International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(9): 01-07
www.biochemjournal.com
Received: 01-06-2024
Accepted: 05-07-2024

AD Tinpayale
PG Scholar, Agricultural Botany Section, College of Agriculture, Nagpur, Maharashtra, India

Sapana B Baviskar
Assistant Professor, Agricultural Botany Section, College of Agriculture, Nagpur, Maharashtra, India

PV Shende
Associate Professor, Agricultural Botany Section, College of Agriculture, Nagpur, Maharashtra, India

Vandana S Madke
Assistant Professor, Agricultural Botany Section, College of Agriculture, Nagpur, Maharashtra, India

Padmaja H Kausadikar
Assistant Professor, Soil Science and Agricultural Chemistry Section, College of Agriculture, Nagpur, Maharashtra, India

Kirti G Khandare
PG Scholar, Agricultural Botany Section, College of Agriculture, Nagpur, Maharashtra, India

Sakshi V Kodape
PG Scholar, Agricultural Botany Section, College of Agriculture, Nagpur, Maharashtra, India

Prema R Manapure
Head of Department, Agricultural Botany Section, College of Agriculture, Nagpur, Maharashtra, India

Corresponding Author:
AD Tinpayale
PG Scholar, Agricultural Botany Section, College of Agriculture, Nagpur, Maharashtra, India

Effect of sowing dates on biochemical, yield and yield attributing parameters of mustard genotypes

AD Tinpayale, Sapana B Baviskar, PV Shende, Vandana S Madke, Padmaja H Kausadikar, Kirti G Khandare, Sakshi V Kodape and Prema R Manapure

DOI: https://doi.org/10.33545/26174693.2024.v8.i9a.2039

Abstract
The field experiment was conducted during the 2023-24 growing season at the experimental farm of Agricultural Botany Section, College of Agriculture, Nagpur to evaluate the effects of various sowing dates on the performance of different genotypes of Indian mustard (*Brassica juncea* L.). This study included four Indian mustard genotypes *viz.,* ACN-237, ACN-226, PM 26 and TAM 108-1 (sub factor) which were sown on five different dates *viz.,* 15th October, 30th October, 15th November, 30th November and 15th December (main factor). The experiment was structured using a factorial randomized block design (FRBD) with three replications. Data revealed that genotype ACN-237 performed better under 15th October and 30th October as compared to other sowing dates and genotypes in terms of biochemical parameters such as chlorophyll content in leaves and oil content in seed. In yield and yield attributing parameters such as number of siliquae plant^{-1}, number of seeds siliqua^{-1}, seed yield ha^{-1} and harvest index showed higher values on 15th and 30th October sowing date in genotype ACN-237.

Keywords: Indian mustard, genotypes, sowing dates, seed yield and factorial randomized block design (FRBD)

Introduction

Mustard is an important oil seed crop next to groundnut. It requires cool weather for its satisfactory growth and therefore, grown as *Rabi* crop in northern-eastern and central part of the country. It belongs to family Crucifereae with chromosome number 2n = 36. Oil content of Indian mustard seeds varies from 30% to 48%. It is known that Indian mustard seeds are largely crushed for oil which is rich source of energy, predominantly in vegetarian diet. Apart from culinary purpose, oil is also used for medicinal purpose, preparation of hair oil and making soap. Oil cake remaining after oil extraction is used as animal feed and manures (Gopale *et al.,* 2022) [1].

The tender leaves of these cultivars serve as vegetable, while the seeds as a source of lubricating and cooking oil. It produces 9 k cal. energy from 1 g of oil unit^{-1} in comparison with other diets (carbohydrate and protein). In a balanced diet for human health 20-25% of calories should come from fats and oils. The protein quality and quantity of *B. campestris* obtained oil cake is high (Chowdhury *et al.,* 2014) [2].

Delayed sowing owing to change in biotic and abiotic environmental conditions may have adverse effect the crop performance. It necessitates developing suitable agro techniques to augment the productivity of the crop. 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 and light etc. Sowing time is one of the most important non-monetary input which influences to a great extent on both the productivity of seed and oil (Shekhawat *et al.,* 2012) [3].

Keeping in view the importance of mustard as a major oil seed crop the present study was investigated to examine the suitable sowing dates and genotypes for biochemical, yield and attributing parameters are the highly remunerative of the cultivation of Indian mustard.

