# Effect of date of sowing in mustard (*Brassica juncea* L.) genotypes on seed growth and yield




## Abstract

Three genotypes of mustard NRCHB – 101, PM-25 and PM-30 were sown during November- December in three different dates at an interval of fifteen days to know the effect of sowing date on seed yield and quality of mustard (*Brassica juncea* L.). The experiment was conducted at farmer's field during *Rabi* 2019-2020 and Department of Seed Science and Technology College of Agriculture Raichur and Department of Crop Physiology, University of Agriculture Sciences Raichur, (India). Significant variations due to different sowing dates were observed in plant height, number of primary branches palnt$^{-1}$, number of secondary branches plant$^{-1}$, chlorophyll content, number of siliqua plant$^{-1}$, number of seed siliqua$^{-1}$, 1000 weight, yield plant$^{-1}$and yield ha$^{-1}$ and oil content of mustard. Delay in sowing caused a significant reduction in the seed yield and oil content. Results showed that the highest seed yield was1962.48 kg ha$^{-1}$ obtained at early sown condition 2$^{nd}$ week of November. The lowest seed yield was 1902.10 kg ha$^{-1}$ from 2$^{nd}$ week of December late sown condition. From the results, the best sowing date of mustard is on 2$^{nd}$ week of November in the northern parts of Karnataka.


## Introduction

Indian mustard (*Brassica juncea* L.) is an important oil yielding crop belongs to the family Brassicaceae, having chromosome number 2n = 36, is a natural amphidiploid derived from interspecific cross between *B. nigra* and *B. campestris* (Nagaharu, 1935). Autogamy species with (2 to 15 %) of cross pollination. Mustard is predominantly cultivated in northern regions of India earlier has now been spread to non-traditional areas in eastern, western and southern parts of the country. There are several genotypes of mustard having variable yield potential, adaptability to different climatic conditions and varied response to diseases, insects and pests. The performance of genotypes keeps fluctuating in different agro-ecological regions. Interactions between the genotype and environment are usually exist

under all situations in lines, varieties, hybrids or any other breeding material, which complicates the advancement of the crop improvement programme (Eberhart and Russell, 1966). Time of sowing is very important for mustard production (Mondal *et al* 1999). Optimum sowing time plays an important role to exploit the genetic potential of a variety as it provides optimum growth conditions such as temperature, light, humidity and rainfall (Iraddi VS 2008). Delayed planting, unfavorable weather conditions during the flowering period, fertilization and pod formation can cause a decrease in duration of maturity period, the number of pods per plant, the number and weight of grains, and finally can lead to decrease in seed yield (Soleymani *et al* 2010) From the above points it is clear that date of sowing plays a great role in mustard seed production. Keeping in view of these facts, the present investigation was carried out to study the effect of sowing date on flowering and seed set of mustard (*Brassica juncea* L.).

**Material and Methods**

The investigations were carried out during *rabi* 2019-2020 in the Itagi village of devadurga taluka of Raichur district, and laboratory experiment was conducted in the Department of Seed Science and Technology College of Agriculture Raichur and Department of Crop Physiology, University of Agriculture Sciences Raichur, (India) situated at $16^{0}28^{'}$ north latitude and $77^{0}6^{'}$ east longitude with an altitude of 389 m above the mean sea level. The three genotypes NRCHB – 101, PM-25 and PM-30 of Indian mustard were sown in field on the three date of sowing, i.e., 2$^{nd}$ week of November, 4$^{th}$ week of November and 2$^{nd}$ week of December during 2019 and 2020 laid out in factorial randomized block design with three replications under normal fertility conditions. Observations on the effect of sowing date on seed growth and yield parameters were recorded.

The meteorological monthly data were recorded at meteorological observatory, Main Agricultural Research Station (MARS), Raichur for the year 2019-20 and 2020-21. The mean data of climatic parameters like rainfall (mm), maximum and minimum temperatures ($^{\circ}$C) and relative humidity (%)isdepicted in Fig. 1. A total of 1904.3 mm rainfall was received during the year 2019-20 in 113 rainy days. During the cropping period 54.4 mm rainfall was received in 6 rainy days with bright sunshine hours of 5.2 hours day$^{-}$

[1]. The rainfall was unevenly distributed during grand growth period of the crop. Thus, there was no prolonged moisture stress faced by the crop at any stage during crop growth period, consequently, the crop could express near to its full potential.

Healthy and clean seeds of three different genotypes were used for sowing. Sowing was done in furrows on three dates, *i.e.*, 2nd week of November, 4th week of November and 2nd week of December in each plot. Intercultural operations such as weeding, hoeing, *etc*. were done as when required to control weeds, conserve moisture and facilitate good aeration. A uniform dose of N, $P_2O_5$, and $K_2O$ @ 40, 40 and 20 kg $ha^{-1}$, respectively was applied as basal before sowing in all the treatments. All plots were surface irrigated at 30 and 60 days after sowing (DAS) with tube-well water.

**Plant height (cm)**

Plant height was measured at vegetative, flowering and pod formation stage on five randomly selected plants in each plot. Plant height was measured from the base of the plant to the tip of the main stem. The height was determined with the help of meter scale and mean values were calculated and expressed in centimetre.

**Chlorophyll content (SPAD value)**

The chlorophyll content of the five randomly selected plants were measured at vegetative, flowering and pod formation stage from the 3rd leaflet of central shoot of each plant and mean leaf chlorophyll content were recorded and average was worked out and Chlorophyll meter observations were expressed as SPAD readings.

**Days to 50 per cent flowering**

Number of days required from sowing to 50 per cent flowering was computed and expressed as days to 50 per cent flowering.

**Seed yield $ha^{-1}$ (kg)**

The seed yield obtained from the net plot area was cleaned, dried in the shade for seven days and weighed in kilogram. The seed weight from five plants used for taking observations was also added for computing the seed yield per ha. On the basis of seed yield per plant, the seed yield per hectare was computed and expressed in kilograms per hectare.

**Oil content (%)**

Approximately 25 g of seeds were drawn randomly from and each treatment was dried at 50 ± 5 °C and estimation of per cent oil content in the seed was done at MARS, UAS Raichur using N.M.R (Nuclear Magnetic Resonance Spectrometer) equipment.

**Results and Discussion**

**Effect of sowing date on growth parameters**

Study revealed the presence of wide range of variability for plant height among the genotypes selected for different date of sowing time and the variability in plant height might be due to the genetic makeup of the different genotypes. NRCHB – 101 genotype recorded significantly highest plant height at early date of sowing D1 (2$^{nd}$ week of November) (156.27 cm) Further, lowest was recorded in PM-25 under late sowing condition D3 (2$^{nd}$ week of December) (142.19 cm) at harvest (Table 1 and fig 2). The results of present investigation are in agreement with the earlier reports of Zafar *et al*. (2008)

Genotype NRCHB – 101 was observed maximum chlorophyll content at early sowing D1 (2$^{nd}$ week of November) had higher SPAD values (45.12) and genotype PM-30 had lower values under late sown condition D3 (2$^{nd}$ week of December) (39.21) at flowering stage. This is because of crop at flowering stage posses maximum stomatal conductance, photosynthetic rate in terms having maximum chlorophyll content (SPAD Values) results were in conformity with the earlier works of Kobraee*et al.* (2011) and Liu *et al.* (2012) in soybean. (Table 2 and fig 3)

Highest number of primary branches plant$^{-1}$ and number of secondary branches plant$^{-1}$ was recorded at D2 (4$^{nd}$ week of November) in NRCHB – 101(6.85 and 26.00) and lowest number of primary branches per plant was recorded under late sown condition D3 (2$^{nd}$ week of December) in PM-30 (5.09) and PM-25 (5.03 and 21.96 respectively). So, genotype with higher primary branches plant$^{-1}$ and number of secondary branches plant$^{-1}$ yielded high and these present results were confirmed with the finding of Akparobi (2009) in cassava (Table 4 & 5).

