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Studies on mustard (*Brassica juncea* L.) varieties under various crop growing environment in eastern plain zone

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Abstract

A field experiment was conducted during rabi season of 2018-19 entitled "Studies on mustard (*Brassica juncea* L.) varieties under various crop growing environment in Eastern Plain Zone" at Agromet Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.). The experiment was conducted in split plot design which consisted of nine treatment combinations comprised of three crop growing environments viz. Oct. 20th, Oct. 30th and Nov. 9th and three varieties viz. Varuna, NDR-8501 and Kranti. Results reveal that taller plants (146.6 cm) were recorded in growing environment 20th October. Shorter plants (116.8 cm) were recorded under 09th November. Among the varieties, taller plant height (143.8 cm) was recorded in Varuna. Significantly higher leaf area index at 60 DAS (4.67) was recorded in 20th October. Among the varieties, highest leaf area index (4.3) was recorded in Varuna variety. The maximum number of primary branches plant⁻¹ was recorded on 20th October at 30, 60, 90 days and at harvest after sowing. Among the varieties, maximum number of primary branches plant⁻¹ was recorded in Varuna variety. Significantly higher number of secondary branches plant⁻¹ was recorded 20th October at 30, 60, 90 DAS and at harvest. Among the varieties, maximum number of secondary branches plant⁻¹ was recorded with Varuna at 30, 60, 90 DAS and at harvest. The higher number of siliquae/plant, length of siliqua, Number of seeds/siliqua were recorded on 20th October date of sowing. Among the varieties, maximum numbers of siliquae/plant, length of siliqua, number of seeds/siliqua were recorded in Varuna variety of mustard. Maximum Seed yield (20.9 q/ha), Stover yield (74.3 q/ha), Biological yield (95.28 q/ha) were recorded on 20th October crop growing environment. Among the varieties, maximum Seed yield (20.2 q/ha), Stover yield (70.3 q/ha), Biological yield (90.6 q/ha) were recorded with Varuna.

Keywords: Leaf area index, plant height, yield attributes, growing environment, mustard

Introduction

Indian mustard belongs to cruciferae family. Rapeseed is locally called sarson, toria, yellow toria, whereas, mustard is called rai or laha. Among the oilseeds *Brassica*, is the most important member of groups because more than 80 per cent of the area under rapeseed-mustard is followed by *toria*, *yellow sarson*, *gobhisarson*, *brown sarson* and *taramira*. Oilseeds, the second largest agricultural commodity after cereals in India, plays a significant role in India's agrarian economy, as more than 85 per cent of country's vegetable oil supply depend upon seven edible oilseeds (groundnut, rapeseed-mustard, soybean, sesame, sunflower, Niger and safflower) and two non-edible oilseeds (linseed and castor). Among the seven edible oilseed cultivation in India, rapeseed-mustard (*Brassica* spp.) contributes 28.6% in the production of oilseeds. Rapeseed-mustard is the major *rabi* oilseed crop of the country. India occupies the third position in rapeseed and mustard production in world after Canada and China. In India during year 2017-18, the area of Rapeseed-mustard was 6.4 million ha. with the production of 6.4 million tonnes and productivity of 987 kg/ha. In India, it is mainly cultivated in Rajasthan, Gujrat, Maharashtra, Haryana, Uttar Pradesh, Madhya Pradesh, Bihar, Assam, and West Bengal in varied situation. (Anonymous, 2017-18). Neog et al., (2005) revealed that as growing degree days (GDD) increased from 1270 to 1684 °C day in Pusa Jaikisan and Varuna, the seed yield also increased and with the further increase in GD Daccumulation, there was a decline in the seed yield of mustard. Change in sowing dates led to change in thermal environments of the cultivars with respect to different growth and development stages leading to variation in completion of life cycle (Roy et al., 2005)^[6]