Materials and Methods

A field experiment was conducted at the experimental farm of section of Agricultural Botany, College of Agriculture, Nagpur during *Rabi* 2023-24 under the research study entitled "Effect of sowing dates on biochemical, yield and yield attributing parameters of mustard genotypes". The experiment was conducted in factorial randomized block design (FRBD) with twenty combinations consisted of five dates of sowing *viz.,* 15th October, 30th October, 15th November, 30th November and 15th December and four genotypes *viz.,* ACN-237, ACN-226, PM 26 and TAM 108-1. Experimental gross plot size was 3.15 m x 2.20 m and net plot size was 2.25 m x 2.00 m with spacing of 45 cm x 10 cm was adopted by using 5 kg seeds ha^{-1}. Five plants form each plot were selected randomly and data of biochemical parameters such as chlorophyll content in leaves was estimated by colorimetric method suggested by Bruinsma (1982) [4] at 45, 60 and 75 DAS and the estimation of oil content in seed was done by Soxhlet's procedure described by Shankaran (1965) [5]. Yield and yield attributing parameters such as number of siliquae $plant^{-1}$, number of seeds $siliqua^{-1}$, seed yield ha^{-1} and harvest index were also recorded at harvest.

Results and Discussions

Chlorophyll content in leaves

Significantly higher chlorophyll content in leaves at 45 DAS was found on 15th October (1.448 mg g^{-1}) and lowest chlorophyll content was recorded on 15th November (0.984 mg g^{-1}) compared with other sowing dates. Significantly higher chlorophyll content in leaves at 60 DAS was found on 15th October (1.808 mg g^{-1}) and lowest chlorophyll content was recorded on 30th November (1.071 mg g^{-1}) compared with other sowing dates. Significantly higher chlorophyll content in leaves at 75 DAS was found on 15th October (1.264 mg g^{-1}) and lowest chlorophyll content was recorded on 15th November (0.741 mg g^{-1}) compared with other sowing dates. Significantly higher chlorophyll content at 15th October sowing date at all stages of observations (i.e. 45, 60 and 75 DAS). This might be due to favourable environment and temperature at vegetative phase of plant which enhanced the chlorophyll synthesis in leaves. Likewise, lower chlorophyll content at 15th November sowing date at 45 and 75 DAS and 30th November at 60 DAS of observations might be due to unfavourable environment due to decrease in chlorophyll content in leaves. Result given by Kumar *et al.,* (2013) [6] revealed that decrease in chlorophyll content at 1st November and 15th November sowings compared to the 15th October.

The data regarding the chlorophyll content in leaves of genotypes at 45, 60 and 75 DAS were found statistically non-significant at all observations. It might be due to genetic factors of genotypes.

Significantly highest chlorophyll content in leaves at 60 DAS was found in interaction on 15th October in genotype ACN-237 (1.833 mg g^{-1}) among all other interactions and lowest chlorophyll content was found in interaction on 30th November in genotype PM 26 (1.033 mg g^{-1}). Interaction between sowing dates and genotypes for chlorophyll content at 45 and 75 DAS was found non-significant at given observations. Among the observation it found that favourable temperature fluctuations can affect the enzyme activity responsible for chlorophyll synthesis. Cooler or more stable temperatures around 60 DAS may support optimal enzyme activity leading to higher chlorophyll content. However, as temperatures vary around 75 DAS the activity of these enzymes may decrease resulting in lower chlorophyll content. Result revealed by Gopale *et al.,* (2022) [1] observed that genotypes ACN-250, ACN-237 and ACN-226 performed better under 30th October sowing as compared to 30th November sowing over two checks (PM 26 and TAM 108-1) and remaining genotypes in respect of chlorophyll. In terms of biochemical characters 30th October sowing date with genotype ACN-250 proved to best among the interactions.

Table 1: Biochemical parameters (Chloroattributing parameters are the highly remunerative of the cultivation of Indian mustardphyll content in leaves and oil content in seed) of Indian mustard as affected by growing environment and genotypes

Treatments		Chlorophyll content in leaves (mg g^{-1})			Oil content in seed (%)
		45 DAS	60 DAS	75 DAS	
		Sowing dates (A)			
A_1	15th October	1.448	1.808	1.264	39.00
A_2	30th October	1.164	1.410	1.128	36.84
A_3	15th November	0.984	1.219	0.741	35.30
A_4	30th November	1.042	1.071	1.065	28.22
A_5	15th December	1.081	1.248	0.814	28.72
	SEm ±	0.046	0.042	0.047	0.12
	CD at 5%	0.131	0.120	0.136	0.34
		Genotypes (B)			
B_1	ACN-237	1.200	1.438	1.043	34.61
B_2	ACN-226	1.186	1.343	0.991	32.20
B_3	PM 26	1.070	1.293	0.964	35.01
B_4	TAM 108-1	1.119	1.331	1.010	32.64
	SEm ±	0.041	0.038	0.042	0.11
	CD at 5%	NS	NS	NS	0.30
		Interaction (A×B)			
	SEm ±	0.112	0.103	0.116	0.29
	CD at 5%	NS	0.295	NS	0.83