Days to 50 per cent flowering was significantly varied among genotypes under different sowing dates NRCHB – 101(39.00 days) took less number of days for days to 50 per cent flowering early sown condition and PM-25 (43.43 days) took more number of days at late sown condition. The possible reason for decrease in flowering duration in the late sown crop during both the years could be that the environmental conditions for plant growth were more favourable. The crop had more time for various activities and could complete various phenological stages. However, in delayed sowing plant tends to reach reproductive and seed production stage earlier due to little aberrant environmental conditions (Table 5. Fig3). Temperature and photoperiod have been reported as the two most important environmental factors affecting phenological development. Results are in agreement with the findings of Khan *et al*., (1994) also similar results were obtained by Manju. D. and Harish K, S. (2017) in mustard.

Specific Leaf Area (SLA) varied significantly aming different sowing dates Genotype PM-30 (23.88 cm$^2$ g$^{-1}$) observed maximum SLA early sowing followed by NRCHB – 101(22.89 cm$^2$ g$^{-1}$), while minimum SLA noticed in PM-25(22.23 cm$^2$ g$^{-1}$) under late sown condition at pod formation stage. Higher specific leaf area (SLA) indicates distribution of dry weight over large leaf area and also the presence of a more number of palisade cell layers in leaves. As palisade cell number increases, the amount of photosynthates fixed does also increases causing higher yield levels. These results were similar with the earlier results of Kaston and Rancut (2009). Table 6.

Genotype NRCHB – 101 recorded maximum crop growth rate (CGR) under early sowing condition (18.12 g m$^{-2}$ day$^{-1}$) owned higher yield levels and genotype which showed lower value for CGR (PM-25) at 2$^{nd}$ week of December late sown (14.59 g m$^{-2}$ day$^{-1}$)

had lower yield levels. The rapid increase in CGR in the genotypes was due to higher production of dry matter due to increased photosynthetic activity at grand growth stage which was also coupled with increased rate of cell multiplication Table 7.

Net assimilation rate varied among different date of sowing the genotype NRCHB-101 recorded highest (14.29 g $g^{-1}$ $day^{-1}$) under early date of sowing D1 (2nd week of November) followed by PM-30 under early date of sowing D1 (2nd week of November) (13.64 g $g^{-1}$ $day^{-1}$). Further, the genotype PM-25 recorded significantly lowest (NAR) (10.80 g $g^{-1}$ $day^{-1}$) under late showing D3 (2nd week of December) (Table 8). Higher values for NAR indicate an increase in genotype's sink demand and also more photosynthetic products availability to growing reproductive parts like flowers and pods leading to higher assimilation in pods (Ozalkan *et al.*, 2014).

**Effect of sowing date on yield parameters**

Number of siliqua $plant^{-1}$, number of seeds $siliqua^{-1}$ and siliqua length was significantly affected by both sowing dates and genotypes. Early sown genotypes on 2nd week of November has recorded higher number of siliqua $plant^{-1}$, number of seeds $siliqua^{-1}$ and siliqua length followed by 4th week of November sowing crop. Lowest was observed under late sown condition at 2nd week of December. This might be due to favourable weather condition and translocation of more photosynthates from source to sink resulted in higher in early sowings than delayed ones. Similar results were suggested by Chand *et al*. (2000), Aziz *et al*. (2011) and Sharif *et al*. (2016).Among genotypes NRCHB-101 (473.85, 12.52 and 6.57 cm) recorded highest siliqua $plant^{-1}$, number of seeds $siliqua^{-1}$ and siliqua length repectively and lowest recorded in PM-25 (138.28, 10.60, 5.07 cm respectively) tabulated in (Table 9, 10 and 11).

Seed yield under early date of sowing D1 (2nd week of November) (9.36g and 2077.92 kg $ha^{-1}$ respectively) recorded highest in genotype NRCHB-101. Further, the genotype PM-25 recorded lowest seed yield (7.55g and 1675.66 kg $ha^{-1}$) under late showing D3 (2nd week of December) ( Table 12 Fig. 4). Higher seed yield in NRCHB-101 may be due to the contribution of cumulative favourable effects of the crop characteristics *viz*., higher number of branches per plant, number siliqua per plant and number seeds per siliqua than other genotypes. Similar results were reported by Helal *et al*. (2016), Raghuvanshi *et al*. (2018) and Biswas *et al*. (2002).

November 2nd week sown crop exhibited significantly higher content of oil followed by November 4th week and December 2nd week (Table 13). The longer duration of reproductive phase under 2nd week of November sowing had a positive influence on the development of seed and therefore, increased oil content (Tobe *et al*., 2013). NRCHB-101 recorded highest oil content (%) (41.15 %) followed by PM-30 (40.84 %) and PM-25 recorded lowest oil content (38.73 %)

**Conclusion**

- It is concluded that if sowing is done late in December then crop experiences higher temperature during early growth phases. And crop experiences heat stress at later stages of plant growth causing reduction in flowering and pod growth phases resulting in decreased total dry matter, primary and secondary branch, siliqua per plant, test weight, quantity and quality of oil in seeds. Instead of 2nd week of December the ideal sowing time of mustard in Raichur region may be considered on 2nd week of November and this shift might be due to climate change and in spring season. Delay in sowing exposes mustard plants to high temperature and long days particularly affecting flowering development less fertilization and during siliqua growth phase, which accelerates crop maturity and decreases seed yield. Farmers or seed growers can go for early sowing of mustard genotype NRCHB-101 during 2nd week of November to increase seed yield.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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**Table 1. Effect of date of sowing on plant height (cm) in mustard genotypes at different plant growth stages**

| Sowing dates | Plant height (cm) at vegetative stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 29.07 | 24.83 | 26.16 | **26.69** | 30.80 | 25.51 | 25.57 | **27.30** | 29.94 | 25.17 | 25.87 | **26.99** |
| D2-4th week of Nov | 23.37 | 21.92 | 24.10 | **23.13** | 24.76 | 22.52 | 23.56 | **23.61** | 25.11 | 22.84 | 23.63 | **23.86** |
| D3-2th week of Dec | 24.23 | 19.98 | 25.24 | **23.15** | 25.67 | 20.53 | 24.66 | **23.62** | 24.95 | 20.26 | 24.95 | **23.38** |
| **Mean** | **25.56** | **22.25** | **25.17** | | **27.08** | **22.86** | **24.60** | | **26.67** | **22.76** | **24.82** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.126 | 0.126 | 0.218 | | 0.428 | 0.428 | 0.742 | | 0.401 | 0.401 | 0.694 | |
| **CD at 5%** | 0.378 | 0.378 | 0.654 | | 1.284 | 1.284 | 2.224 | | 1.201 | 1.201 | 2.080 | |

