The Pharma Innovation Journal 2023; 12(8): 1781-1785

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(8): 1781-1785

www.thepharmajournal.com
Received: 20-06-2023
Accepted: 23-07-2023

HC Kalita
ICAR-KVK, Goalpara, Dudhnoi, Assam, India

P Dutta
ICAR-KVK, Goalpara, Dudhnoi, Assam, India

SK Baishya
ICAR-KVK, Goalpara, Dudhnoi, Assam, India

Corresponding Author:
HC Kalita
ICAR-KVK, Goalpara, Dudhnoi, Assam, India

Fertility management in rapeseed (*Brassica campestris*) varieties sown at different dates under rainfed condition of Assam

HC Kalita, P Dutta and SK Baishya

Abstract
To investigate the impact of sowing dates and fertility management on the rapeseed varieties TS-46 and TS-38 under rainfed conditions, a field experiment was conducted at the ICAR-KVK, Goalpara for two seasons (Rabi 2020-21 and 2021-22). The experiment included three sets of treatments, including four planting dates, two variety types, and three fertility doses. The treatments were arranged in a split-plot design, with three replications placing the sowing date in the main plot. The sandy loam soil at the experimental site contained low amounts of available total phosphorus and potassium and an acidic p^H, but medium levels of available total nitrogen and organic carbon. Results showed that for every 10 days of delayed sowing at the crop, the seed and stover yield and seed oil content declined considerably. The crop that was sowed on November 10, the highest seed yield of 8.65 qha^{-1} and stover output of 36.58 qha^{-1} were recorded. Further, each 10 day delay in planting caused a considerable reduction in the seed oil content. In terms of seed yield, the variety TS-46 was superior to the variety TS-38. Gypsum application at 133 kg ha^{-1} along with N, P_2O_5, and K_2O application at 40, 35, and 15 kg ha^{-1} each enhanced the seed and stover production as well as the seed oil content. Gypsum at 133 kg $ha^{-1}$and borax at 1.1kg ha^{-1} application further enhanced the yield of seeds (8.64qha^{-1}), stover (30.70 qha^{-1}) and seed oil (39.86%).

Keywords: Rapeseed, fertility, sowing time, yield, yield attributes

Introduction

In Indian agriculture, oilseed crops are significant. Rapeseed-mustard is one of the main oilseed crops. The largest contributor to the nation's output of edible oils is rapeseed-mustard (31%) followed by soybean (26%) and groundnut (25%) (Bhagat *et al*., 2022) [1]. Rapeseed and mustard are the oilseed crops in Assam that take up the most land after rice. The crop is rainfed, which results in lower productivity. The best period to sow this crop is in the middle of October to the middle of November, although farmers frequently had to sow the crop later than recommended since the monsoon rains were delayed, which results in a low yield. The length of the growing season, which affects yield attributes and yield of any crop, is determined by the sowing date, which is a significant influence. Since rapeseed and mustard are photosensitive plants, the sowing date has a considerable impact on their growth and output. The optimum time for sowing of rapeseed-mustard is important as it depends on the prevailing climatic conditions in the location. The rapeseed-mustard crop's maximum production potential is often attained when it is exposed to the most suitable temperature range, which can be regulated by seeding at the right time. In order to minimize any negative effects on the production of mustard, the sowing timing can be altered to suit the crop's optimal thermal requirements at different phenological phases (Gupta *et al*., 2017) [2]. Physical elements, namely climatic ones, cannot be changed under field settings. Furthermore, the right timing to sow a crop is a crucial agronomic component and non-financial input for maximizing yield potential in any region by fostering the conditions for optimum growth and development, which result in superior yield attributes (Bhagat *et al*., 2022) [3]. It is becoming more challenging to forecast the ideal sowing dates for mustard crops due to climate change.