Note: A:- Sowing date, B:- Genotype and NS:- Non-significant

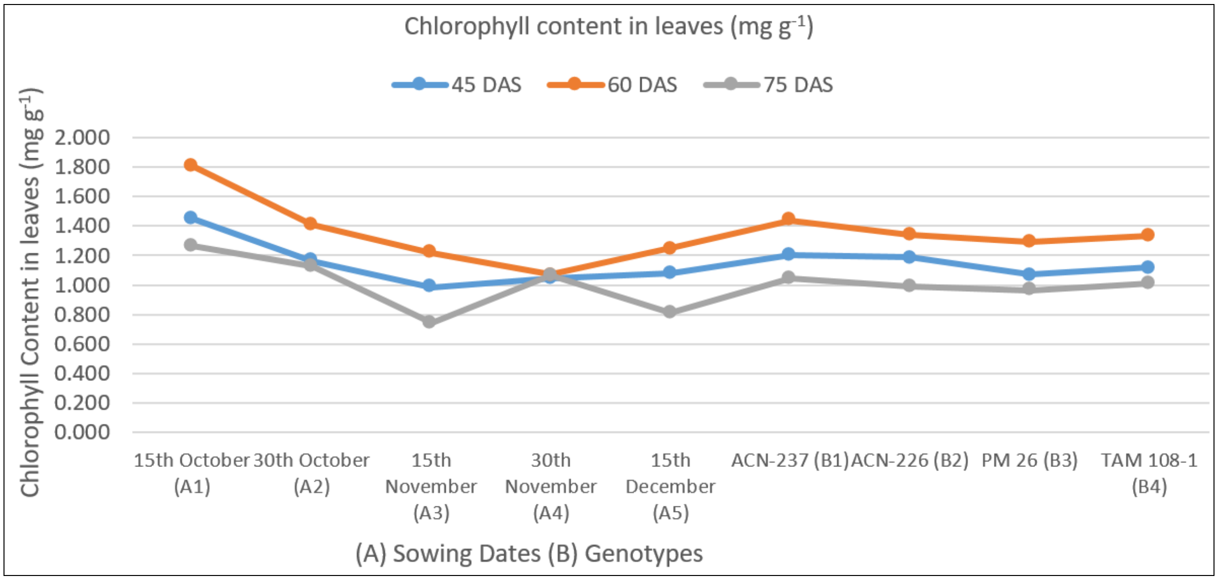

Fig 1: Total chlorophyll content in leaves of Indian mustard as affected by growing environment and genotypes

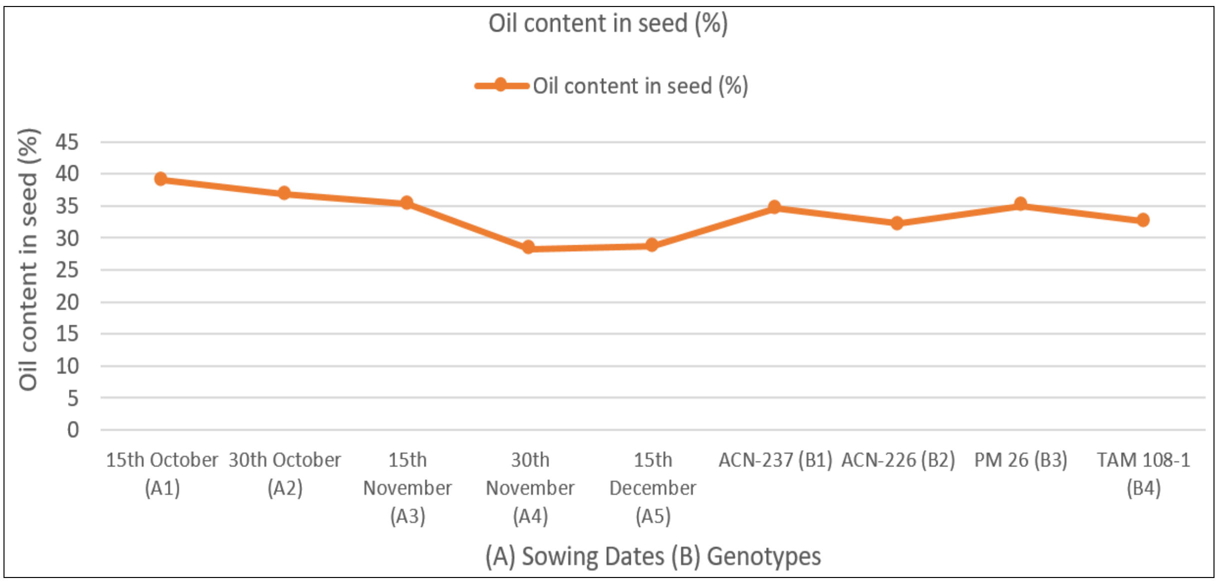

Fig 2: Oil content in seeds of Indian mustard as affected by growing environment and genotypes

