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Influence of dates of sowing and irrigation scheduling on growth and yield of mustard (*Brassica juncea* L)

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ABSTRACT

A field experiment was conducted at Agronomy Research Farm, ND University of Agriculture & Technology, Faizabad, UP during the Rabi season of 2009-10 and 2010-11 to assess the influence of different dates of sowing and irrigation scheduling on growth and yield of mustard (*Brassica juncea* L). Results revealed that all the growth and yield attributes were increased significantly under 30 October sowing. Plant height (cm), leaf area index and dry matter accumulation (g plant^{-1}) and yield attributes like number of siliquae plant^{-1}, number of seeds siliqua^{-1}, length of siliqua (cm) and seed and stover yields of mustard crop were significantly higher with irrigation at 0.7 IW/CPE ratio. Interaction between dates of sowing and irrigation scheduling was found significant on yields of mustard. Highest seed yield (16.36 q ha^{-1}) was recorded with 0.7 IW/CPE ratio sown on 30 October. Irrigation at 0.7 IW/CPE ratio under 30 October sowing proved most remunerative and economically feasible for mustard under the agroclimatic conditions of eastern UP.

Keywords: Dates of sowing; irrigation scheduling; growth; yield

INTRODUCTION

Mustard is the second most important edible oil seed crop after groundnut. It plays an important role in the oil seed economy of the country. India occupies the third position in mustard production in world after China and Canada. In India during 2009-2010 the production of mustard was about 6.40 million tons from an area of 6.45 million hectares with an average productivity of 990 kg ha^{-1}. In UP it is grown in an area of 0.82 million hectares with production of 0.90 million tons. The average productivity in UP is 1,141 kg ha^{-1} which is quite less than the national average productivity (Anon 2010).

Among the different agronomic practices optimum sowing time plays an important role to fully exploit the genetic potentiality of a variety as it provides optimum crop growing environment such as temperature, humidity, light etc. Sowing time is one of the most important non-monetary input which influences the productivity of seed and oil to a great extent. Mustard is usually sown by the end of September to first fortnight of October in north India when grown as a sole, mixed or intercrop. But with the development of new varieties of crop and adoption of multiple cropping systems under irrigated conditions it has become essential to extend its sowing from October to mid November or even later. Delayed sowing would adversely influence the crop performance. It necessitates to develop suitable agro-techniques to augment the productivity of the crop. Water is very precious and scarce input during winter and its efficient utilization is quite necessary. Efficient use of irrigation water aims at the utilization of available water resources to the maximum possible advantages in the crop production. As such use of this costly and scarce input through efficient water management practices is very essential. Among the several recognized criteria of irrigation scheduling the climatological approach (IW/CPE ratio) is very useful. Evapo-transpiration by a full crop cover is closely associated with the evaporation from an open pan (Dastane 1967). Information on optimum water requirement of mustard is not available under agro-climatic conditions of eastern UP which calls for a need to generate more information on the combined effect different dates of sowing and irrigation scheduling based on IW/CPE ratio for greater yields in mustard.

MATARIAL and METHODS

The experiment was conducted at Agronomy Research Farm of ND University of Agriculture & Technology, Faizabad, UP during Rabi season 2009-10 and 2010-11. Geographically experimental site is situated at 26^0 472 N latitude, 82^0 122 E longitude and an altitude of 113 meters above msl in the Indogangetic regions of eastern UP. The soil of the experimental site was silt loam having 0.32 per cent organic carbon, 180.4 kg/ha available N, 18.4 kg/ha available P_2O_5, 290.0 kg/ha available K_2O, 7.9 pH and 0.33 dsm^{-1} EC. The experiment was conducted in split plot design with 3 replications. Twelve treatment combinations comprising of date of sowing viz D_1 (30 October), D_2 (14 November) and D_3 (29 November) were kept as main plot treatments and four irrigation schedulings viz I_1 (irrigation at 0.5 IW/CPE ratio), I_2 (irrigation at 0.7 IW/CPE ratio), I_3 (one irrigation at pre-bloom stage) and I_4 (irrigations at pre-bloom stage + pod filling stage) were kept as sub-plot treatments. Seeds were sown at 30 cm spacing using Desi plough. Thinning was done twice at emergence stage at 10 DAS and at 20 DAS in order to maintain optimum plant to plant distance of 15 cm.