Poor fertility management is another cause of this crop's decreased yield. Agriculture is using more intense farming systems and high producing varieties, which is depleting the nutrients in the soil. Over time, indiscriminate use of chemical fertilizer to supply the key nutrients and sparing use of other nutrients and organic input sources have resulted in soil and plant deficiencies. One of the main obstacles to sustained production in rainfed environments is emerging micronutrients, in particular zinc and boron. Oilseeds respond strongly to applied sulphur and boron because they directly affect the oil quality and quantity, in addition to the primary plant nutrients like nitrogen, phosphorus, and potassium, in the production phenology (Barthwal *et al*., 2022) [4]. Among other things, sulphur contributes to the synthesis of cystein, methionine, chlorophyll, and the oil content of oilseed crops. It is necessary for the synthesis of several vitamins (B, biotin, and thiamine), the metabolism of carbohydrates, the production of protein and oil, and the emergence of flavoring compounds in crucifers (Rameeh *et al*., 2021) [5]. Boron is also critical for the development of cell walls, root elongation, glucose metabolism, synthesis of nucleic acids, lignification, and tissue differentiation. As agricultural intensification rises, the soils are becoming increasingly depleted of secondary plant nutrients like sulfur. According to Singh *et al*. (2015) [6] accessible sulphur levels were insufficient in 41% of the soil samples they analyzed across the nation. Therefore, the experiment was carried out to determine the sowing window and appropriate fertility management of the crop in order to meet the difficulties for better production of rapeseed.

Materials and Methods

During the rabi seasons of 2020–21 and 2021–22, the experiment was conducted at the ICAR–KVK Goalpara in Assam under rainfed circumstances. The experiment comprised three sets of treatments *viz*. dates of sowing (D_1: November 10, D_2: November 20, D_3: November 30 and D_4: December 10) variety (V_1: TS-46 and V_2: TS-38) and fertility management (F_1: 40:35:15 kg ha^{-1} of $N:P_2O_5:K_2O$ as urea, SSP and MOP respectively, F_2: F_1+ 20 kg ha^{-1} of S as gypsum and F_3: F_2+ 1.1 kg ha^{-1} of B as borax). In the experiment's split-plot design, the sowing dates were placed in the main plot, and the combinations of variety and fertility management treatments were put in the sub plots, each of which had three replications. Following accepted practices, the chemical and physical characteristics of soil were estimated. The soil at the experimental site was sandy loam, p^H was 5.4, readily available N, P_2O_5, and K_2O contents were 248.1, 17.7, and 50.4 kg ha^{-1}, soluble SO_4 concentration was 0.23%, and readily available B concentration was 0.77 ppm. Harvest dates were February 22, February 29, March 13, and March 21 for crops that were sown on November 10, November 20, November 30, and December 10. The crop sowed on the first, second, third, and fourth dates, respectively, got 32.5, 28.2 9.6, and 5.2 mm of total average rainfall during the initial crop season. Figure 1 shows the temperature and rainfall averages for the region over a two-year period.