Oil content in seed

Significantly higher oil content in seed was recorded on 15th October (39.00%) lowest oil content was recorded on 30th November (28.22%) compared with other sowing dates. This might be due to higher temperature at time of crop growth which directly impact on fatty acid accumulation in mustard seeds. Result revealed by Singh *et al.,* (2017) [7] indicated that the oil content was significantly higher under 25th October sown crop as compared to 05th October and 25th September sown crop.

Significantly maximum oil content in seed was recorded in genotype PM 26 (35.01%) and minimum oil content was recorded in genotype ACN-226 (32.20%) compared with other genotypes. This might due to genetic performance of genotypes. Result revealed by Deotale *et al.,* (2019) [8] observed that among these twenty mutants, the highest oil content after harvesting was obtained from ACM_{18}, ACM_{12}, ACM_6, ACM_8 and ACM_4. In case of proximate analysis, the highest chlorophyll and oil were recorded from ACM_{18}. The oil content of different mutants of mustard varied from 33.30-42.67%.

Significantly highest oil content in seeds at harvesting of mustard was found in interaction on 15th October in genotype ACN-237 (40.99%) among all other interactions and lowest oil content in seeds was found in interaction 30th November in genotype ACN-226 (25.15%). Result showed by Gopale *et al.,* (2022) [1] indicated that genotypes ACN-250, ACN-237 and ACN-226 performed better under 30th October sowing as compared to 30th November sowing over two checks (PM 26 and TAM 108-1) and remaining genotypes in respect of oil content in seeds. In terms of chemical and biochemical characters 30th October sowing date with genotype ACN-250 proved to best among the interactions.

Number of siliquae plant^{-1}

Significantly highest number of siliquae plant^{-1} (303.92) was observed on 30th October. 15thOctober and 15th November sowing dates were found to be at par with 30th October and lowest number of siliquae^{-1} (202.58) was recorded on 15th December at the time of harvesting. The reduction in seed yield under delayed sowing could be due to less number of silique plant^{-1} duration because of non-fulfillment of temperature demands under late sowings. Result revealed by Pandey *et al.,* (2024) [9] identified that the mustard crop showed a substantial increase in yield supporting characters such as the number of siliqua and seeds silique^{-1} when sown at last week of September as compared to the second week of October.

Significantly highest number of siliquae plant^{-1} (286.16) was recorded in genotype ACN-237 and lowest number of siliquae plant^{-1} (237.07) was recorded in PM 26 genotype at the time of harvesting. ACN-226 and TAM 108-1 genotypes were found to be at par with genotype ACN-237. This might be due to genetic factors of genotype. Result revealed by Sowjanya *et al.,* (2021) [10] showed that among the varieties, PUSA Mehak gave the highest number of siliqua plant^{-1} (174.1) than other varieties.

Interaction between sowing dates and genotypes for number of siliquae plant^{-1} was found non-significant at the time of harvesting.

Number of seeds siliqua^{-1}

Significantly highest number of seeds siliqua^{-1} (13.36) was observed on 30th October. Sowing dates 15th October and 15th November were found to be at par with 30th October and lowest number of seeds siliqua^{-1} (10.33) was recorded on 15th December at the time of harvesting. This might due to favourable environmental condition and optimum temperature at the time of physiological maturity. Result identified Akhter *et al.,* (2015) [11] indicated that number of seeds siliqua^{-1} (21.4) were obtained highest yield and yield components in first sowing date and P-3 variety.

The data regarding the number of seeds siliqua^{-1} of genotypes were found statistically non-significant at all observations. It might be due to genetic impact of genotypes.

Interaction between sowing dates and genotypes for number of seeds siliqua^{-1} was found non-significant at the time of harvesting.

