Original Research Article

"STUDY ON MICRO-CLIMATE AND ITS EFFECT ON GROWTH AND YIELD OF MUSTARD CROP UNDER PRAYAGRAJ CONDITIONS"

ABSTRACT

A field experiment was conducted during *Rabi* season of 2022-2023at field of collage of forestry in Prayagraj district of utter Pradesh.Keeping in this view experiment was conducted in Factorial RBD with three replications having two factors. The first factor comprised of three DOS (170ct. 3Nov. and 17 Nov.) whereas the second factor consisted of Four Indian mustard Cultivar viz: Jhalak, Kala Sona, Sriram, and Ratna Results showed that both dates and varieties 17 oct and Ratna were superior as compared to rest of treatmentmax. yield observed. However, the highest growth attributes Like plant height, number of leaves, no of branches yield, and yield attributes like No. of silique (cm) per plant, test weight, seed yield (q/ha) grain yield, dry matter, and length of siliqua was recorded under 17 Oct. growing crop Ratna variety, the Lowest yield and growth recorded under date 17 Nov. growing crop Jhalak followed by 3 Nov. growing Crop Jhalak.

Keyword: Date of sowing, Micro Climateand Cultivar

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Introduction

India is the fourth largest oilseed economy in the world after USA, China and Brazil. Rapeseed mustard (Brassica junceaL.) is the second most important oilseed crop in India, next to soybean, with almost one fourth share in area and production (Raghuvanshi et al. 2018). Mustard is a cash crop and more remunerative than other field crops. Mustard is the most important rabi season oilseed crop of Rajasthan. It is grown in 2.71 million ha with a production of 4.3 million tonnes and 1586 kg/ha of average productivity. The average production of the district is 906 kg/ha (Anonymous, 2019-20). Climate change becomes a major bottleneck for sustainable agriculture in recent years. Extreme climatic events such as frost, heat stress, moisture stress, new diseases and pests become major drivers in successful crop production. Frost or Tusar or Pala is a localized phenomenon which is fairly common in northern India. Due to Climate change frost becomes a regular phenomenon in recent years in semi arid regions of Rajasthan. Frost damage occurs when ice forms inside the plant tissue and injures plant cell. The extent of injury caused by frost mainly depends upon the temperature below freezing point, period of low temperature and the crop stage at which frost occurs. The freezing can be either extracellular or intracellular. The ice formation disrupts the protoplasts (Levitt, 1980).

Indian mustard (*Brassica juncea*) is the second most important oilseed crop in India after groundnut sharing 27.8% in the India's oilseedproduction. The crop occupies an area of 8.74 m ha, with the production of 10.95 m tons and average productivity of 1270 kg/ha in the country (Anonymous, 2022). Haryana state also contributes 10.2% to the total rapeseed-mustard production in the country. Indian mustard is an important *rabi* crop raised under rainfed areas of Haryana but also in adjoining Rajasthan. High probability of irregular monsoon not only jeopardizes the *kharif* production but rabi crops also due to inadequate moisture storage in the soil profile. In the last decade, against the normal precipitation of 54.9 mm rainfall during *rabi* season, the values differed every year due to change in climatic conditions. Indian mustard also suffers from frost at maturity phase and yields are drastically affected in winter season. Adoption of improved varieties and their timely sowing are important factors for improving their productivity. Different cultivars may respond differently to different sowing time (Rajput *et al.* 1991).

Time of sowing is very important for crop production as different sowing dates provide variable environmental conditions within the same location for growth and development of crop. Growth and yield of Brassica species largely depends upon change in environment during crop growth and this change in environment can occur through many practices including sowing dates and water availability. For getting higher yields, sowing time of crop needs to be adjusted with suitable agro climatic environment (Saha and Khan, 2008). Pradhan *et al.* (2014) reported that there was significant interaction between date of sowing and cultivars with respect to seed yield of mustard. Indian mustard is much sensitive to climatic variables. Hence climate change could have significant effect on its production. Planting window and mustard cultivars is the most important element realizing potential yield of crop. Generally, the time of planting varies depending on the climatic condition of the region and the variety to be grown. Different varieties of mustard are sensitive to change in environmental conditions where the crop is being grown. Delayed sowing owing to change in biotic and abiotic environmental conditions may have adverse affect on crop performance. Sowing time is also one of the most important non-monetary input which influences to a great extent on both the productivity of seed and oil of Indian mustard under