| Sowing dates | Plant height (cm) at flowering stage |
|---|---|

| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 138.54 | 138.13 | 137.09 | 137.92 | 145.26 | 141.93 | 135.40 | 140.86 | 141.17 | 140.03 | 136.97 | 139.39 |
| D2-4th week of Nov | 140.60 | 129.50 | 131.67 | 133.92 | 139.52 | 133.06 | 137.41 | 136.66 | 135.60 | 131.28 | 139.00 | 135.29 |
| D3-2th week of Dec | 136.58 | 126.78 | 132.62 | 131.99 | 140.53 | 130.26 | 133.48 | 134.76 | 138.87 | 129.59 | 135.49 | 134.65 |
| Mean | 138.57 | 131.47 | 133.79 | | 141.77 | 135.08 | 135.43 | | 138.55 | 133.63 | 137.15 | |
| | D | G | D x G | | D | G | D x G | | D | G | D x G | |
| S.Em ± | 0.634 | 0.634 | 1.099 | | 2.422 | 2.422 | 4.194 | | 1.580 | 1.580 | 2.737 | |
| CD at 5% | 1.902 | 1.902 | 3.294 | | NS | NS | NS | | NS | NS | NS | |

| Sowing dates | Plant height (cm) at pod formation stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 171.20 | 163.60 | 164.20 | 166.33 | 155.53 | 144.12 | 145.56 | 148.40 | 156.27 | 149.82 | 151.76 | 152.62 |
| D2-4th week of Nov | 158.52 | 151.48 | 156.38 | 155.46 | 147.48 | 145.51 | 142.95 | 145.31 | 153.00 | 148.50 | 149.67 | 150.39 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **D3-2th week of Dec** | 146.78 | 140.26 | 148.94 | **145.33** | 141.34 | 136.05 | 139.32 | **138.90** | 151.15 | 142.19 | 147.25 | **146.86** |
| **Mean** | **158.83** | **151.78** | **156.51** | | **148.11** | **141.89** | **142.61** | | **153.47** | **146.84** | **149.56** | |
| | | | | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.799 | 0.799 | 1.385 | | 2.545 | 2.545 | 4.409 | | 1.631 | 1.631 | 2.824 | |
| **CD at 5%** | 2.397 | 2.397 | 4.151 | | NS | NS | NS | | NS | 4.888 | NS | |

**Table 2. Effect of date of sowing on chlorophyll content (SPAD values) in mustard genotypes at different plant growth stages**

| **Sowing dates** | **Chlorophyll content (SPAD values) at vegetative stage** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2019** | | | | **2020** | | | | **Pooled Mean** | | | |
| | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** |
| **D1-2nd week of Nov** | 36.21 | 34.12 | 34.82 | **35.05** | 35.62 | 32.46 | 34.25 | **34.11** | 35.91 | 33.29 | 34.54 | **34.58** |
| **D2-4th week of Nov** | 34.53 | 32.46 | 33.46 | **33.48** | 32.80 | 31.81 | 31.79 | **32.13** | 33.67 | 32.14 | 32.62 | **32.81** |
| **D3-2th week of Dec** | 34.16 | 33.13 | 33.15 | **33.48** | 34.56 | 33.00 | 33.92 | **33.83** | 34.36 | 33.07 | 33.54 | **33.66** |
| **Mean** | **34.97** | **33.24** | **33.81** | | **34.33** | **32.42** | **33.32** | | **34.65** | **32.83** | **33.57** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.457 | 0.457 | 0.792 | | 0.261 | 0.261 | 0.453 | | 0.248 | 0.248 | 0.429 | |
| **CD at 5%** | 1.370 | 1.370 | NS | | 0.783 | 0.783 | NS | | 0.743 | 0.743 | NS | |

| **Sowing dates** | **Chlorophyll content (SPAD values) at flowering stage** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2019** | | | | **2020** | | | | **Pooled Mean** | | | |
| | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **D1-2nd week of Nov** | 45.58 | 42.60 | 43.11 | **43.77** | 44.65 | 43.87 | 42.06 | **43.53** | 45.12 | 43.24 | 42.59 | **43.65** |
| **D2-4th week of Nov** | 43.00 | 40.23 | 40.24 | **41.16** | 42.75 | 40.33 | 39.96 | **41.01** | 42.88 | 40.28 | 40.10 | **41.09** |
| **D3-2th week of Dec** | 40.11 | 39.80 | 39.49 | **39.80** | 39.81 | 40.24 | 38.92 | **39.66** | 39.96 | 40.02 | 39.21 | **39.73** |
| **Mean** | **42.90** | **40.88** | **40.95** | | **42.40** | **41.48** | **40.31** | | **42.65** | **41.18** | **40.63** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.254 | 0.254 | 0.441 | | 0.320 | 0.320 | 0.553 | | 0.252 | 0.252 | 0.436 | |
| **CD at 5%** | 0.763 | 0.763 | 1.321 | | 0.958 | 0.958 | NS | | 0.754 | 0.754 | NS | |

| **Sowing dates** | **Chlorophyll content (SPAD values) at pod formation stage** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2019** | | | | **2020** | | | | **Pooled Mean** | | | |
| | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** |
| **D1-2nd week of Nov** | 40.35 | 36.53 | 39.15 | **38.68** | 40.58 | 36.83 | 38.77 | **38.73** | 40.47 | 36.68 | 38.96 | **38.70** |
| **D2-4th week of Nov** | 39.26 | 34.72 | 37.16 | **37.05** | 38.25 | 34.26 | 36.42 | **36.31** | 38.75 | 34.49 | 36.79 | **36.68** |
| **D3-2th week of Dec** | 37.53 | 36.34 | 37.02 | **36.96** | 37.34 | 37.46 | 36.45 | **37.08** | 37.43 | 36.90 | 36.74 | **37.02** |
| **Mean** | **39.05** | **35.87** | **37.78** | | **38.72** | **36.18** | **37.21** | | **38.88** | **36.03** | **37.50** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.338 | 0.338 | 0.585 | | 0.257 | 0.257 | 0.445 | | 0.200 | 0.200 | 0.346 | |
| **CD at 5%** | 1.012 | 1.012 | NS | | 0.770 | 0.770 | 1.333 | | 0.599 | 0.599 | 1.037 | |

**Table 3. Effect of date of sowing on number of primary branches in mustard genotypes at different plant growth stages**

| Sowing dates | Number of Primary branches at vegetative stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 2.00 | 1.00 | 1.00 | **1.33** | 2.00 | 1.67 | 1.33 | **1.67** | 2.00 | 1.33 | 1.17 | **1.50** |
| D2-4th week of Nov | 1.00 | 2.00 | 2.00 | **1.67** | 1.33 | 1.00 | 1.33 | **1.22** | 1.17 | 1.50 | 1.67 | **1.44** |
| D3-2th week of Dec | 2.00 | 1.00 | 1.00 | **1.33** | 1.33 | 1.00 | 1.33 | **1.22** | 1.67 | 1.00 | 1.17 | **1.28** |
| **Mean** | **1.67** | **1.33** | **1.33** | | **1.56** | **1.22** | **1.33** | | **1.61** | **1.28** | **1.33** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.014 | 0.014 | 0.024 | | 0.134 | 0.134 | 0.232 | | 0.067 | 0.067 | 0.117 | |
| **CD at 5%** | 0.042 | 0.042 | 0.072 | | 0.402 | NS | NS | | NS | 0.202 | 0.350 | |