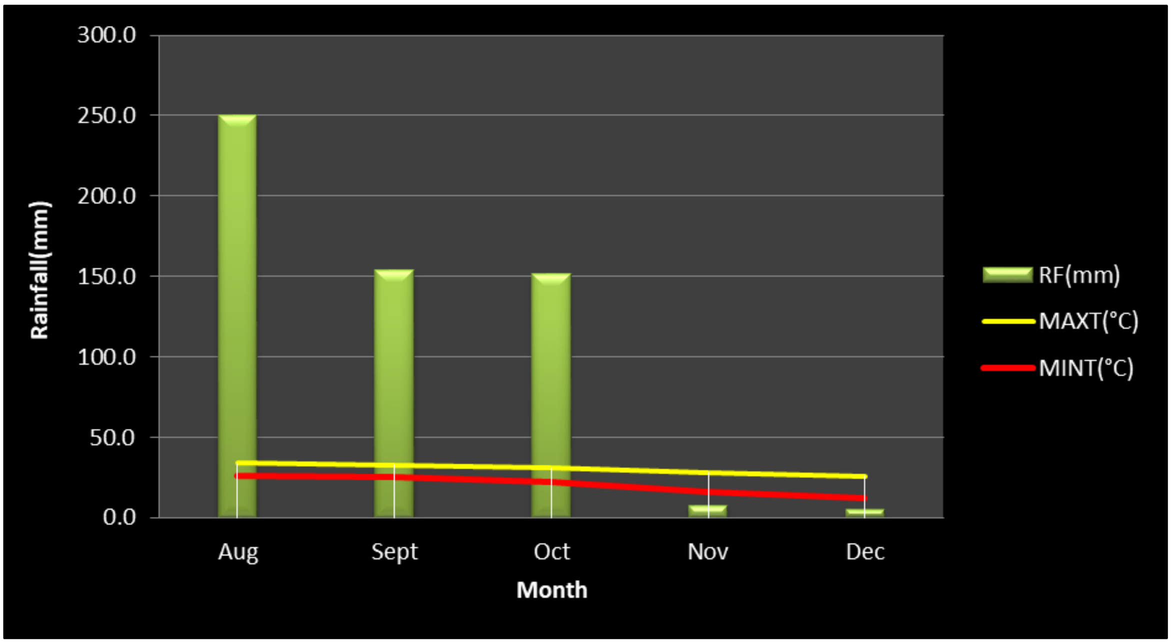

Fig 1: Total rainfall and temperature during 2021-2022

Yield attributes

At the time of maturity of the first pod of main raceme $plant^{-1}$, number of branches and number of siliques $plant^{-1}$ were counted after harvest four plants $plot^{-1}$ and then divided by four. Number of seeds $silique^{-1}$ was also determined from four plants sample, fifty pods from all four plants was taken, threshed and the number of seeds $silique^{-1}$ were counted. The seed weight was recorded by counting 1000 seeds from each silique sample, then seeds were dried at 30°C in a forced air dryer, weighed and then seed weight rate (g) was counted. Actual harvest time was 2-4 days after maturity of first silique on the main raceme for each plot.

Yield

Total yield was obtained by cutting the plants sample from the center row (1m x1m) = $1m^2$ to count seed yield and then converted into yield $hectare^{-1}$.

Seed oil content

Oil content of the seed was determined by the Soxhlet and oil yield was recorded by percentage oil multiply by seed yield.

Analysis

The obtained data was subjected to variance analysis as a split-plot design using the statistical analysis system. The statistical analysis of the experimental data was conducted with the software ANOVA. Least significant difference was the statistical method used to determine differences among means.