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rainfed conditions (Shekhawat *et al.* 2012). On the other hand, sowing time of Indian mustard was determined long back but therefore, the fertility status, varieties and other inputs have inadequate a considerable change, so there is a need to give fresh look for time of sowing of Indian mustard in the light of introduction of new varieties. Hence, keeping in view the importance of Indian mustard as a major oilseed crop of the state, the present study was investigated to find out the best time of sowing and suitable variety for mustard under rainfed conditions. Furthermore, abnormal weather conditions during the establishment phase, including cold spells, fog, frost, leaf wetting, and intermittent rains during flowering and pod formation, have become concerning in major mustard-producing states such as Punjab, Haryana, Rajasthan, and Uttar Pradesh. Additionally, mustard crops in India face yield losses caused by physiological disorders and the spread of pests and diseases like aphids, white rust, downy mildew, and stem rot. Uttar Pradesh is the fourth largest producer of mustard in India, after Rajasthan, Haryana, and Madhya Pradesh. In 2022-23, the state produced 1.6 million tonnes of mustard, accounting for about 11% of the country's total production. The area under mustard cultivation in Uttar Pradesh is about 2.2 million hectares. The major mustard-growing districts in the state are Hardoi, Rae Bareli, Sitapur, Unnao, Lucknow, and Prayagraj. India is also expected to produce a record 115.25 lakh tonnes of mustard in 2022- 23, up from 109.5 lakh tonnes in 2021-22. Agriculture production and productivity are governed by the local climate, which includes factors like temperature, rainfall, light intensity, radiation, and sunny duration

MATERIALS AND METHODS

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The present field study was conducted at Research Farm of the College of Forestry, SHUATS, Prayagraj (25° 45'N, 81° 84'E, and 98.2 m amsl) during rabi season 2022. The experiment was laid out in split plot and consisted of three growing environments imposed through different sowing dates (D1: Oct. 17, 2022; D2: Nov. 03, 2022; and D3: Nov. 17, 2022) in the main plots and four mustard variety (V1: Jhalak, V2: Kalasona and V3: Sriram V4: Ratna) in sub-plots and replicated three time. The weather data recorded at Agrometeorology Observatory of the college of forestry, SHUATS and observations on crop phenology, seed and biological yield have been used to compute temperature based agrometeorological indices and establish their relationship with phenology, seed and biological yield of mustard at Prayagraj. The crop phenology was recorded by visual observation in experimental plots on every alternate day during the crop growing period and the number of days taken for occurrence of different pheno-phases viz., P1: Emergence, P2: four-leaf stage, P3: Early vegetative phase, P4: 50% flowering, P5: 50% pod development, P6: Start of seed filling, P7: End of seed filling, P8: Physiological maturity.

3.ResultAnd Discussion

In order to study the results and the data studied during the course of investigation**"STUDY ON MICRO-CLIMATE AND ITS EFFECT ON GROWTH AND YIELD OF MUSTARD CROP UNDERPRAYAGRAJ CONDITIONS",**were statistically analyzed and explained in this chapter with the help of tables and figures, wherever considered necessary, under the following heads:

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Table 1Variation in Plant Height (cm) with different treatments