Seed yield ha^{-1}

Significantly highest seed yield ha^{-1} (18.65 q) was observed on 30th October and lowest seed yield ha^{-1} (8.88 q) was recorded on 15th December at the time of harvesting. Highest seed yield ha^{-1} on 30th October might be due to sowing at favourable environmental conditions for better growth of crop in term of maximum chlorophyll content in leaves and oil content in seed which leads to found greater number of number of siliquae plant^{-1} and number of seeds silique^{-1} which get result into highest seed yield ha^{-1} While, late sown crop was exposed to more temperature resulted into less chlorophyll content in leaves and oil content in seed which result to decrease in seed yield ha^{-1}. Result revealed by Tripathi *et al.,* (2021) [12] observed that both dates and varieties (10th Nov. and Varuna) superior compare to rest of treatment. However, highest yield and yield attributes i.e. seed yield (18.50 q ha^{-1}) was recorded under 10th Nov. and Varuna variety.

Significantly highest seed yield ha^{-1} (16.46 q) recorded in genotype ACN-237 and lowest seed yield ha^{-1} (14.34 q) was recorded in PM 26 genotype at the time of harvesting. This might be due to genetic ability of genotypes to produce higher chlorophyll content in leaves and oil content in seed which enhance the photosynthetic rate, dry matter accumulation and results give higher yield of the crop. Result revealed by Bhagat *et al.,* (2023) [13] observed that among cultivars, GSL-1 recorded significantly higher seed yield followed by ONK-1 and DGS-1.

Significantly highest seed yield ha^{-1} at harvesting was found in interaction on 30th October in genotype ACN-237 (20.02 q) among all other interactions and lowest seed yield ha^{-1} was found in interaction on 15th December in genotype TAM 108-1 (8.21 q). Result performed by Gopale *et al.,* (2022) [1] revealed that genotypes ACN-250, ACN-237 and ACN-226 performed better under 30th October sowing as compared to 30th November sowing over two checks (PM 26 and TAM 108-1) and remaining genotypes in respect of seed yield ha^{-1}. In terms of yield and yield contributing characters 30th October sowing date in genotype ACN-250 proved to best among the interactions. These all characters showed positive and highly significant correlation with yield.

Harvest index

Significantly highest harvest index (27.54%) was observed on 30th October and lowest harvest index (22.08%) was recorded on 15th December at the time of harvesting. Highest harvest index on 30th October might be due to chlorophyll content in leaves and oil content in seed which leads to found greater number of dry matter accumulation and favourable environmental condition at time of harvesting. Result revealed by Uikey *et al.,* (2017) [14] observed that sowing on 43rd MW found to be superior on various yield characters of mustard *viz.,* harvest index (8.49%). As regard to different yield contributing characters of mustard *viz.,* harvest index per cent were significantly highest during sowing in 43rd MW as compared to sowing in 42nd, 44th and 45th MW.

Significantly highest harvest index (26.71%) was recorded in genotype ACN-237 and lowest harvest index (23.95%) was recorded in TAM 108-1 genotype at the time of harvesting. This might be due to variation in genotypes. Result revealed by Singh *et al.,* (2017) [7] observed that harvest index (24.40%) were increased significantly with variety Coral–437.

Significantly highest harvest index at harvesting was found in interaction on 30th October in genotype ACN-237 (29.02%) among all other interactions and lowest harvest index was found in interaction on 15th December in genotype TAM 108-1 (20.22%). Result showed that, significantly highest harvest index was recorded in interaction on 30th October sowing date with genotype ACN-237 and lower on 15th December sowing date with genotype TAM 108-1. Result observed by Sowjanya *et al.,* (2021) [10] investigated that among the sowing dates, significantly higher harvest index (26.75%) were recorded in 15th October sown crop than other sowing dates. Among the varieties, PUSA Mehak gave the highest harvest index (26.41%) than other varieties.

Table 2: Yield and yield attributing parameters (Oil content in seeds, Number of siliquae plant^{-1}, number of seeds silique^{-1}, seed yield ha^{-1} and harvest index) of Indian mustard as affected by growing environment and genotypes

	Treatments	Number of siliquae plant^{-1}	Number of seeds silique^{-1}	Seed yield ha^{-1} (q)	Harvest index (%)
		Sowing dates (A)			
A_1	15th October	285.33	12.97	17.53	27.07
A_2	30th October	303.92	13.36	18.65	27.54
A_3	15th November	283.19	12.42	16.59	26.86
A_4	30th November	242.89	12.25	13.74	23.46
A_5	15th December	202.58	10.33	8.88	22.08
	SEm ±	15.55	0.33	0.11	0.08
	CD at 5%	44.51	0.96	0.32	0.21
		Genotypes (B)			
B_1	ACN-237	286.16	12.62	16.46	26.71
B_2	ACN-226	284.18	12.29	14.96	26.17
B_3	PM 26	237.07	11.93	14.34	24.78
B_4	TAM 108-1	246.93	12.22	14.55	23.95
	SEm ±	13.91	0.30	0.10	0.07
	CD at 5%	39.81	12.62	0.29	0.19
		Interaction (A×B)			
	SEm ±	38.09	0.82	0.27	0.18
	CD at 5%	NS	NS	0.79	0.56

