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Effect of variable weather condition on growth and yield of mustard cultivars

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Abstract
Mustard is a major oilseed crop grown during *rabi* season. Weather variability causes substantial fluctuations in any crop production a field experiment was conducted during *Rabi season* of 2015-16 on the topic entitled "Effect of variable weather condition on growth and yield of mustard cultivars" in sandy loam soil of N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The experimental comprised of three growing environments *viz*., 15th, October, 30th, October, 14th, November and three cultivars *viz*., NDR-8501, Varuna and Vardan. Results revealed that Highest Accumulation heat unit efficiency was recorded when sowing was done 15th, October growing environment, followed by 30th, October. Vardan variety was found more conducive for growth development, grain yield and Accumulated heat unit. Accumulated heat unit (1447.4.0^{0}days), solar radiation interception (529.2MJm^{-2}), from sowing to maturity produced the high yield of Indian mustard.

Keywords: Phenophases, Mustard, Yield

Introduction
The crop occupies an area of approximately 6.90 million hectare with a production of 8.18 million tonnes (Shekhawat *et al*. 2012) [8]. In India, the Haryana state contributes 10.2% to the total rapeseed-mustard production in the coun-try. Likewise, area under mustard in Uttar Pradesh has increased from 1.98 lakh ha in 1966-67 to 5.70 lakh ha in 2013-14. A considerable improvement in mustard productivity has also happened during the period with its increase from 405 kg/ha in 1966-67 to 1350 kg/ha in 2013-14 (Indiastat, 2014) [3]. Indian-mustard is much sensitive to climatic variables; hence, climate change could have significant effect on its production. One month delay in sowing from mid of October resulted in 40.6% loss in seed yield (Lallu, *et al.*, 2010) [5]. Gill and Bains (2008) [2] observed a linear and pos-itive relation between leaf area development and pho-tosynthetically active radiation (PAR) interception, which leads to higher dry matter production. LAI plays an important role for crop growth based on its interception and utilization of PAR for producing dry matter (Kumar *et al*., 2007) [4] and with the delay in planting date, the higher mean temperature was experienced during flowering which led to accelerate the decrease in LAI and reduction in the flowering period. Neog *et al*. (2005) [6] revealed that as growing degree days (GDD) increased from 1270 to 1684 ºC day in PusaJaikisan and Varuna, the seed yield also increased and with the further increase in GDD accumulation, there was a decline in seed yield. At the value of 1606 ºC day, the yield was found to be highest. Adak *et al*. (2011) [1] reported that 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) [7] attributed the reduction in seed yields to the relatively higher temperature prevailing during the pod filling stage**.**

Materials and Methods
An experiment was conducted during *Rabi* seasons of 2015-16 at student instructional farm NDUA&T Kumarganj Faizabad (U.P.), India on the topic entitled "Effect of variable weather condition on growth and yield of mustard cultivars" The experimental site is located in the main campus of NDUA&T, Kumarganj, (Faizabad) situated at a distance of about 42 km. away from Ayodhya district headquarter on Faizabad Raibarelly road. The geographical situation of experimental site lies at latitudes 26^0 47' North longitude 82^0 12′ East and altitude of 113 meter from mean sea level in the Indo genetic alluvium of eastern Uttar Pradesh. The details of materials and methods employed & techniques adopted during the course of experimentation has been described in this paper. The experiment was conducted in Split Plot Design (S.P.D) and replicated the three times. The different growth parameters studied were white as phenological stages, Yield.

Results

Leaf area index

Data regarding to leaf area index of mustard as affected by different dates of sowing and varieties recorded at successive growth stages have been presented in Table-1. Different dates of sowing under present investigation have no significant influence on the leaf area index at 30 DAS. Significantly higher leaf area index was obtained at date of sowing15th, Octoberas compared to sowing done on 30th, Octoberas date of sowing & 14th, November date of sowing proved lowest LAI at all the stages of crop. Different varieties have no significant influence on the leaf area index at 30 DAS. Among the varieties NDR-8501recorded significantly higher leaf area index at 60 DAS, 90 DAS and at harvest as compared to Varuna and Vardan.

Dry matter accumulation(g/m^2)

Data with respect to dry matter accumulation as affected by dates of sowing and varieties recorded at successive growth stages have been presented in Table-2. It is quite obvious from the data that dry matter accumulation varied significantly due to date of sowing at all the stages of mustard. It was recorded higher under the treatment when mustard was sown on 15th, October which was at while significantly superior over rest both of the date of sowing. Wider date of sowing recorded lowest dry matter at all the stages. . It is obvious from the data revealed that dry matter accumulation was significantly influenced by different dates of sowing. Highest dry matter accumulation was recorded in NDR-8501 variety which was at par with Varuna while significant over VARDAN at all the stages of Indian mustard.