TREATMENT	PLANT HEIGHT						MEAN
	30DAS	45DAS	60DAS	75DAS	90DAS	105DAS	
T1	19.4	55.4	82.4	107.4	156	188.4	101.5
T2	20.47	66.4	87.4	115.33	157.87	194.4	106.9783
T3	21.5	64.73	90.4	116.33	167.67	196	109.4383
T4	21.6	76.67	100.26	132.67	180.27	207.2	119.7783
T5	18.47	55.35	81.41	101.4	156.47	185.4	99.75
T6	20.44	63.67	84.33	114.27	161.67	192.33	106.1183
T7	21.47	64.4	88.4	127.93	173	199.27	112.4117
T8	21.47	73.07	99.13	131.07	178.33	202.2	117.545
T9	18.4	52.3	80.53	100.07	153.67	184.47	98.24
T10	20.1	63.13	82.4	110.07	164.4	192.2	105.3833
T11	20.4	6330	87.44	110.93	175.33	195.4	1153.25
T12	21.33	72.4	96.4	114.4	177.4	200	113.655

Comment [IA13]: Treatments should show the varieties and the time of sowing.

Data pertaining to plant height of Indian mustard recorded at various growth stages as affected by different date and sowing and varieties have been presented in (Table 1). Plant height increased successively with age of crop.

It is quite evident from the data at 30 days higher plant height was recorded in 1st date of sowing (21.60cm) Varity-Ratna (V_4). Data also showed that 3rd date of sowing (18.40cm)Jhalak(V_1)variety recorded smaller height of plant at all the stages.At 105 T4 attain maximum height and smallest ht. recorded in T9.Similar results studied by **Dinda *et al.* (2015)** effect of sowing dates on growth of rapeseed-mustard varieties at West Bengathe plant height reduced significantly under late sown crop as compared to early sown crop.**Singh (1991)**, **Singh *et al.*, (2008)** and **Kumari *et al.*, (2011)**.

Table 2.Variation in leaves per Plant with different treatments

TREATMENT	PLANT LEAVES						mean
	30DAS	45DAS	60DAS	75DAS	90DAS	105DAS	
T1	5.6	9.46	13.42	17.53	22.46	19.33	14.63333
T2	5.27	10.4	13.2	17.4	22.4	19.33	14.66667
T3	6.47	10.47	14.47	19.2	22.33	20.77	15.61833
T4	7.6	11.6	15.47	19.47	24.6	21.8	16.75667
T5	5.53	9.4	13.6	17.4	21.6	18.4	14.32167

T6	6.53	9.44	14.4	18.4	22.47	19.47	15.11833
T7	7.4	10.33	14.53	18.5	22.53	19.4	15.44833
T8	7.33	11.25	14.44	19.33	23.4	19.86	15.935
T9	5.4	9.33	13.44	16.4	20.4	18.3	13.93333
T10	6.27	9.4	14.2	17.2	22.27	19.07	14.735
T11	6.4	11.13	14.35	18.2	23.4	18.63	15.29667
T12	7.1	11.2	14.2	19.2	23.13	18.6	15.57167

Data pertaining to no of leaf per plant Indian mustard recorded at various growth stages as affected by different date of sowing and varieties have been presented in (Table 2). no of leaf per plant leaf increased successively with age of crop.

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It is quite evident from the data that maximum no of leaf per plant was recorded in ^{1st} date of sowing T4 21.8 leaves) Varity-Ratna (V_4). Data also showed that 3rddate of sowing (18.3 leaves) Jhalak(V_1) variety recorded minimum no of leaf per plant at all the stage.The result was observed for interaction of date of sowing and variety on number of leaves **(Chap lot *et al*., 2012)** also conducted.

Table 3 :**Variation in branch per Plant with different treatments**

	NUMBER OF BRANCH PER PLANT						
TREATMENT	**30DAS**	**45DAS**	**60DAS**	**75DAS**	**90DAS**	**105DAS**	MEAN
T1	3.53	5.42	8.6	12.53	16.53	21.4	11.335
T2	4.17	5.47	9.2	12.6	16.4	20.4	11.37333
T3	3.5	6.47	9.6	14.4	17.6	21.53	12.18333
T4	4.37	7.6	11.4	15.4	18.6	22.41	13.29667
T5	3.37	5.53	8.4	12.4	16.4	20.4	11.08333

T6	3.47	6.47	9.4	13.4	17.53	21.4	11.945
T7	3.6	6.33	9.4	13.4	17.8	21.33	11.97667
T8	4.23	7.33	10.4	14.47	18.1	21.1	12.605
T9	1.8	5.4	8.36	11.2	16.1	20.15	10.50167
T10	3.4	6.4	9.33	13.1	17.4	21.3	11.82167
T11	3.23	6.7	10.4	12.53	16.4	22.2	11.91
T12	3.63	7.47	10.1	14.3	17.2	20.53	12.205

Data pertaining to no of Branch per plant Indian mustard recorded at various growth stages as affected by different dates of sowing and varieties have been presented in (Table 3). No of Branch per plant increased successively with age of crop.