Materials and Methods

The experiment was conducted at Agromet Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya- (U.P.) during Rabi season 2018-19, respectively. The farm is located 40 km away from Ayodhya city on Ayodhya- Raibareilly road at 26°47' N latitude and 82°12' E longitude and at an altitude of about 113 meter above the mean sea level. The experiment was conducted in split plot design which consist of nine treatment combinations comprised of three crop growing environments viz., Oct. 20th, Oct. 30th and Nov. 9th and three varieties viz. Varuna, NDR-8501 and Kranti. The crop was fertilized with a uniform dose of nitrogen, phosphorus and potassium @ 80kg, 60kg and 40 kg ha⁻¹, respectively Urea, DAP and muriate of potash were used as the source of nitrogen, phosphorus and potassium. The specific quantity of fertilizer was calculated on the basis of gross plot size. Sulphur was applied as per treatment through elemental sulphur. Half dose of nitrogen along with full dose of phosphorus, potassium and sulphur were applied as basal dressing and remaining dose of nitrogen was top dressed into two equal splits. First split was top dressed at 30 DAS and second splits at pre flowering stage of the crop.

Plant height (cm)

Five plants were selected randomly in each plot and tagged for measuring height at different intervals, height was measured during different phenological stages with the help of meter scale from soil surface to the tip of plant.

Leaf area index

For leaf area five plants were cut down close to the ground surface and then total leaf area five plants were randomly selected to cut down close to the ground surface and then leaf area measured by automatic leaf area meter (model No LJ-251) and finally averaged to get leaf area/plant and LAI was calculated as per following formula:

$$\text{Leaf area index} = \frac{\text{Leaf area per plant (cm}^2\text{)}}{\text{Ground area (cm}^2\text{)}}$$

No. of primary/Secondary branches per plant:

The numbers of primary /secondary branches were counted for five plants per plot randomly selected, tagged plants and averaged for each plant. The observation on number of branches was recorded at 30 days interval after sowing.

Yield attributing characters

Number of siliquae per plant

Total number of siliquae of sample plants of each plot were counted and average were calculated. Number of siliquae was counted separately on primary, secondary and tertiary branches. Total number of siliquae per plant was worked out by totaling the siliquae number on different type of branches.

Length of siliquae (cm)

Ten siliquae were randomly selected from each plot of the experimental field. The length was measured from the base to the beak and average was drawn.

Number of seeds per siliquae

No. of seed per siliquae were recorded at harvest by counting the number of seeds of ten randomly selected siliqua from three sample plants of each plot.

Test weight (g)

Counting of 1000 seeds was done on from sample of each net plot produce and weight of counted seeds was done on electronic balance. It was recorded for all the plots separately and average was drawn.

Seed Yield (q/ha)

From the individual plot, the net plot area was harvested and produce was sun dried. After drying the crop was threshed and cleaned separately on the net plot basis. The final weight was recorded in kg per net plot and finally converted into q/ha.

Stover yield (q/ha.)

Stover yield was computed by subtracting the seed yield from total produce on the net plot basis. Stover yield was recorded in kg per net plot area and converted into q/ha.

Biological yield (q/ha)

Above the ground parts of plant was harvested per plot after maturity them weighted to represent the biological yield and expressed in q/ha.

Harvest index (%)

The harvest index is the ratio of grain yield and biological yield, it was calculated by following formula;

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

Results and Discussion

Plant height (cm)

Plant height increased successively with age of crop. It is evident from the data that different crop growing environment and varieties influenced plant height significantly at all the stages except 30 DAS. Taller plants (146.6 cm) were obtained in 20th October which was significant over rest both of dates of environment. Shorter plants (116.8 cm) were recorded under 09th November. Varieties had significant variation on plant height at all the stages except 30 DAS. It was quite evident from the data that higher plant height (143.8 cm) was obtained in Varuna which was significantly over NDR-8501 and Kranti at all the stages. Data also showed that Kranti cultivar recorded smaller height of plant all the stages (Panda *et al.* (2004) [5], Bhuiyan *et al.* (2008) [1] and Kumari *et al.*, 2012) [3].