RESULTS and DISCUSSION

Dates of sowing brought significant variation in plant height, leaf area index, dry matter accumulation plant^{-1} and number of branches plant^{-1} at harvest of mustard crop. Crop sown on 30 October produced significantly taller plants, higher LAI, number of branches and dry matter accumulation in comparison to 29 November sowing (Table 1) due to prolonged vegetative growth period because of congenial environmental conditions especially atmospheric temperature which formed a basis for rapid cell division in the meristematic tissues of the crop and led to better growth attributes under normal sowing (30 October). The late sown crop on 29 November experienced sub-optimal temperature regime especially during the second fortnight of December and first fortnight of January which retarded their growth compared to normal date (30 October) or mid-sown (14 November) crops on earlier dates. Height of the plants, number of branches, LAI and dry matter accumulation were significantly affected by irrigation scheduling (Table 1). The significantly taller plant height recorded with 0.7 IW/CPE ratio might be due to rapid cell division under adequate water supply. Shorter plant height recorded under 0.5 IW/CPE ratio was mainly due to poor growth caused by stress conditions (Panda et al 2004, Kurmi 2002). Leaf area index was significantly influenced by various irrigation scheduling. Significantly higher LAI was recorded with 0.7 IW/CPE ratio. Increase in LAI under increasing moisture availability might be due to increased nutrient absorption which contributed for more number of green leaves and size of leaves and ultimately led to higher LAI. The lowest LAI was recorded under 0.5 IW/CPE ratio due to reduced cell expansion under moisture stress conditions. Crop sown on 30 October accumulated significantly higher dry matter plant^{-1} which did not differ significantly than sown on 14 November. However crop sown on 29 November accumulated significantly lower dry matter than 30 October sowing. Accumulation of dry matter is directly related to vigorous plant height, LAI and number of branches plant^{-1} which is appreciably reduced as sowing is delayed (Panda et al 2004, Khushu and Singh 2005). Higher dry matter accumulation at all the stages was recorded under 0.7 IW/CPE followed by irrigation at pre-bloom stage + pod filling stage. This might be due to taller plants, number of branches and LAI under adequate moisture availability which in turn contributed for higher dry matter accumulation as a result of proper cell turgidity and opened leaves which unltimately increased the photosynthetic activity of plants and led to higher dry accumulation under the treatment. Significantly higher dry matter accumulation due to increasing irrigation level has also been reported. Higher number of branches were recorded under 0.7 IW/CPE ratio followed by irrigation given at pre-bloom + pod filling stage which might be due to adequate availability of moisture which

Table 1. Effect of different dates of sowing and irrigation scheduling on growth of mustard (pooled data)

Treatment	Plant height (cm) at harvest	Leaf area index at 90 DAS	Dry matter accumulation at harvest (g/plant)	Number of branches plant^{-1} at harvest	
				Primary	Secondary
Date of sowing					
D_1	149.15	3.20	49.31	7.43	15.97
D_2	144.66	3.09	47.26	6.69	14.38
D_3	118.50	2.50	38.93	5.65	12.15
SEm±	4.52	0.11	1.48	0.22	0.52
$CD_{0.05}$	17.77	0.43	5.82	0.88	2.05
Irrigation scheduling					
I_1	128.59	2.73	42.02	5.94	12.77
I_2	147.03	3.15	48.18	7.25	15.59
I_3	130.08	2.80	43.01	6.06	13.02
I_4	144.04	3.03	47.46	7.11	15.29
SEm±	3.40	0.06	1.11	0.17	0.30
$CD_{0.05}$	10.09	0.18	3.31	0.49	0.88

Table 2. Effect of different dates of sowing and irrigation scheduling on yield and yield attributes of mustard (pooled data)

Treatment	# of siliquae plant^{-1}	Length of siliqua (cm)	# of seeds siliqua^{-1}	1000-seed weight (g)	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)
Date of sowing							
D_1	399.75	5.35	13.51	4.71	14.65	44.96	24.56
D_2	364.90	5.17	13.05	4.68	12.79	40.02	24.20
D_3	309.72	4.56	11.51	3.69	10.05	30.23	24.89
SEm±	13.18	0.12	0.27	0.16	0.29	1.04	0.66
$CD_{0.05}$	51.75	0.46	1.04	0.64	1.15	4.08	NS
Irrigation scheduling							
I_1	321.34	4.75	12.00	4.30	10.53	33.90	23.66
I_2	398.77	5.34	13.47	4.46	14.52	45.55	25.59
I_3	332.97	4.86	12.27	4.30	11.01	35.67	23.58
I_4	379.41	5.16	13.04	4.38	13.94	41.48	25.36
SEm±	7.44	0.08	0.19	0.09	0.20	0.62	0.51
$CD_{0.05}$	22.10	0.23	0.56	NS	0.59	1.84	NS

perhaps increased the availability of nutrients and led to more number of branches plant^{-1}.

Number of siliquae plant^{-1}, length of siliqua, number of seeds siliqua and 1000-seed weight were successively decreased with delay in sowing from 14 November to 29 November (Table 2). However the differences between 30 October and 14 November sowing were not significant. Late sowing (29 November) restricted the growth duration and induced early flowering, delayed pod initiation and seed setting to the great extent as compared to 30 October and 29 November sowing due to low temperature during the months of December and January which not only restricted the growth but also induced slow pollination and flowering in late sown crop. Similar results were reported by Panda et al (2004). Number of siliquae plant^{-1}, length of siliqua and number of seeds siliqua^{-1} were significantly influenced due to different irrigation scheduling. The higher values of these yield contributing characters were observed when crop was irrigated at 0.7 IW/CPE ratio. This might be due to the fact that reproductive organs are determined much before the emergence of siliqua and largely governed by the vegetative growth and initiation of flower primordia. Better vegetative growth ultimately builds higher yield attributing characters due to increased absorption of mineral nutrients under adequate moisture conditions. Growth characters were highest which contributed for highest yield attributes due to increased photosynthetic activity and translocation of photosynthates from source to sink.

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