Result and Discussion

Dates of Sowing

The most significant yield-contributing characteristics of rapeseed and mustard are the number of branches, siliqua plant^{-1}, number of seeds siliqua^{-1}, and test weight. Every 10 days of crop planting delay resulted in a decreasing trend in the growth and yield attributing character, which was finally reflected in the yield of seed and stover (Table 1 and 2). For every additional 10 days after November 10 (D_1) when the crop was delayed being sown, the yield of both seed and stover likewise fell. From the crop that was sowed on November 10, the highest seed yield of 8.65 qha^{-1} and stover output of 36.58 qha-^{1} were noted. For the delays of 10 and 30 days, the seed output decreased by 14.5 to 47.3% and the stover yield by 12.2 to 37.0%. To improve cultivar tolerance to environmental circumstances and to produce high seed yields, sowing time is a crucial factor (Butkeviciene *et al*., 2021) [7]. Some of the most crucial elements affecting seed swelling and subsequent plant development are temperature and moisture. During initial growth stages, the first crop, which was sowed on November 10, received a total of 32.5 mm of rain, but the final crop, which was sown on December 10, only received 5.2 mm of rain (Figure 1). Additionally, the air temperature drastically dropped, going from a maximum of 25^0 C to a minimum of 10^0 C. A conducive environment for disease and pest attack is also created by low air temperature and high humidity. These could be the cause of the poor yield brought on by the delayed sowing. Because of the favorable climate that exists throughout all growth phases, seeding at the ideal time results in increased yields (Shekhawat *et al*., 2012) [8]. Delays in rapeseed seeding have also been linked to significant production reductions, according to various researchers, including Butkeviciene *et al.* (2021) [7], Kaur *et al*., (2018) [9], Singh *et al*., (2019) [10], Bhuyian *et al*., (2008) [11]. Each 10 day delay in planting caused a considerable reduction in the seed oil content. The extend of decrease was more when the crop was sown beyond November 20. The crop planted in November 10 had the highest oil content (39.88%), which fell to 37.24% in the crop planted in December 10 after a month. In comparison to the variety TS-38, the TS-46 produced significantly higher yields of stover (2.69%) and seed (2.54%). In terms of seed oil content, the two varieties did not significantly differ from one another. In two seasons at IARI New Delhi, Srivastava *et al*., (2011) [12] examined the quality of *Brassica juncea* with 10 various dates of planting at weekly intervals beginning on October 1 and ending on December 3. Additionally, they noted that both *Brassica juncea* cultivars, Pusa Jaikisan and Varuna, had significantly lower oil contents after the ideal sowing window (15 October to 22 October). Angrej *et al*., (2002) [13] also noted that at PAU, Ludhiana, oil content and oil yield were higher on the 10th and 30th of October than on the 20th and 10th of November.

Fertility Management

Over the past century, mineral fertilization has increased crop productivity. The primary cause of high rapeseed yields is mineral fertilizers. The most effective and balanced fertilizer application promotes rapid development. In our investigation, the yield of seed and stover, the content of seed oil, and three distinct fertility treatments were statistically significant in terms of growth and yield attributing characteristics. Under F_3 treatment (NPK+S+B), the maximum seed yield (8.64 qha^{-1}), stover yield (30.70 qha^{-1}), and oil content (39.86%) were noted (Table 2). Gypsum along with recommended NPK application resulted significant increases in seed and stover yields as well as seed oil content of 9.67, 3.59, and 3.05%, respectively. Further, gypsum and borax applications caused a comparable increase of 28.57, 9.06, and 5.76% in seed and stover yields as well as seed oil content.

Wani (2005) [14] studied how oilseeds responded to sulphur application and found that mustard seed yield and protein content increased significantly as sulphur levels rose up to 80 kg S ha^{-1}, whereas seed oil content increased significantly in Kashmiri silty clay soils up to 60 kg S ha^{-1}. In clay loam soils with low sulphur and boron status, Gupta *et al*., (1996) [15] found that application of sulphur at 50 kg ha^{-1} in the form of gypsum and borax at 10 kg ha^{-1} on average enhanced mustard seed yield by 22-25% and oil content by 2-3%. Sharma and Arora (2008) [16] found that adding gypsum or pyrite to mustard increased its S content, S absorption, oil content, and yield significantly compared to the control under rainfed conditions in the Jammu region. In a study conducted at BHU, Varanasi, Yadev *et al*., (2016) [17] also found that applying boron at a rate of 1.5 kg ha^{-1} to the mustard crop enhanced the oil content and seed yield by up to 36%, and 2.02 t ha^{-1} respectively.