Note: A:- Sowing date, B:- Genotype and NS:- Non-significant

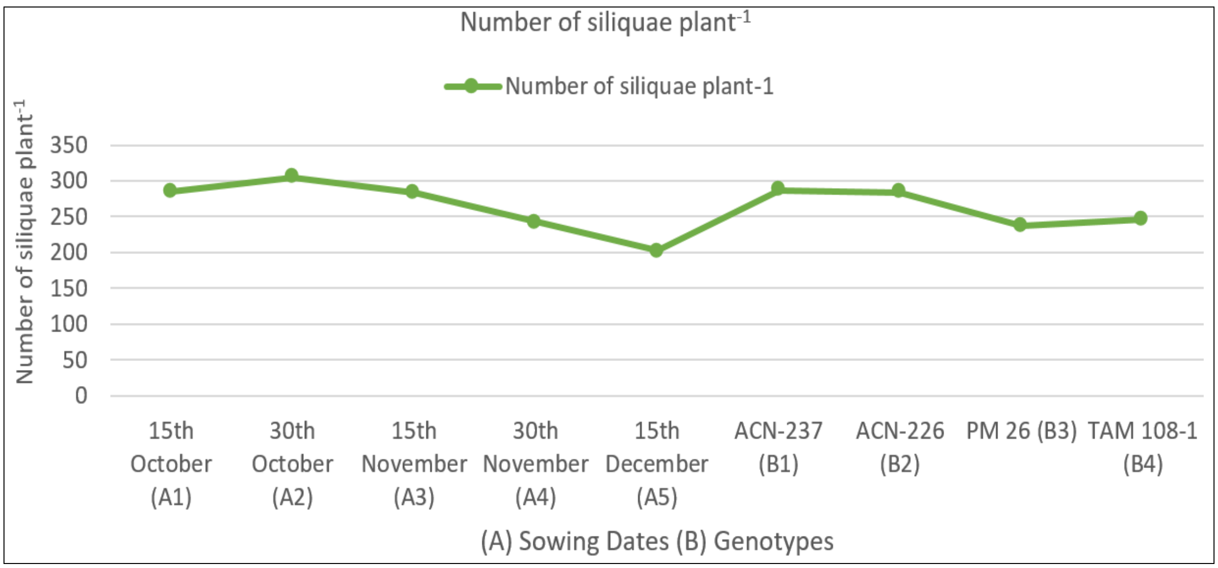

Fig 3: Number of siliquae plant^{-1} of Indian mustard as affected by growing environment and genotypes

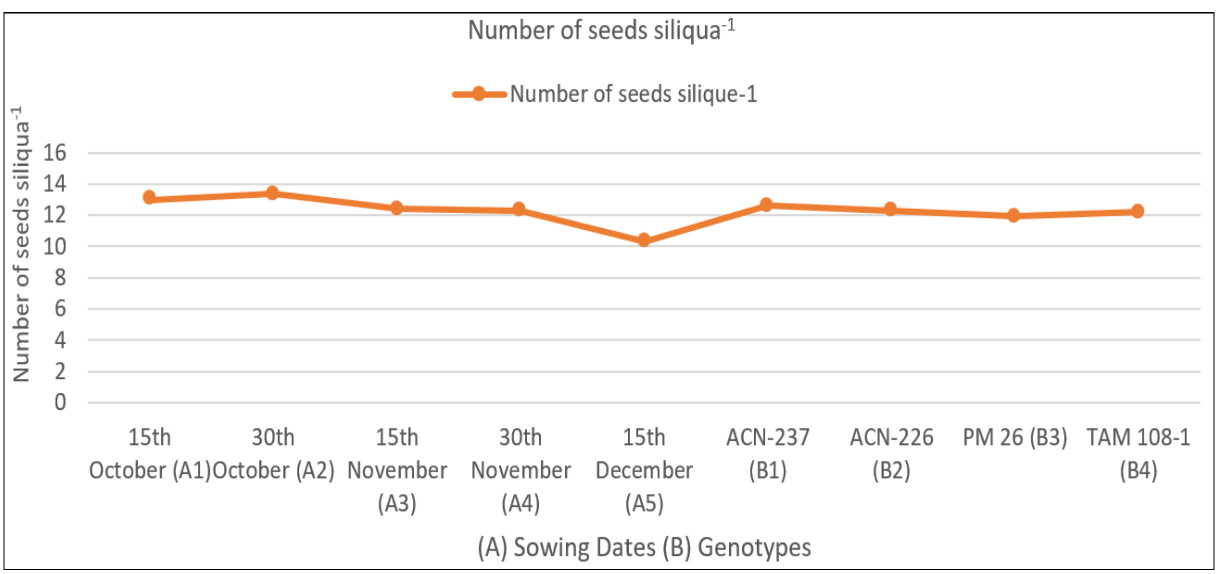

Fig 4: Number of seeds siliquae^{-1} of Indian mustard as affected by growing environment and genotypes