| Sowing dates | Number of Primary branches at flowering stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 5.00 | 4.00 | 5.00 | **4.67** | 5.00 | 4.67 | 5.00 | **4.89** | 5.00 | 4.83 | 4.50 | **4.78** |
| D2-4th week of Nov | 6.00 | 5.00 | 6.00 | **5.67** | 5.67 | 4.67 | 5.00 | **5.11** | 5.50 | 5.33 | 5.33 | **5.39** |
| D3-2th week of Dec | 5.00 | 5.00 | 4.00 | **4.67** | 5.00 | 5.00 | 5.00 | **5.00** | 5.00 | 4.50 | 5.00 | **4.83** |
| **Mean** | **5.33** | **4.67** | **5.00** | | **5.22** | **4.78** | **5.00** | | **5.17** | **4.89** | **4.94** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.029 | 0.029 | 0.049 | | 0.255 | 0.255 | 0.441 | | 0.132 | 0.132 | 0.228 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CD at 5%** | 0.086 | 0.086 | 0.148 | | NS | NS | NS | | 0.395 | NS | NS | |

| **Sowing dates** | **Number of Primary branches at pod formation stage** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2019** | | | | **2020** | | | | **Pooled Mean** | | | |
| | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** |
| **D1-2nd week of Nov** | 6.32 | 5.65 | 6.37 | **6.11** | 6.69 | 6.22 | 5.80 | **6.24** | 6.51 | 5.72 | 6.29 | **6.17** |
| **D2-4th week of Nov** | 6.65 | 5.82 | 6.18 | **6.22** | 7.05 | 6.04 | 5.98 | **6.36** | 6.85 | 5.90 | 6.11 | **6.29** |
| **D3-2th week of Dec** | 5.70 | 5.82 | 5.15 | **5.56** | 6.04 | 5.03 | 5.98 | **5.68** | 5.87 | 5.90 | 5.09 | **5.62** |
| **Mean** | **6.22** | **5.76** | **5.90** | | **6.59** | **5.76** | **5.92** | | **6.41** | **5.84** | **5.83** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.032 | 0.032 | 0.055 | | 0.105 | 0.105 | 0.182 | | 0.067 | 0.067 | 0.116 | |
| **CD at 5%** | 0.095 | 0.095 | 0.165 | | 0.316 | 0.316 | 0.547 | | 0.200 | 0.200 | 0.346 | |

**Table 4. Effect of date of sowing on number of secondary branches in mustard genotypes at different plant growth stages**

| **Sowing dates** | **Number of secondary branches at flowering stage** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2019** | | | | **2020** | | | | **Pooled Mean** | | | |
| | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** |
| **D1-2nd week of Nov** | 14.90 | 13.85 | 14.00 | **14.25** | 16.20 | 14.70 | 15.12 | **15.34** | 15.55 | 14.27 | 14.56 | **14.79** |
| **D2-4th week of Nov** | 14.25 | 13.72 | 13.30 | **13.76** | 15.39 | 14.41 | 14.36 | **14.72** | 14.82 | 14.06 | 13.83 | **14.24** |
| **D3-2th week of Dec** | 14.24 | 13.12 | 13.58 | **13.65** | 15.71 | 14.26 | 14.67 | **14.88** | 14.98 | 13.69 | 14.12 | **14.26** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | **14.46** | **13.56** | **13.63** | | **15.77** | **14.46** | **14.72** | | **15.12** | **14.01** | **14.17** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.082 | 0.082 | 0.142 | | 0.082 | 0.082 | 0.142 | | 0.080 | 0.080 | 0.139 | |
| **CD at 5%** | 0.246 | 0.246 | NS | | 0.245 | 0.245 | NS | | 0.240 | 0.240 | NS | |

| **Sowing dates** | **Number of secondary branches at pod formation stage** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2019** | | | | **2020** | | | | **Pooled Mean** | | | |
| | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** |
| **D1-2nd week of Nov** | 25.00 | 22.00 | 24.00 | **23.67** | 27.00 | 23.76 | 25.20 | **25.32** | 26.00 | 22.88 | 24.60 | **24.49** |
| **D2-4th week of Nov** | 24.25 | 21.34 | 23.28 | **22.96** | 25.65 | 22.57 | 24.70 | **24.31** | 24.95 | 21.96 | 23.99 | **23.63** |
| **D3-2th week of Dec** | 23.75 | 20.90 | 23.52 | **22.72** | 26.19 | 23.05 | 24.44 | **24.56** | 24.97 | 21.97 | 23.98 | **23.64** |
| **Mean** | **24.33** | **21.41** | **23.60** | | **26.28** | **23.13** | **24.78** | | **25.31** | **22.27** | **24.19** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.115 | 0.115 | 0.198 | | 0.128 | 0.128 | 0.221 | | 0.121 | 0.121 | 0.210 | |
| **CD at 5%** | 0.343 | 0.343 | NS | | 0.383 | 0.383 | NS | | 0.363 | 0.363 | NS | |

**Table 5. Effect of date of sowing on days to 50 % flowering in mustard genotypes**

| Sowing dates | Days to 50 % Flowering | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 38.00 | 42.23 | 41.71 | **40.65** | 40.00 | 41.00 | 43.00 | **41.33** | 39.00 | 41.62 | 42.36 | **40.99** |
| D2-4th week of Nov | 39.90 | 42.23 | 41.71 | **41.28** | 41.30 | 41.41 | 42.14 | **41.62** | 40.60 | 41.82 | 41.93 | **41.45** |
| D3-2th week of Dec | 41.71 | 45.15 | 40.92 | **42.59** | 42.28 | 43.43 | 43.12 | **42.94** | 42.00 | 44.29 | 42.02 | **42.77** |
| **Mean** | **39.87** | **43.20** | **41.45** | | **41.19** | **41.95** | **42.75** | | **40.53** | **42.58** | **42.10** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.191 | 0.191 | 0.331 | | 0.689 | 0.689 | 1.193 | | 0.268 | 0.268 | 0.464 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CD at 5%** | 0.573 | 0.573 | 0.993 | | NS | NS | NS | | 0.804 | 0.804 | 1.392 | |

**Table 6. Effect of date of sowing on specific leaf area ($cm^2$ $g^{-1}$) in mustard genotypes at different plant growth stages**

| **Sowing dates** | **Specific leaf area ($cm^2$ $g^{-1}$ ) at vegetative stage** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2019** | | | | **2020** | | | | **Pooled Mean** | | | |
| | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** |
| **D1-2nd week of Nov** | 14.11 | 13.20 | 14.07 | **13.79** | 15.17 | 13.54 | 14.02 | **14.24** | 14.64 | 13.37 | 14.04 | **14.02** |
| **D2-4th week of Nov** | 13.06 | 12.58 | 13.03 | **12.89** | 14.13 | 12.89 | 13.95 | **13.66** | 13.60 | 12.73 | 13.49 | **13.27** |
| **D3-2th week of Dec** | 12.67 | 12.20 | 12.63 | **12.50** | 13.46 | 12.37 | 13.74 | **13.19** | 13.06 | 12.28 | 13.19 | **12.85** |
| **Mean** | **13.28** | **12.66** | **13.24** | | **14.25** | **12.93** | **13.90** | | **13.77** | **12.80** | **13.57** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.071 | 0.071 | 0.123 | | 0.078 | 0.078 | 0.135 | | 0.074 | 0.074 | 0.129 | |
| **CD at 5%** | 0.213 | 0.213 | NS | | 0.234 | 0.234 | 0.406 | | 0.223 | 0.223 | NS | |