Table 1: Yield attributing character of rapeseed varieties as influenced by dates of sowing and fertility management

Treatment	No of branches plant^{-1}		No of siliqua plant^{-1}		No seeds siliqua^{-1}		1000- seed weight (g)	
	A	B	A	B	A	B	A	B
Date of sowing								
10 Nov. (D_1)	7.03	7.64	95.58	102.20	19.61	20.22	3.57	3.64
20 Nov. (D_2)	6.89	7.32	84.28	88.67	18.44	19.22	3.42	3.42
30 Nov. (D_3)	6.28	6.10	68.18	72.13	17.39	17.38	3.06	3.16
10 Dec. (D_4)	5.90	5.82	82.91	58.48	15.00	15.16	2.92	2.91
CD(p=0.05)	0.25	0.47	NS	4.24	0.77	1.14	0.22	0.19
Variety								
TS-46 (V_1)	6.67	6.96	77.88	81.70	17.94	18.25	3.26	3.27
TS-38 (V_2)	6.37	6.46	87.59	79.04	17.28	17.75	3.22	3.30
CD(p=0.05)	0.17	0.19	NS	1.90	0.54	NS	NS	NS
Fertility management								
NPK alone (F_1)	5.99	6.10	90.82	73.32	16.58	16.91	3.03	3.15
NPK+S (F_2)	6.57	6.75	74.95	78.07	17.71	18.25	3.22	3.27
NPK+S+B (F_3)	7.01	7.30	82.45	89.72	18.54	18.83	3.48	3.44
CD(p=0.05)	0.15	0.23	NS	2.33	0.64	0.98	0.13	0.17

A= 2020-21, B= 2021-22

Table 2: Seed, Stover yield and oil content of rapeseed varieties as influenced by dates of sowing and fertility management

Treatment	Seed yield (q ha^{-1})		Stover yield (q ha^{-1})		Seed oil content (%)	
	A	B	A	B	A	B
Date of sowing						
10 Nov. (D_1)	8.65	9.98	33.77	36.58	38.96	39.88
20 Nov. (D_2)	7.65	8.53	29.96	32.10	39.22	39.63
30 Nov. (D_3)	5.94	6.53	22.80	25.61	38.12	38.23
10 Dec. (D_4)	4.93	5.26	20.02	23.06	37.24	37.45
CD(p=0.05)	0.21	0.31	0.50	0.22	0.22	0.23
Variety						
TS-46 (V_1)	6.90	7.67	26.92	29.73	38.38	38.85
TS-38 (V_2)	6.69	7.48	29.35	28.95	38.44	38.75
CD(p=0.05)	0.15	0.14	0.36	0.41	NS	NS
Fertility management						
NPK alone (F_1)	6.09	6.72	25.32	28.15	38.12	37.69
NPK+S (F_2)	6.80	7.37	26.78	29.16	38.62	68.84
NPK+S+B (F_3)	7.49	8.64	27.81	30.70	39.36	39.86
CD(p=0.05)	0.13	0.17	0.29	0.51	0.21	0.22

A= 2020-21, B= 2021-22

Summary and conclusions

The length of the growing season, which affects yield attributes and yield of any crop, is significantly influenced by the sowing date. Being a photosensitive crop, rapeseed-mustard is greatly impacted by sowing date in terms of growth and productivity and is closely related to local weather patterns. With each additional 10 days beyond the sowing date of November 10, the yield and oil content of this crop drastically reduced. Accordingly, the findings of our research showed that the highest yield potential of rapeseed-mustard crops is typically attained when the crop is exposed to the most suitable temperature range and rainfall, both of which may be regulated by sowing at the right time. Additionally, it is established that boron and sulphur are essential ingredients in the production of oilseed rapeseed and mustard, maintaining its productivity. This is demonstrated by a notable increase in seed production, oil content, and yield characteristics. 20 kg of gypsum and 1.1 kg of borax ha^{-1} showed an average increase in seed yield of 28.57% and oil yield of 5.76%, respectively; therefore, its use in deficient areas is advised to boost rapeseed and mustard productivity in the area.