It is quite evident from the data that the maximum no branch per plant was recorded in 1st date of sowing (22..41 branches) Varity-Ratna (V_4). Data also showed that 3rd date of sowing (20.4 branches) Jhalak(V_1) variety recorded minimum no of Branch per plant at all the stages. The result was observed for interaction of date of sowing and variety on number of branches per plant. Similar study reported by **Kumari *et al.* (2012**) the crop sown on 10th October recorded significantly higher primary (7.8) as well as secondary branches (19.9) /plant over 20th October (7.0 & 17.6) and 30th October sown crop (6.4 & 14.1), respectively.

3.3.LENGTH OF SILIQUA PER PLANTS. (CM)

Data pertaining to length of siliquae (cm.) as affected by different dates of sowing and varieties have been presented in Table 4 A perusal of data showed that maximum length of siliquae 1st date of sowing (8.41 cm.) Varity Ratna v4 was recorded. Data also showed that 3rd date of sowing (5.80cm) Jhalak(V_1) variety recorded maximum length of siliqua per plant at all the stages. The no significant result was observed for interaction of date of sowing and variety on number of silique similar study observed by **Dinda *et al.* (2015)** reported that early sown (20th October: 125.7) crop recorded significantly higher number of siliquae per plant as compared to late sown crop (5th October: 118.6 and 5th November: 109.5) and **Gawariya*et al.* (2015)** evaluated the effect of sowing dates on yield attributes of mustard and found that number of siliquae/ plant were significantly affected at Karnal. They further reported that the crop sown on 1st October (1391.47 g/ plant) recorded significantly higher number of siliquae/ plant as compared to 16th October (1227.96 g/per plant) and 31st October (847.41 g/plant) and 15th November (656.75 g/plant) sowing

Levels of	**Levels of Date (D)**	**Mean (V)**

Varieties(V)				
	1ST DOS (17.10.2022)	2 NDDOS (03.11.2022)	3 RDDOS (17.11.2022)	
V1	5.82	5.85	5.80	**5.82**
V2	7.41	7.40	6.60	**7.13**
V3	6.40	6.40	6.53	**6.44**
V4	8.4	8.2	7.42	**8.40**
Mean (D)	**7.00**	**7.25**	**7.33**	

	C.D.	F test	SE(d)	SE(m)
Varieties (V)	0.25	S	0.12	0.085
Date of Sowing (D)	0.216	S	0.104	0.073
V X D	0.432	S	0.207	0.146

Table 4 :**Length Of Siliqua Per Plants**

Comment [IA15]: The title of table should be placed above the table.

3.4. NO OF SILIQUA PER PLANT

Data pertaining to length of siliquae (cm.) as affected by different dates of sowing and varieties have been presented in Table 5. A perusal of data showed that maximum no of siliqua per plant 1st date of sowing (240 siliqua) Varity Ratna v4 was recorded. Data also showed that 3rd date of sowing (157) Varity Jhalak(V_1) variety recorded minimum no of siliqua per plant at all the stages. The no significant result was observed for interaction of date of sowing and variety on number of silique .***Dinda et al. (2015)*** reported that early sown (20th October: 125.7) crop recorded significantly higher number of siliquae per plant as compared to late sown crop (5th October: 118.6 and 5th November: 109.5).

Table 5 :Data statistics result

Comment [IA16]: Growth parameter shown in this table should be added.