Leaf area index

The LAI increased successive till 60 DAS and there after declined. It is quite obvious from the data that the LAI was significantly affected due to different dates of sowing at all the stages except 30 DAS. Significantly higher leaf area index at 60 DAS (4.67) was obtained in 20th October at 60 DAS as compared to sowing date on 30th October, while sowing on 09th November recorded lowest LAI at all the stages of crop. The Leaf area index was affected significantly at all the stages due to varieties except 30 DAS. At 90 DAS, highest leaf area index (4.37) was recorded in Varuna variety. Data also reveal that Kranti recorded lowest (4.21) leaf area index at all the growth stages at 60 DAS. The results are in conformity with (Panda *et al.* 2004, Bhuiyan *et al.* 2008, Singh *et al.* 2008 and Kumari *et al.* 2012) [5, 1, 7, 3].

Number of primary branches plant⁻¹

Number of primary branches plant⁻¹ at different crop growing environment was observed during all growth stage. Maximum number of primary branches plant⁻¹ was noticed with sowing on 20th October at 30, 60, 90 days and at harvest after sowing which was significantly higher over 30th October and 09th November at all the stages of crop. Among the varieties, maximum number of primary branches plant⁻¹ was found with Varuna, which was significantly superior over the NDR-8501 and Kranti at all the growth stages.

Number of secondary branches plant⁻¹

The Crop growing environment significantly affected the number of secondary branches plant⁻¹ at all the stages except 30 DAS. Significantly higher number of secondary branches plant⁻¹ was noticed 20th October at 30, 60, 90 DAS and at harvest; which was significantly superior over 30th October and 09th November at all the stages of crop. Among the varieties, maximum number of secondary branches plant⁻¹ was recorded with Varuna at 30, 60, 90 DAS and at harvest which was significantly higher than NDR-8501 and Kranti at all growth stages of mustard crop.

Yield and yield attributes

No of siliquae/plant

Higher number of siliquae/plant (289.8) was recorded when crop was sown on 20th October which was significantly superior over 30th October and 09th November date of sowing. The lowest number of siliquae/plant was recorded when sowing was done at 09th November. Number of siliquae/plant was significantly affected by different varieties. Maximum numbers of siliquae/plant (300.9) were recorded with Varuna followed by NDR-8501 (273.7). These findings are in agreement with (Singh *et al.* 2008, Singh, 1989 and Thakuria and Gogoi, 1996)^[7, 8, 10].

Length of siliqua (cm)

Maximum length of siliqua (8.1 cm) was recorded when crop was sown on 20th October which was significantly superior over 30th October and 09th November crop growing environment. The minimum length of siliqua was recorded when sowing date was done on 09th November.

Length of siliqua was significantly affected by different varieties. Maximum length of siliqua (8.32cm) was recorded with Varuna followed by NDR-8501 (7.6cm) and then Kranti (6.8cm). Similar results were reported by (Singh *et al.*, 2008, Singh, 1989)^[7, 8].

No of seeds/siliqua

Maximum number of seeds/siliqua (15.9) was recorded when sown date on 20th October which was significantly superior over 30th October and 09th November crop growing environment. The minimum number of seeds siliqua-1 (11.9) was recorded when sown was done at 09th November crop growing environment. Number of seeds siliqua-1 was significantly affected by different varieties. Maximum numbers of seeds/siliqua (14.9) were recorded with Varuna followed by NDR-8501 (13.6). Similar results are reported by (Singh, 1989, Singh, 1991, Singh *et al.* 2008 and Yadav *et al.* 1994)^[8, 9, 7, 12].

Seed yield (q/ha)

Maximum Seed yield (20.9 q/ha) was recorded when crop sown date on 20th October which was significantly superior over 30th October and 09th November crop growing

environment. The minimum Seed yield 15.7 q/ha was recorded when sowing was done at 09th November crop growing environment. The seed yield (q/ha) was significantly affected by different varieties. Maximum Seed yield (20.25 q/ha) was recorded with Varuna followed by NDR-8501 (18.7 q/ha) and then Kranti (16.2 q/ha). Similar results are reported by (Panda *et al.* 2004, Singh *et al.*, 2008, Lallu *et al.* 2010 and Kumari *et al.*, 2012)^[5, 7, 4, 3].