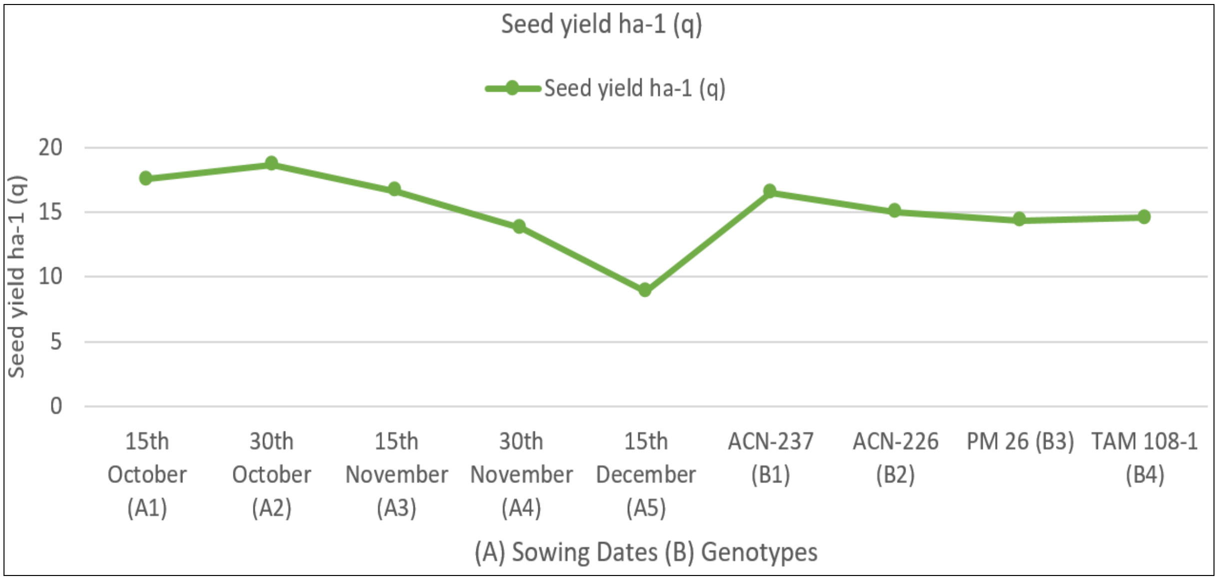

Fig 5: Seed yield ha^{-1} (q) of Indian mustard as affected by growing environment and genotypes