| | **specific leaf area ($cm^2$ $g^{-1}$ ) at flowering stage** |
|---|---|

| Sowing dates | 2019 | | | | 2020 | | | | Pooled Mean | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 24.44 | 23.02 | 24.40 | **23.95** | 26.18 | 24.22 | 25.22 | **25.21** | 25.31 | 23.62 | 24.81 | **24.58** |
| D2-4th week of Nov | 22.63 | 21.93 | 22.59 | **22.38** | 22.10 | 20.71 | 23.40 | **22.07** | 22.36 | 21.32 | 23.00 | **22.23** |
| D3-2th week of Dec | 21.50 | 21.49 | 21.46 | **21.48** | 21.12 | 20.73 | 21.88 | **21.24** | 21.31 | 21.11 | 21.67 | **21.36** |
| **Mean** | **22.86** | **22.15** | **22.82** | | **23.13** | **21.89** | **23.50** | | **23.00** | **22.02** | **23.16** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.121 | 0.121 | 0.209 | | 0.140 | 0.140 | 0.242 | | 0.101 | 0.101 | 0.175 | |
| **CD at 5%** | 0.362 | 0.362 | 0.628 | | 0.419 | 0.419 | 0.727 | | 0.302 | 0.302 | 0.523 | |

| | Specific leaf area($cm^2$ $g^{-1}$ ) at pod formation stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sowing dates | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 25.01 | 23.56 | 26.47 | **25.01** | 24.04 | 22.62 | 25.14 | **23.93** | 24.52 | 23.09 | 25.80 | **24.47** |
| D2-4th week of Nov | 23.15 | 22.44 | 24.51 | **23.37** | 21.78 | 21.10 | 23.89 | **22.26** | 22.47 | 21.77 | 24.20 | **22.81** |
| D3-2th week of Dec | 22.02 | 21.93 | 21.96 | **21.97** | 21.33 | 21.74 | 21.33 | **21.46** | 21.68 | 21.83 | 21.64 | **21.72** |
| **Mean** | **23.40** | **22.64** | **24.31** | | **22.38** | **21.82** | **23.45** | | **22.89** | **22.23** | **23.88** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.178 | 0.178 | 0.308 | | 0.291 | 0.291 | 0.503 | | 0.189 | 0.189 | 0.327 | |
| **CD at 5%** | 0.534 | 0.534 | 0.924 | | 0.871 | 0.871 | 1.509 | | 0.566 | 0.566 | 0.980 | |

**Table 7. Effect of date of sowing on crop growth rate (g $m^{-2}$ $day^{-1}$) in mustard genotypes at different plant growth stages**

| Sowing dates | Crop growth rate (g $m^{-2}$ $day^{-1}$) at vegetative stage to flowering stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 10.60 | 9.74 | 10.38 | **10.24** | 11.91 | 10.83 | 10.84 | **11.19** | 11.25 | 10.28 | 10.61 | **10.71** |
| D2-4th week of Nov | 9.75 | 8.96 | 9.23 | **9.31** | 9.79 | 9.57 | 9.11 | **9.49** | 9.77 | 9.26 | 9.17 | **9.40** |
| D3-2th week of Dec | 9.56 | 9.42 | 9.35 | **9.44** | 8.97 | 8.63 | 8.46 | **8.69** | 9.27 | 9.02 | 8.91 | **9.07** |
| **Mean** | **9.97** | **9.37** | **9.65** | | **10.22** | **9.67** | **9.47** | | **10.10** | **9.52** | **9.56** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.145 | 0.145 | 0.251 | | 0.107 | 0.107 | 0.186 | | 0.090 | 0.090 | 0.155 | |
| **CD at 5%** | 0.434 | 0.434 | NS | | 0.322 | 0.322 | NS | | 0.269 | 0.269 | NS | |

| Sowing dates | Crop growth rate (g $m^{-2}$ $day^{-1}$) at flowering stage to pod formation stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2nd week of Nov | 17.40 | 16.17 | 16.73 | **16.77** | 18.83 | 17.52 | 17.51 | **17.95** | 18.12 | 16.85 | 17.12 | **17.36** |
| D2-4th week of Nov | 15.55 | 15.30 | 15.62 | **15.49** | 17.14 | 16.34 | 16.54 | **16.67** | 16.34 | 15.82 | 16.08 | **16.08** |
| D3-2th week of Dec | 16.14 | 15.07 | 14.86 | **15.36** | 15.33 | 14.11 | 14.93 | **14.79** | 15.74 | 14.59 | 14.89 | **15.07** |
| **Mean** | **16.36** | **15.51** | **15.74** | | **17.10** | **15.99** | **16.33** | | **16.73** | **15.75** | **16.03** | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | G | D x G | | D | G | D x G | | D | G | D x G | |
| S.Em ± | 0.117 | 0.117 | 0.203 | | 0.113 | 0.113 | 0.195 | | 0.107 | 0.107 | 0.186 | |
| CD at 5% | 0.351 | 0.351 | 0.607 | | 0.338 | 0.338 | NS | | 0.322 | 0.322 | NS | |

**Table 8. Effect of date of sowing on net assimilation rate (g g $^{-1}$ day$^{-1}$) in mustard genotypes at different plant growth stages**

| Sowing dates | Net Assimilation Rate (g g $^{-1}$ day$^{-1}$) at Vegetative stage to flowering stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2$^{nd}$ week of Nov | 9.23 | 8.16 | 8.36 | **8.58** | 9.54 | 8.68 | 8.41 | **8.88** | 9.39 | 8.42 | 8.39 | **8.73** |
| D2-4$^{th}$ week of Nov | 7.80 | 7.25 | 7.69 | **7.58** | 7.87 | 6.80 | 7.37 | **7.35** | 7.84 | 7.02 | 7.53 | **7.46** |
| D3-2$^{th}$ week of Dec | 7.44 | 6.69 | 7.27 | **7.14** | 6.85 | 6.37 | 6.82 | **6.68** | 7.14 | 6.53 | 7.05 | **6.91** |
| Mean | **8.16** | **7.37** | **7.77** | | **8.09** | **7.28** | **7.54** | | **8.12** | **7.33** | **7.65** | |
| | D | G | D x G | | D | G | D x G | | D | G | D x G | |
| S.Em ± | 0.052 | 0.052 | 0.091 | | 0.124 | 0.124 | 0.215 | | 0.067 | 0.067 | 0.116 | |
| CD at 5% | 0.157 | 0.157 | 0.272 | | 0.373 | 0.373 | 0.645 | | 0.201 | 0.201 | 0.348 | |

| Sowing dates | Net Assimilation Rate (g g $^{-1}$ day$^{-1}$) at Flowering stage to pod formation stage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| D1-2$^{nd}$ week of Nov | 14.41 | 13.75 | 13.84 | **14.00** | 14.17 | 13.14 | 13.45 | **13.58** | 14.29 | 13.45 | 13.64 | **13.79** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **D2-4th week of Nov** | 13.11 | 11.17 | 12.85 | **12.38** | 12.75 | 10.60 | 12.49 | **11.95** | 12.93 | 10.89 | 12.67 | **12.16** |
| **D3-2th week of Dec** | 12.45 | 11.12 | 11.55 | **11.71** | 11.48 | 10.47 | 11.23 | **11.06** | 11.96 | 10.80 | 11.39 | **11.38** |
| **Mean** | **13.32** | **12.01** | **12.74** | | **12.80** | **11.40** | **12.39** | | **13.06** | **11.71** | **12.57** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.066 | 0.066 | 0.114 | | 0.121 | 0.121 | 0.210 | | 0.086 | 0.086 | 0.150 | |
| **CD at 5%** | 0.198 | 0.198 | 0.343 | | 0.364 | 0.364 | 0.630 | | 0.259 | 0.259 | 0.449 | |