Stover yield (q/ha)

Maximum Stover yield (74.3 q/ha) was recorded when crop was sown on 20th October which was significantly superior over 30th October and 09th November crop growing environment. The minimum Stover yield (57.4 q/ha) was recorded when sowing was done at 09th November crop growing environment. The Stover yield (q/ha) was significantly affected by different varieties. Maximum Stover yield (70.3 q/ha) was recorded with Varuna followed by NDR-8501 (66.3 q/ha) and then Kranti (60.5 q/ha). Similar results were reported by (Sarma *et al.* 1999 Singh *et al.*, 2008 and Kumar and Singh, 2003)^[11, 7, 2].

Biological yield (q/ha)

The perusal of data showed that different crop growing environment influenced significantly to the Biological yield. Maximum Biological yield 95.28 q/ha was recorded when crop was sown on 20th October which was significantly superior over 30th October and 09th November crop growing environment. The minimum Biological yield (73.2 q/ha) was recorded when sowing was done at 09th November crop growing environment.

The Biological yield (q/ha) was significantly affected by different varieties. Maximum Biological yield (90.6 q/ha) was recorded with Varuna followed by NDR-8501 (85.1q/ha) and then Kranti (76.7 q/ha).

Harvest index (%)

The perusal of data showed that different crop growing environment and varieties had non-significant to the effect on the biological yield. Similar results are reported by (Singh *et al.* 2008)^[7].

Table 1: Plant height of Indian mustard as affected by crop growing environment and varieties.

Treatments	Plant Height (cm)			
	30 DAS	60 DAS	90 DAS	At Harvest
Crop growing environment				
20 th Oct.	25.0	79.7	127.5	146.6
30 th Oct.	23.3	75.8	115.6	132.9
09 th Nov.	22.2	63.5	101.6	116.8
SEM±	0.62	2.17	3.78	4.33
CD at 5%	NS	6.83	11.93	13.72
Varieties				
Varuna	24.03	78.3	125.0	143.8
NDR-8501	23.40	72.7	116.1	133.5
Kranti	23.10	68.0	103.6	119.1
SEM±	0.46	1.73	2.44	2.81
CD at 5%	NS	5.07	7.1	8.21

Table 2: Leaf area Index of Indian mustard as affected by crop growing environment and varieties

Treatments	Leaf area index		
	30 DAS	60 DAS	90 DAS
Crop growing environment			
20 th Oct.	1.3	4.6	4.5
30 th Oct.	1.3	4.4	4.2
09 th Nov.	1.3	4.1	3.9
SEm±	0.03	0.11	0.12
CD at 5%	NS	0.37	0.38
Varieties			
Varuna	1.3	4.5	4.3
NDR-8501	1.3	4.4	4.3
Kranti	1.3	4.2	4.0
SEm±	0.02	0.08	0.07
CD at 5%	NS	0.24	0.22

Table 3: Primary branches plant⁻¹ of mustard as affected by crop growing environment and varieties.

Treatments	primary branches plant ⁻¹			
	30 DAS	60 DAS	90 DAS	At Harvest
Crop growing environment				
20 th Oct.	1.5	5.3	6.4	6.1
30 th Oct.	1.4	4.8	5.8	5.6
09 th Nov.	1.3	4.2	5.1	4.9
SEm±	0.04	0.13	0.14	0.13
CD at 5%	NS	0.43	0.43	0.41
Varieties				
Varuna	1.5	5.2	6.3	6.0
NDR-8501	1.4	4.8	5.8	5.6
Kranti	1.4	4.3	5.2	5.0
SEm±	0.02	0.09	0.10	0.08
CD at 5%	NS	0.27	0.30	0.24

Table 4: Secondary branches plant⁻¹ of mustard as affected by crop growing environment and varieties.