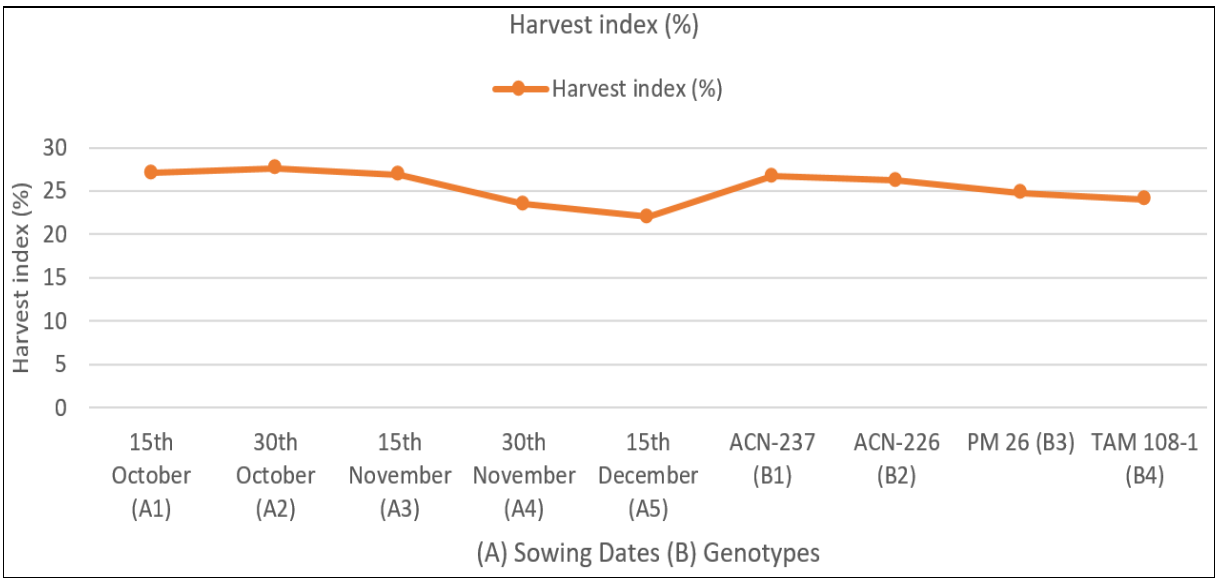

Fig 6: Harvest Index (%) of Indian mustard as affected by growing environment and genotypes

Conclusion

Indian mustard found higher values for biochemical, yield and yield attributing parameters from 15th to 30th October along with genotype ACN-237. While delay in sowing dates shows reduction in chlorophyll content in leaves, oil content in seed and also shows impact on yield and yield attributing parameters might be due to environmental condition and temperature at critical growing stages of crop.

Acknowledgments

Authors gratefully acknowledge the facilities provided by Department of Agricultural Botany, College of Agriculture, Nagpur.

References

1. Gopale R, Deotale RD, Raut A, Kamdi SR, Baviskar SB, Aade A. Effectivity of different sowing dates on chemical, biochemical, yield and yield traits in mustard genotypes. J Soils Crops. 2022;32(1):171-179.
2. Chowdhury MFEN, Ahmed KS, Hosen M, Paul RK, Bhattachariya DK. Evaluation of grain weight, moisture, dry matter, oil cake, a-carotene, oil content and aflatoxin content of different varieties and advanced lines of mustard and rapeseed. IOSR J Agric Vet Sci. 2014;7(6):34-39.
3. Shekhawat K, Rathore SS, Premi OP, Kandpal BK, Chauhan JS. Advances in agronomic management of Indian mustard (*Brassica juncea* (L.) Czernj. Cosson): An overview. Int J Agron. 2012;1-14.
4. Bruinsma J. A comment on spectrophotometric determination of chlorophyll. *Biochim Biophys* Acta. 1982;52(1):576-578.
5. Shankaran A. A laboratory manual for agricultural chemistry. Bombay: Asia Pub.; c1965. p. 258.
6. Kumar S, Sairam RK, Prabhu KV. Physiological traits for high temperature stress tolerance in *Brassica juncea*. Indian J Plant Physiol. 2013;18(1):89-93.
7. Singh AK, Singh H, Rai OP, Singh G, Singh VP, Singh NP, *et al*. Effect of sowing dates and varieties for

higher productivity of Indian mustard (*Brassica juncea* L.). J Appl Nat Sci. 2017;9(2):883-887.
8. Deotale RD, Dhongade AP, Kamdi SR, Madke VS, Meshram MP, Kalamkar VB. Experimental study on biochemical parameters and yield of M4 Indian mustard mutants. J Soils Crops. 2019;29(2):297-301.
9. Pandey B, Yadav R, Ramawat N, Vishwakarma H, Pandey S. Optimization of sowing dates in Indian mustard (*Brassica juncea* L.) to combat yield losses caused by high temperature at reproductive stage. Plant Sci Today. 2024;11(1):81-92.
10. Sowjanya M, Reddy GS, Revathi P, Chandrashaker K. Effect of sowing dates and varieties on productivity of mustard under northern Telangana zone. J Plant Interact. 2021;10(9):183-187.
11. Akhter S, Singh L, Rasool R, Ramzan S. Effect of date of sowing and varieties on yield of brown sarson (*Brassica rapa* L.) under temperate Kashmir. Int J Eng Sci Inv. 2015;4(3):65-69.
12. Tripathi KBM, Gaur T, Pandey L, Singh A, Tiwari A, Prakash V, Rathore US, Singh RK. Effect of sowing dates on growth and yield of Indian mustard (*Brassica juncea* L.). Int J Curr Microbiol App Sci. 2021;10(1):3046-3057.
13. Bhagat R, Singh M, Sharma BC. Crop weather relationship in oilseed rape (*Brassica napus*) for north-west foothills of Himalayas, India. Indian J Agric Sci. 2023;93(4):409-414.
14. Uikey M, Nawalakhe SM, Kothikar RB. Effect of different meteorological weeks on yield parameters of mustard. Int J Adv Sci Eng Technol. 2017;5(2):87-88.