Days to flower initiation (DAS)

Data pertaining to days taken to flowering of mustard as influenced by date of sowing and varieties have been presented in Table-3. The minimum flower initiation was recorded at 14th, November date of sowing.Days to flower initiation were influenced by different varieties. To maximum days taken to flower initiation were recorded with NDR-8501 (51 Days) variety followed by Varuna (47 Days) and then Vardan (42 Days).

Days to maturity (DAS)

Data pertaining days to maturity as influenced by date of sowing and varieties have been presented in Table-3. Maximum days taken to maturity (123) were recorded when crop was sown on 15th, October date of sowing which was superior over 30th, October 14th, November date of sowing. to minimum day taken to maturity was recorded (116) at 14th, November date of sowing. Days to maturity were influenced by different varieties. The maximum days taken to maturity were recorded with NDR-8501 (132 Days) variety followed by Varuna (122) and then Vardan (105 Days).

No of siliquae (plant^{-1})

Data pertaining to number of siliquae plant^{-1} as affected by dates of sowing and varieties have been presented in Table-4. Data reveal that dates of sowing and varieties had significant influence on the number of siliquae plant^{-1}. Higher number of siliquae Plant^{-1} (284) was recorded when crop was sown 15th, October which was significantly superior over 30th, October and 14th, November date of sowing. The lowest number of siliquae Plant^{-1} was recorded when sowing was done at 14th, November. Number of siliquae plant^{-1} was significantly affected due to varieties. A critical examination over data quite reveal that among the varieties NDR-8501 (298) recorded significantly higher number of siliquae plant^{-1} as compared to Varuna and Vardan.

Table 1: Leaf area index of Indian mustard as influenced by different date of sowing and varieties

Treatments	Leaf area index					
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS
Date of sowing						
15th, Oct.	1.69	2.69	4.49	3.90	15.21	11.25
30^{th,} Oct.	1.65	2.57	4.28	3.72	13.38	9.99
14th, Nov.	1.59	2.36	3.94	3.42	12.76	9.55
SEm±	0.04	0.07	0.12	0.09	0.39	0.27
CD at 5%	NS	0.22	0.38	0.31	1.23	0.85
Varieties						
NDR-8501	1.68	2.84	4.73	4.11	14.34	10.66
Varuna	1.65	2.54	4.23	3.68	13.80	10.28
Vardan	1.61	2.25	3.75	3.26	13.22	9.85
SEm±	0.03	0.04	0.08	0.07	0.27	0.19
CD at 5%	NS	0.14	0.24	0.21	0.79	0.56

Table 2: Dry matter accumulation (g/m^2) as influenced by different date of sowing and varieties:

Treatments	Dry matter accumulation (g/m^2)					
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS
Date of sowing						
15th, Oct.	37.57	182.10	331.08	517.62	738.91	770.59
30^{th,} Oct.	36.84	173.51	315.47	492.84	704.06	734.24
14th, Nov.	35.38	159.76	290.48	453.80	648.29	676.09
SEm±	1.05	4.24	7.34	13.45	19.45	19.49
CD at 5%	NS	13.37	23.13	42.39	61.28	61.42
Varieties						
NDR-8501	37.38	190.89	347.06	542.20	774.57	807.79
Varuna	36.74	171.87	312.48	488.18	697.40	727.30
Vardan	35.67	152.62	277.48	433.88	619.28	645.84
SEm±	0.70	2.95	4.38	9.38	13.08	14.24
CD at 5%	NS	8.63	12.81	27.39	38.20	41.56

Table: 3: Days to flower initiation and Maturity (DAS) of Indian mustard influenced by different date of sowing and varieties:

Treatments	Days to flower initiation (DAS)	Days to maturity (DAS)
date of sowing		
15th, October	48	123
30th, October	47	120
14th, November	45	116
varieties		
NDR-8501	51	132
Varuna	47	122
Vardan	42	105

Table 4: Yield attributes of Indian mustard as influenced by different date of sowing and varieties:

Treatments	No of Siliqua plant^{-1}	Length of siliqua (cm.)	No of Seeds siliqua^{-1}	Test weight (g)
date of sowing				
15th,Oct.	284.52	7.31	13.36	4.91
30th, Oct.	271.10	6.96	12.73	4.80
14th, Nov.	249.62	6.41	11.73	4.68
SEm±	6.25	0.16	0.28	0.13
CD at 5%	19.71	0.51	0.90	NS
varieties				
NDR-8501	298.24	7.66	14.01	4.94
Varuna	268.59	6.90	12.62	4.76
Vardan	238.41	6.12	11.20	4.70
SEm±	4.09	0.09	0.19	0.09
CD at 5%	11.94	0.28	0.57	NS

Conclusion

It is concluded that study in Highest Accumulation heat unit efficiency was recorded when sowing was done 15th, October growing environment, followed by 30th,October.Vardan variety was found more conducive for growth development, grain yield and Accumulated heat unit.

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