 24 recorded higher crop yield attributes including number of branches/plant, siliquae/plant, seeds/siliqua, seeds weight/plant, test weight, seed yield (2159 kg/ha) and economics with gross return (79898.64 Rs./ha), net return (54429.38 Rs./ha) and B:C ratio (3.14), respectively. The better plant growth and higher dry matter accumulation in yield components was also observed as compared to other date of sowing. Crop geometry of 45 x 30 cm recorded significantly increased branches/plant and seeds weight/plant (g) as compared to all other crop geometry while number of siliquae/plant and test weight increased significantly as compared to all other crop geometry except 45 x 15 cm crop geometry. Seed yield (2218 kg/ha), gross return (82085.61 Rs./ha), net return (56496.35Rs./ha) and B:C ratio (3.21) were increased significantly in crop geometry of 30 x 20 cm over to 30 x 10 cm and 45 x 30 cm crop geometry. Hence, the present study suggested to revise plant to plant spacing with similar line to lines spacing alongwith sowing in mid October could enhance the productivity of Indian mustard.

Keywords: *Crop geometry, Indian mustard, sowing time*

Introduction

Indian mustard (*Brassica juncea* L) is important oilseed crop of India and third important oilseed crop in term of production and area in the world. Important of oilseed in agriculture needs further attention, as they are valuable goods of human diet and soil fertility. In India, rapeseed-mustard is grown over 5.98 million ha area with a production of 8.43 million tones at an average productivity of 1410 kg/ha (Anonymous, 2019). It is the most important *Rabi* season oilseed crop of Rajasthan which is grown on 2.38 million ha with annual production of 3.95 MT at an average productivity of 1656 kg/ha (Anonymous, 2019-20). The optimum sowing time of Indian mustard is second fortnight of October in north-eastern of Rajasthan.

Productivity of mustard is largely dependent on the prevailing environmental conditions throughout the life cycle of the crop. It is a thermo sensitive as well as photosensitive crop (Ghosh and Chatterjee, 1988). The production potential of rapeseed-mustard can be fully exploited with suitable agronomic practices and genotypes. Among the different agronomic practices, optimum time of sowing plays as important role towards fully exploitation of the genetic potentiality of a variety as it provides optimum growth conditions such as temperature, light, humidity and rainfall. The growth phase of the crop should synchronize with optimum environmental conditions for better expression of growth and yield. The optimum plant population varies with the environment, genotype, sowing time and the season. Uniform distribution of crop plants an area, results utilized efficiently use of nutrients, moisture and suppression of weeds, leading to high yield (Sonani *et al*., 2002). Desired plant density obtained maximum leaf area to harvest maximum sunlight at the beginning of reproductive stage. A uniform distribution of plants per unit area is a prerequisite for yield stability (Diepenbrock, 2000). So with the selection of optimum sowing time, it is also essential to select suitable plant geometry for obtaining the higher productivity to a great extent.

Materials and Methods

A field experiment was conducted in *Rabi* season during 2016-17 at Agriculture Research Station, Navgaon (Alwar) which is comes under the Flood Prone Eastern Plain Zone III b of the agro-climatic zone of Rajasthan lies at the extreme North-East corner between $76^0$7'-$28^0$2' N latitude. The field study conducted to evaluate optimization of sowing time and crop geometry on yield attributes, yield and economics of Indian mustard cultivar RH-749 under irrigated condition of Rajasthan. The experiment was

arranged in split plot design (SPD) with three replications, taking three level of sowing dates (October 14, October 24 and November 03) as main plots treatments and five level of crop geometries (30 x 10, 30 x 20, 30 x 30, 45 x 15 and 45 x 30 cm) as sub-plots treatments. In totality there were 45 experimental plots of different treatment combinations. Fertilizer (kg/ha) applied as per RDF (80:40:40) were applied through urea, di-ammonium phosphate (DAP) and Mureate of potash (MOP), respectively. Full dose of phosphorus and potassium and half dose of N were applied as basal dose and incorporated in the soil. The remaining half of the dose of N was applied as top dressing at 40 days after sowing with first irrigation. Intercultural operations viz. weeding, and irrigation, was done as and when required. Observations taken as yield attributes characters were recorded randomly from selected five plant from each plots at harvesting stages viz. number of branches/plant, silliques/plant, seeds/ silliqua, test weight (g) and seed yield/plant (g). Seed yield and economics were recorded and calculated for each plot as per treatments. Treatments wise crop was harvested manually at physiological maturity stage. Data were analyzed statistically and treatment means were compared by least significant difference test.

Results and Discussion

Physico-chemical properties of experimental field were sandy loam soil texture, bulk density ranged between (1.41-1.58 g cm^{-3}), pH (2.5; 8.1 – 8.4), EC (0.28 – 0.72 dSm^{-1}), organic carbon was low (0.34%), available nitrogen low (155.84 kg ha-1), available phosphorus was low to medium (15.76 kg ha-1) and available potassium was medium to high (148.96 kg ha-1), water holding capacity (10.0 – 13.0%), and hydraulic conductivity (0.55 – 5.26 cm/hr).