Treatments	Secondary branches plant ⁻¹			
	30 DAS	60 DAS	90DAS	At Harvest
Crop growing environment				
20 th Oct.	2.4	10.1	12.5	12.0
30 th Oct.	2.2	9.4	11.4	11.0
09 th Nov.	2.0	8.1	10.1	9.7
SEm±	0.06	0.25	0.26	0.25
CD at 5%	NS	0.80	0.84	0.81
Varieties				
Varuna	2.3	10.0	12.3	11.8
NDR-8501	2.2	9.3	11.5	11.0
Kranti	2.1	8.3	10.2	9.8
SEm±	0.04	0.16	0.16	0.15
CD at 5%	NS	0.47	0.48	0.46

Table 5: Yield attributes of Indian mustard as affected by affected by crop growing environment and varieties.

Treatments	No. of Siliquae/plant	Length of siliqua (cm)	No. of seeds/siliqua	Test weight (g)
Crop growing environment				
20 th Oct.	289.8	8.1	15.9	4.5
30 th Oct.	278.1	7.7	12.7	4.3
09 th Nov.	246.8	6.9	11.9	4.3
SEm±	6.41	0.17	0.31	0.10
CD at 5%	20.20	0.56	0.99	NS
Varieties				
Varuna	300.9	8.3	14.9	4.9
NDR-8501	273.7	7.6	13.6	4.5
Kranti	240.1	6.8	12.1	3.7
SEm±	3.84	0.11	0.20	0.06
CD at 5%	11.22	0.33	0.59	NS

Table 6: Yield of Indian mustard as affected by crop growing environment and varieties

Treatments	Grain Yield (q/ha)	Stover Yield (q/ha)	Biological Yield (q/ha)	Harvest index (%)
Crop growing environment				
20 th Oct.	20.9	74.3	96.2	21.9
30 th Oct.	18.5	65.4	84.8	22.1
09 th Nov.	15.7	57.4	73.5	21.5
SEm±	0.51	1.76	2.22	0.62
CD at 5%	1.62	5.56	7.01	NS
Varieties				
Varuna	20.2	70.3	91.4	22.3
NDR-8501	18.7	66.3	85.6	22.0
Kranti	16.2	60.5	77.4	21.2
SEm±	0.36	1.29	1.65	0.43
CD at 5%	1.06	3.76	4.82	NS

Conclusions

Conclusively, taller plants (146.6 cm) were recorded in growing environment 20th October. Shorter plants (116.8 cm) were recorded under 09th November. Among the varieties, taller plant height (143.8 cm) was recorded in Varuna. Significantly higher leaf area index at 60 DAS (4.67) was recorded in 20th October. Among the varieties, highest leaf area index (4.3) was recorded in Varuna variety. The maximum number of primary branches plant⁻¹ was recorded on 20th October at 30, 60, 90 days and at harvest after sowing. Among the varieties, maximum number of primary branches plant⁻¹ was recorded in Varuna variety. Significantly higher number of secondary branches plant⁻¹ was recorded 20th October at 30, 60, 90 DAS and at harvest. Among the varieties, maximum number of secondary branches plant⁻¹ was recorded with Varuna at 30, 60, 90 DAS and at harvest. The higher number of siliquae/plant, length of siliqua, Number of seeds/siliqua were recorded on 20th October date of sowing. Among the varieties, maximum numbers of siliquae/plant, length of siliqua, number of seeds/siliqua were recorded in Varuna variety of mustard. Maximum Seed yield (20.9 q/ha), Stover yield (74.3 q/ha), Biological yield (95.28 q/ha) were recorded on 20th October crop growing environment. Among the varieties, maximum Seed yield (20.2 q/ha), Stover yield (70.3 q/ha), Biological yield (90.6 q/ha) were recorded with Varuna.

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