References

1. Bhagat R, Singh M, Sharma BC, Shankar U. Effect of sowing environments on yield attributes and yield of Gobhi Sarson (*B. napus*) cultivars under sub-tropics of Jammu region. Journal of Oilseed Brassica. 2022:13:7-10.
2. Gupta M, Sharma C, Sharma R, Gupta, V, Khushu MK. Effect of sowing time on productivity and thermal utilization of mustard (*B. juncea*) under sub-tropical irrigated conditions of Jammu. Journal of Agrometeorology. 2017:19: 137-141.
3. Bhagat R, Singh M, Sharma BC. Growth and productivity of Gobhi Sarson (*B. napus*) cultivars under diverse sowing environments. The Indian Journal of Agricultural Sciences. 2022:92:1202–1207.
4. Barthwal A, Swaroop N, Thomas T, Sharma V, Khatana RNS, Rao PS. Role of Nutrient Interaction Between Sulphur and Boron on Oilseed Crops. Biological Forum – An International Journal. 2022:14(2):275-279
5. Rameeh V, Niakan M, Mohammad HM. Effects of sulphur on the yield, yield component characters and oil content of oilseed rape. Journal of Agricultural Sciences. 2021:66(1):17-25.
6. Singh SK, Dey P, Singh S, Sharma PK, Singh YV, Latare AM, *et al*. Emergence of boron and sulphur deficiency in soils of Chandauli, Mirzapur, Sant Ravidas Nagar and Varanasi districts of Eastern Uttar Pradesh. Journal of the Indian Society of Soil Science. 2015:63:200-208.
7. Butkeviciene L, Kriauciuniene Z, Pupaliene R, Velicka R, Kosteckiene S, Kosteckas R, *et al*. Influence of Sowing Time on Yield and Yield Components of Spring Rapeseed in Lithuania. Agronomy. 2021:11(11):2170
8. Shekhawat K, Rathore SS, Premi OP, Kandpal BK, Chauhan JS. Advances in agronomic management of Indian mustard (*B. juncea*): An overview. International Journal of Agronomy. 2012:40824.
9. Kaur L, Sardana V, Sharma P. Effect of sowing dates and nitrogen application on growth and productivity of canola oilseed rape (*B. napus*). Journal of Oilseed Brassica. 2018:9:114-121
10. Singh HV, Choudhary RL, Meena MD, Dotaniya ML, Meena MK, Jat RS, Premi OP, Rai PK. Productivity enhancement of Indian mustard (*B. juncea*) through innovative crop establishment technique. The Indian Journal of Agricultural Sciences. 2019:89:1669-1673.
11. Bhuiyan MS, Mondol MRI, Rahaman MA, Alam MS, Faisal AHMA. Yield and yield attributes of rapeseed as influenced by date of planting. International Journal of Sustainable Crop Production. 2008;3:25-29.
12. Srivastava AK, Adak T, Chakravarty NVK. Quantification of growth and yield of oilseed Brassica using thermal indices under semi-arid environment. Journal of Agrometeorology. 2011;13:135-140.
13. Angrej S, Dhingra KK, Singh J, Singh MP. Effect of sowing time and plant density on growth, yield and quality of Ethopian mustard (*B. carinata*). J Res PAU. 2002;39:471-475.
14. Wani M.A. Gypsum-An efficient source of sulphur for mustard crop. SKUAST Journal of Research. 2005;7:90-97.
15. Gupta JP, Wali Pardeep, Gupta SC, Bedi AS, Khanna YP. Response of Rapeseed-Mustard to zinc, Boron, Boron and sulphur. Annuals of Agri-Bio. Research.

1996;1:25-28.

16. Sharma KR, Arora Sanjay. Effectiveness of gypsum and pyrite for sulfur fertilization on yield and quality of Indian mustard under rainfed conditions of North India. Communications in Soil Science and Plant Analysis. 2008;39:2431-2439.
17. Yadev SN, Singh SK, Kumar O. Effect of Boron on Yield Attributes, Seed Yield and Oil Content of Mustard (*Brassica juncea* L.) on an Inceptisol. J Indian Soc Soil Sci. 2016:64(3):291-296.