**Table 9. Effect of date of sowing on number of siliqua per plant in mustard genotypes**

| Sowing dates | Number of siliqua per plant | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **D1-2nd week of Nov** | 471.42 | 232.20 | 310.03 | **337.88** | 476.28 | 226.17 | 304.01 | **335.49** | 473.85 | 229.18 | 307.02 | **336.68** |
| **D2-4th week of Nov** | 331.74 | 211.44 | 195.70 | **246.29** | 335.16 | 211.06 | 191.90 | **246.04** | 333.45 | 211.25 | 193.80 | **246.17** |
| **D3-2th week of Dec** | 275.48 | 136.80 | 139.05 | **183.78** | 273.59 | 141.12 | 139.50 | **184.74** | 274.53 | 138.96 | 139.28 | **184.26** |
| **Mean** | **359.55** | **193.48** | **214.93** | | **361.68** | **192.78** | **211.80** | | **360.61** | **193.13** | **213.37** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 3.219 | 3.219 | 5.575 | | 4.694 | 4.694 | 8.131 | | 1.940 | 1.940 | 3.361 | |
| **CD at 5%** | 9.649 | 9.649 | 16.713 | | 14.074 | 14.074 | 24.377 | | 5.817 | 5.817 | 10.075 | |

**Table 10. Effect of date of sowing on siliqua length (cm) in mustard genotypes**

| Sowing dates | Siliqua length (cm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| **D1-2nd week of Nov** | 6.46 | 5.72 | 5.56 | **5.92** | 6.69 | 5.78 | 5.45 | **5.97** | 6.57 | 5.75 | 5.51 | **5.94** |
| **D2-4th week of Nov** | 5.89 | 5.14 | 5.97 | **5.67** | 6.08 | 5.11 | 5.99 | **5.73** | 5.98 | 5.12 | 5.98 | **5.70** |
| **D3-2th week of Dec** | 5.32 | 5.04 | 5.46 | **5.27** | 5.51 | 5.10 | 5.35 | **5.32** | 5.41 | 5.07 | 5.41 | **5.30** |
| **Mean** | **5.89** | **5.30** | **5.67** | | **6.09** | **5.33** | **5.60** | | **5.99** | **5.32** | **5.63** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.029 | 0.029 | 0.051 | | 0.087 | 0.087 | 0.151 | | 0.038 | 0.038 | 0.066 | |
| **CD at 5%** | 0.088 | 0.088 | 0.153 | | 0.262 | 0.262 | 0.453 | | 0.114 | 0.114 | 0.198 | |

**Table 11. Effect of date of sowing on number of seeds per siliqua in mustard genotypes**

| Sowing dates | Number of seeds per siliqua | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| **D1-2nd week of Nov** | 12.52 | 12.22 | 12.34 | **12.36** | 12.15 | 11.97 | 11.99 | **12.03** | 12.33 | 12.10 | 12.17 | **12.20** |
| **D2-4th week of Nov** | 12.49 | 11.92 | 11.98 | **12.13** | 12.19 | 11.53 | 11.89 | **11.87** | 12.34 | 11.72 | 11.94 | **12.00** |
| **D3-2th week of Dec** | 11.95 | 10.82 | 11.78 | **11.51** | 11.58 | 10.37 | 11.66 | **11.20** | 11.76 | 10.60 | 11.72 | **11.36** |
| **Mean** | **12.32** | **11.65** | **12.03** | | **11.97** | **11.29** | **11.85** | | **12.15** | **11.47** | **11.94** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.118 | 0.118 | 0.205 | | 0.128 | 0.128 | 0.221 | | 0.098 | 0.098 | 0.170 | |
| **CD at 5%** | 0.355 | 0.355 | NS | | 0.383 | 0.383 | NS | | 0.295 | 0.295 | 0.511 | |

**Table 12. Effect of date of sowing on seed yield kg ha$^{-1}$ in mustard genotypes**

| Sowing dates | Seed yield kg ha$^{-1}$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | 2020 | | | | Pooled Mean | | | |
| | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean | NRCHB-101 | PM-25 | PM-30 | Mean |
| **D1-2nd week of Nov** | 2067.26 | 1982.46 | 2195.14 | **2081.62** | 2052.02 | 2152.51 | 2088.58 | **2097.70** | 2077.92 | 2173.82 | 2017.24 | **2089.66** |
| **D2-4th week of Nov** | 1938.06 | 1792.65 | 1875.01 | **1868.57** | 1855.55 | 1838.60 | 1958.04 | **1884.06** | 1948.05 | 1856.81 | 1824.10 | **1876.32** |
| **D3-2th week of Dec** | 1851.92 | 1961.37 | 1692.08 | **1835.13** | 2030.19 | 1659.23 | 1871.02 | **1853.48** | 1861.47 | 1675.66 | 1995.78 | **1844.30** |
| **Mean** | **1952.42** | **1912.16** | **1920.74** | | **1979.25** | **1883.45** | **1972.54** | | **1962.48** | **1902.10** | **1945.71** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S.Em ±** | 10.065 | 10.065 | 17.434 | | 33.435 | 33.435 | 57.911 | | 12.598 | 12.598 | 21.820 | |
| **CD at 5%** | 30.176 | 30.176 | 52.266 | | 100.237 | NS | 173.616 | | 37.769 | 37.769 | 65.418 | |

**Table 13. Effect of date of sowing on oil content (%) in mustard genotypes**

| **Sowing dates** | **Oil content (%)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2019** | | | | **2020** | | | | **Pooled Mean** | | | |
| | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** | **NRCHB-101** | **PM-25** | **PM-30** | **Mean** |
| **D1-2nd week of Nov** | 41.53 | 38.66 | 40.84 | **40.34** | 40.78 | 38.96 | 39.59 | **39.77** | 41.15 | 38.81 | 40.21 | **40.06** |
| **D2-4th week of Nov** | 40.13 | 39.13 | 39.88 | **39.72** | 40.42 | 39.30 | 39.68 | **39.80** | 40.28 | 39.21 | 39.78 | **39.76** |
| **D3-2th week of Dec** | 39.45 | 38.67 | 39.14 | **39.09** | 40.12 | 38.79 | 38.93 | **39.28** | 39.79 | 38.73 | 39.04 | **39.18** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | **40.37** | **38.82** | **39.95** | | **40.44** | **39.02** | **39.40** | | **40.40** | **38.92** | **39.68** | |
| | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | | **D** | **G** | **D x G** | |
| **S.Em ±** | 0.259 | 0.259 | 0.448 | | 0.176 | 0.176 | 0.304 | | 0.145 | 0.145 | 0.251 | |
| **CD at 5%** | 0.776 | 0.776 | NS | | Ns | 0.527 | NS | | 0.435 | 0.435 | NS | |