Levels of Varieties(V)	Levels of Date (D)			Mean (V)
	1ST DOS (17.10.2022)	2 NDDOS (03.11.2022)	3 RDDOS (17.11.2022)	
V1	221.67	201.33	157.00	**200.667**
V2	179.33	109.67	190.33	**148.778**
V3	126.67	220.00	197.00	**200.889**
V4	240.40	194.67	190.33	**178**
Mean (D)	**149.167**	**210.667**	**196.167**	

	C.D.	F test	SE(d)	SE(m)
Varieties (V)	43.02	S	20.611	14.574
Date of Sowing (D)	37.256	S	17.849	12.621
V X D	N/A	N/A	35.699	25.243

3.5.Average Test Weight (g.)

Data pertaining to of Average test weight of Indian mustard recorded at various growth stages as affected by different dates of sowing and varieties have been presented in (Table 6).

It is quite evident from the data that maximum average test weight was recorded in 1st date of sowing (4.43g) Varity-Ratna (V_1). Data also showed that 3rd date of sowing (3.23g) Jhalak(V_1) variety recorded minimum average test weight. The similar results also observed by). **Akhter *et al*. (2015)** reported a significant decline in test weight in brown sarson under delayed planting of rapeseed sown on 1st October (2.27 g) followed by 15th October (2.1 g) and 30th October (2.1 g), respectively.

Levels of Varieties(V)	Levels of Date (D)			Mean (V)
	1ST DOS (17.10.2022)	2 NDDOS (03.11.2022)	3 RDDOS (17.11.2022)	
V1	3.45	3.36	3.23	**3.34**
V2	3.48	3.48	3.47	**3.43**
V3	4.27	4.36	3.29	**4.02**
V4	4.43	4.36	4.23	**4.28**
Mean (D)	**3.62**	**3.82**	**3.87**	

	C.D.	F test	SE(d)	SE(m)
Varieties (V)	0.178	S	0.085	0.06
Date of Sowing (D)	0.154	S	0.074	0.052
V X D	0.309	S	0.148	0.105

Table 6 :**Average Test Weight in different treatments used**

Comment [IA17]: Title should be provided above the table

3.6. YIELD(Q) IN HEC.

Data pertaining of yield(q)inhectare of Indian mustard recorded at various growth stages as affected by different dates of sowing and varieties have been presented in (Table 7).

It is quite evident from the data that maximumyield(q)inhectare of was recorded in 1st date of sowing (22.40q) Varity-Ratna (V_4). Data also showed that 3rd date of sowing (14.80) Jhalak(V_1) variety recorded minimum yield in q per hectare.The no significant result was observed**Singh et al. (2019)** also reported transplanting of mustard on 13th October was found highly superior with respect to growth, physiological parameters, yield and yield attributes compared to transplanting done on 22nd October and 01st November. interaction of date of sowing and variety grain yield **Singh (2002**) also conducted.

Levels of Varieties(V)	Levels of Date (D)			Mean (V)
	1ST DOS (17.10.2022)	2 NDDOS (03.11.2022)	3 RDDOS (17.11.2022)	
V1	16.73	15.73	14.80	**16.75**
V2	18.40	16.40	15.40	**17.40**
V3	18.40	19.40	19.20	**19.20**
V4	22.40	21.33	20.40	**21.37**
Mean (D)	**17.73**	**18.96**	**19.20**	

	C.D.	F test	SE(d)	SE(m)
Varieties (V)	0.711	S	0.341	0.241
Date of Sowing (D)	0.616	S	0.295	0.209
V X D	1.232	S	0.59	0.417

Table 7 :Results showing Yield per plant

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CONCLUSION

On the basis of present research work findings, it can be concluded that growth and yield of the mustard crop is influenced by variety as well as date sowing. However, 3rd week of October (17Oct) was most suitable time for sowing of mustard crop whereas variety Ratna is most suitable variety in Prayagraj condition. Based on the study T1 treatment is highest. So, that treatment T4 best recommended for farmers around Prayagraj to prefer Ratna variety and sowing of mustard in the 3rd week of October.

Reference

Comment [IA19]: References should be listed in the order that they appear in the text

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