Yield attributes

Crop sown on October 24 produced higher number of branches/plant (17.62), siliquae/plant (361.16) and seed weight/plant (28.45 g) over to crop sown on October 14 and November 03. Crop sown on October 14 increased significantly test weight (5.35) over to November 03 and also superior to crop sown on October 24 data are presented in Table 1. Crop sown on October 24 faced favourable soil moisture condition and relatively warmer temperature during vegetative growth and conducive temperature during flowering and pod formation stages while later sown crop faced low temperature at the time of emergence as well as flowering stage. Mondal and Islam (1993) supported the above result and showed that sowing in the last October gave the highest plant height than in first October and November. Pal *et al*. (1985) also reported declining trend in yield attributes with delay in sowing.

Crop geometry 45 x 30 significantly higher produced braches/plant (19.05), siliquae/plant (380), test weight (5.32 g) and seed weight/plant 33.70 g) over to first three crop geometry viz. 30 x 10, 30 x 20, 30 x 30 and non-significantly increased as compared to 45 x 15 cm presented in Table 1. These results were mainly due to wider spacing less competition for space and nutrients. Increasing spacing

Table 1: Effect of the date of sowing and crop geometry on yield attributes of Indian mustard under irrigated condition of Rajasthan

Treatments	Branches/ plant	Siliquae/ plant	Seeds/ siliqua	1000-seed weight (g)	Seed yield/ plant (g)
Main plot: Date of sowing					
D1 : 14 October	16.48	340.91	15.46	5.35	26.63
D2 : 24 October	17.62	361.16	15.43	5.20	28.45
D3 : 03 November	16.62	302.00	15.11	4.99	26.12
SEm±	0.35	16.12	0.10	0.06	0.69
CD (0.05%)	NS	NS	NS	0.25	NS
Sub plot: planting geometry					
S1 : 30 x 10 cm	12.87	238.25	14.83	4.95	17.64
S2 : 30 x 20 cm	15.99	331.71	15.11	5.03	24.66
S3 : 30 x 30 cm	18.10	349.27	15.37	5.21	27.65
S4 : 45 x 15 cm	18.53	374.24	15.77	5.32	31.67
S5 : 45 x 30 cm	19.05	380.00	15.58	5.40	33.70
SEm±	0.48	24.73	0.16	0.11	1.27
CD (0.05%)	1.40	72.18	0.47	0.33	3.70

enhanced the roots extension and better uptake of nutrients by crop roots (Singh *et al*., 2001; Shivani and Kumar, 2002). Similar results were also reported for different situations by (Gupta and Saini, 1988; Kumari *et al*., 2012; Arya and Shukla, 2019).

Seed yield and economics

Crop sown on October 24 produced higher seed yield (2159.42 kg/ha), gross return (79898.64 Rs./ha), net return (54429.38 Rs./ha) and B:C ratio (3.14) as compared to both other date of sowing data presented in Table 2 . Crop sown on October 24 faced favourable soil moisture condition and relatively warmer temperature during vegetative growth and conducive temperature during flowering and pod formation stages while later sown crop faced low temperature at the time of emergence as well as flowering stage. Lakra *et al*. (2018) and Pal *et al.* (1985) also reported declining trend in yield attributes with delay in sowing.

Data in Table 2 revealed that Crop geometry 30 x 20 cm significantly increased seed yield (2218.53 kg/ha), gross return (82085.61 Rs./ha), net return (56494.35 Rs./ha) and B:C ratio (3.21) over to crop geometry (30 x10 cm and 45 x 30 cm) and superior to third and forth crop geometry. It is may be due very closed plantation increased the competition between plants for water, nutrient, light and space and wider spacing could not fully utilized the available soil nutrients, moisture and light consequently reducing the seed yield. Similar findings on planting geometry have been reported by Chaniyara *et al*. (2002) and Arya and Suukla (2019).

Table 2: Effect of the time of sowing and crop geometry on yield and economic of Indian mustard under irrigated condition of Rajasthan

Treatments	Seed yield (Kg/ha)	Gross returns (Rs. / ha)	Net returns (Rs. / ha)	B:C ratio
Main plot: Date of sowing				
D1 : 14 October	2116.08	78294.94	52825.68	3.07
D2 : 24 October	2159.42	79898.64	54429.38	3.14
D3 : 03 November	2113.78	78209.81	52740.55	3.07
SEm±	17.90	662.38	662.38	0.03
CD (0.05%)	NS	NS	NS	NS
Sub plot: planting geometry				
S1 : 30 x 10 cm	2000.40	74014.88	48325.62	2.88
S2 : 30 x 20 cm	2218.53	82085.61	56496.35	3.21
S3 : 30 x 30 cm	2183.27	80780.83	55291.57	3.17
S4 : 45 x 15 cm	2203.17	81517.29	56178.03	3.21
S5 : 45 x 30 cm	2043.43	75607.03	50367.77	3.00
SEm±	46.45	1718.70	1718.70	0.07
CD (0.05%)	135.57	5016.02	5016.02	0.20

Conclusion

Form the above results, it may be concluded that the variety RH 749 performed better in 24 October sowing and a wide range of planting geomatry for higher seed yield and delay in sowing reduces seed yield in irrigated conditions of Rajasthan.

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