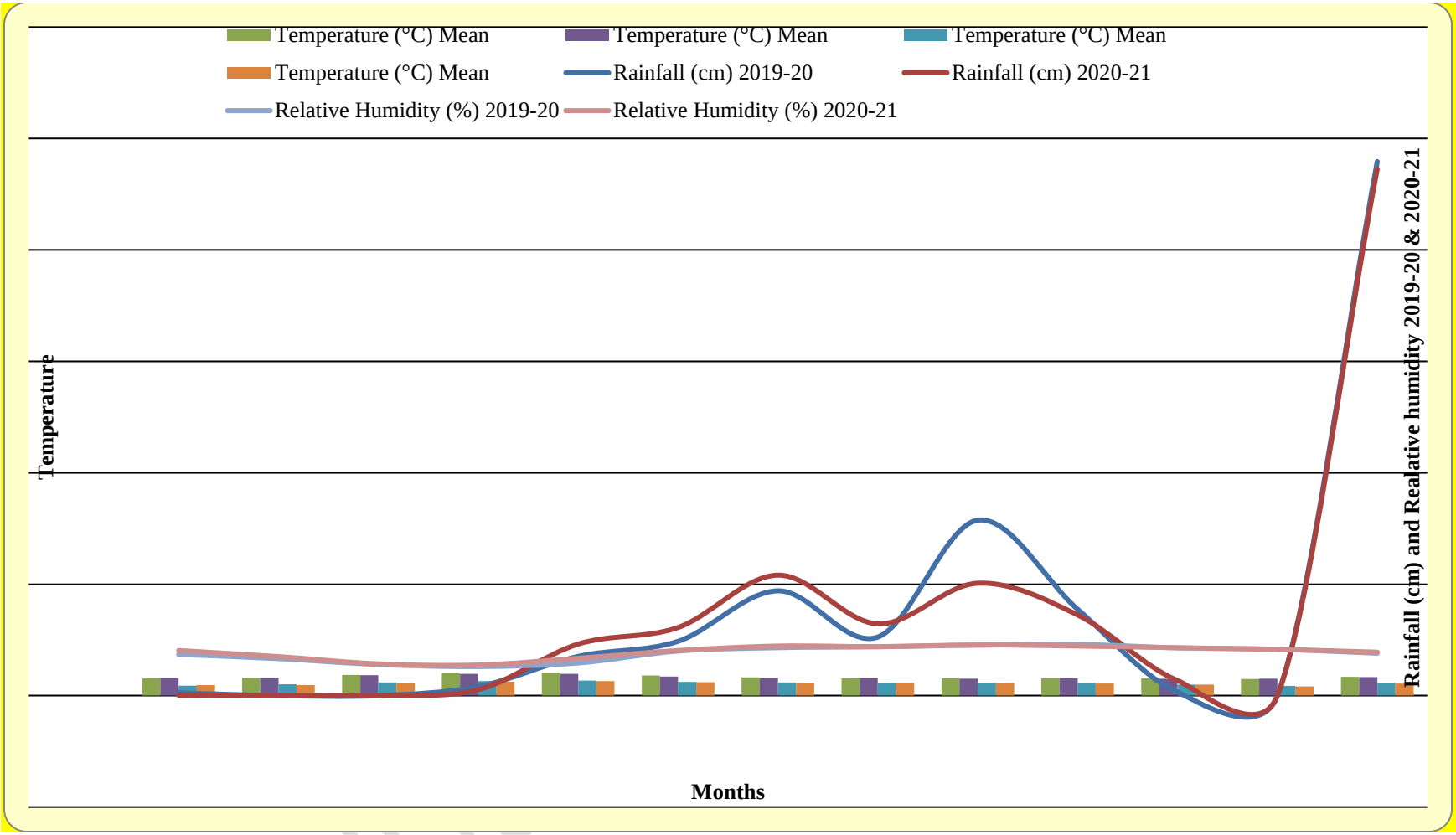


**Fig. 1. Monthly meteorological data for the experimental year 2019-20 and 2020-21**

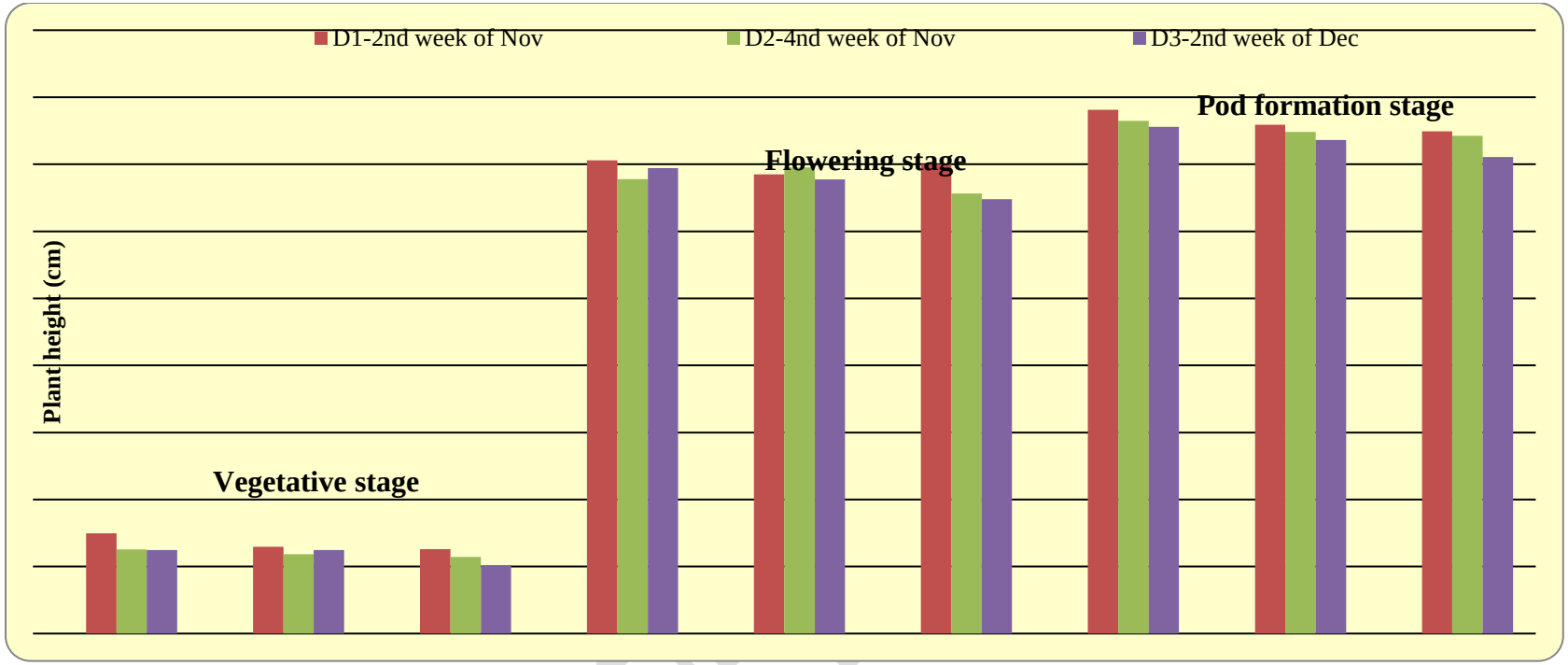


**Fig 2. Effect of date of sowing on Plant height (cm) in mustard genotypes**

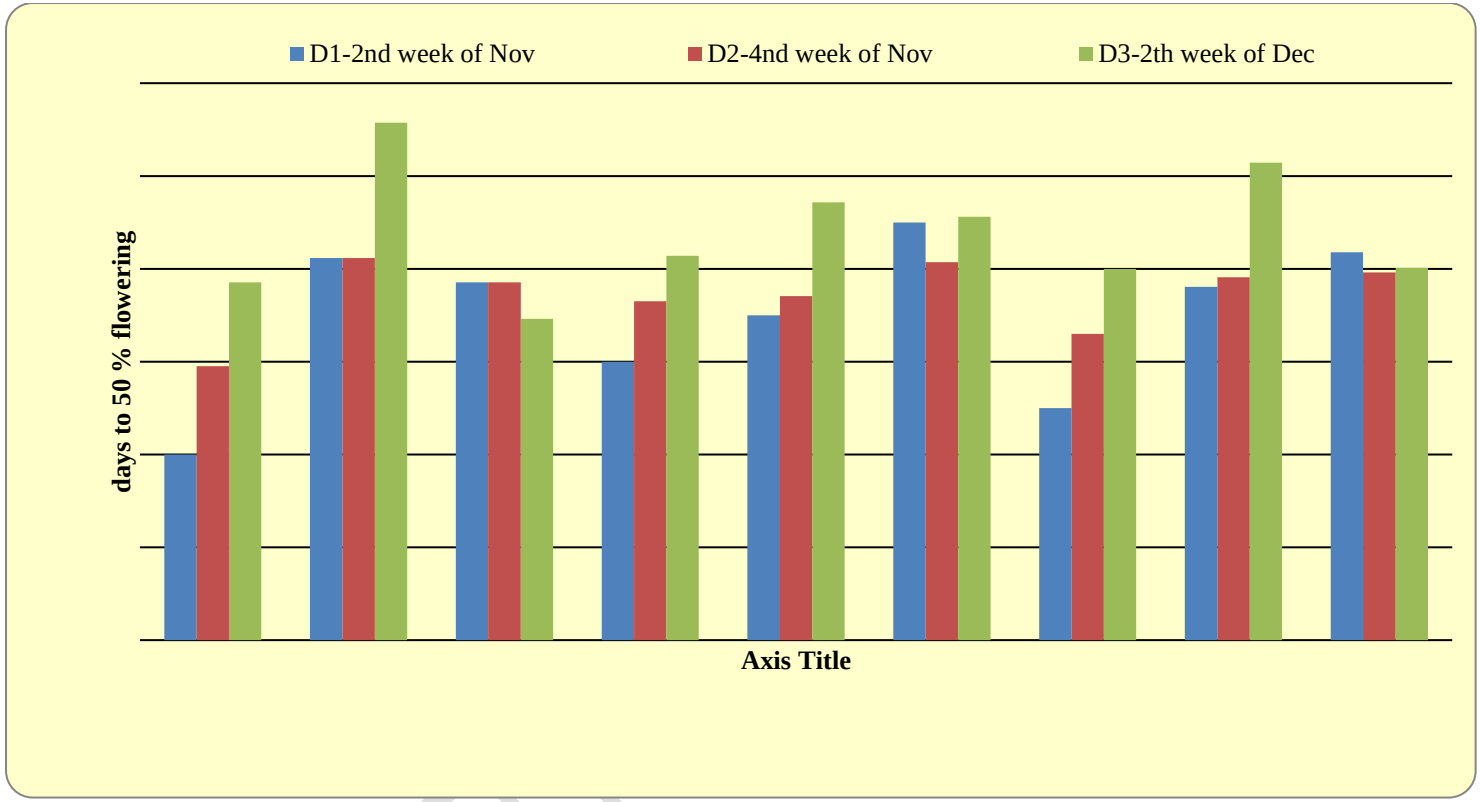


**Fig3. Effect of date of sowing on days to 50 % flowering in mustard genotypes**

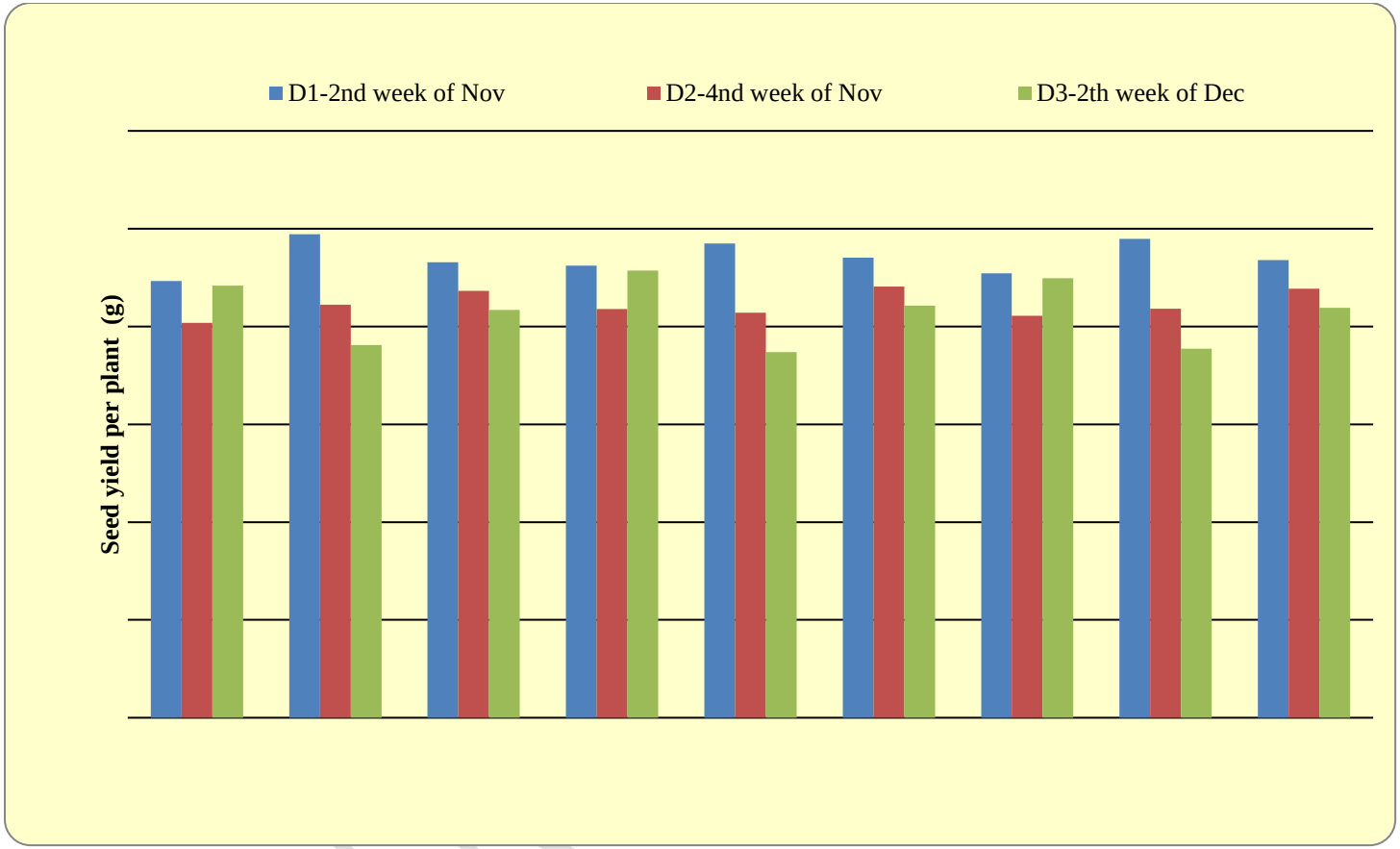


**Fig 4. Effect of date of sowing on seed yield per plant in mustard genotypes**