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Effect of Sowing Dates on Seed Yield Attributes in Indian Mustard

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ABSTRACT

The effects of early and late sowings were studied on Indian mustard cultivars. During the years 2021-22, the 8 genotypes were cultivated in RBD with 3 replications on three sowing dates: September (D_1), October (D_2), and November (D_3) at SST, IARI, and New Delhi. Sowing dates were found to be significant for all of the characters, although genotypes and their interactions were only significant for a no. of seeds per siliqua studied. The results revealed that the timely sown condition (D_2) was found to be better for all genotypes. Among the eight genotypes, JC-33 had a maximum no. of seeds per siliqua in timely sown condition (D2). It was discovered that the sowing date influenced yield characteristics significantly. As the sowing date was extended, the seed yield was found to decline dramatically.

Key words: *Early and late sowings, Genotypes, Indian mustard, Seed yield*

Introduction

High-temperature stress is the most important abiotic stress which can strike a crop at any time and impose many limitations on growth and development around the world (Hall, 1992). Heat stress negatively affects plant growth, development, and plant yield (Boyer, 2004). Mustard is a major oilseed crop because of its economic value and oilseed production. However, its productivity has been reduced by many environmental adversities. Among crop production factors, sowing time and variety contribute a lot towards yield potential. A good variety often fails to express its potential even under good management conditions, unless it is grown at the optimum time. Mustard's early sown condition implies many important advantages such as escape from aphid infestation, while late sown crop encounters high-temperature stress at the seed development stage, which causes a great yield reduction (Abolfazl *et al*., 2009).

Indian mustard is very sensitive to heat stress at the early seedling stage. Stresses disrupt germination, vegetative growth, reproductive processes (Prasad *et al*., 2011), seed filling and seed quality (Britz *et al*. 2007). Reproductive processes and seed filling are more sensitive to these stress and have optimum and ceiling temperatures that are relatively lower than those for vegetative growth and development phases. However, to fulfil the demand for nutrition-rich edible oil with an ever-increasing population and with increasing consumer awareness in such fluctuating environmental conditions. It is necessary to evaluate the high-temperature stress characteristics of Indian-quality mustard genotypes and to predict their suitability under stress conditions. The aim of the study is to analyse the effect of early and late sowing on seed yield parameters to assess which genotype will be more tolerant to high-temperature stress among all. Finally, the *Brassica* species were evaluated for their ability to recover from heat stress.

Materials and Methods

Experimental materials

The experimental material was planted in the research area of the Division of SST, IARI, New Delhi between 2021- 22. Eight genotypes were used, including one conventional genotype, Pusa Vijay, and seven quality genotypes. PM-30, and Pusa Karishma were single-zero genotypes, while JC-21, JC-33, PDZ-1, PDZ-5, and PDZM-33 were double-zero genotypes. Thus genotypes were considered the main factor (1). For each replication, 50 uniformly sized seeds from each were chosen. Three sowing dates were used in the experiment: D_1 (Early sowing) - 27th September, D_2 (Timely sowing) - 28th October, and D_3 (Late Sowing)- 23rd November. As a result, each of the three sowing dates was treated as a sub-factor. The experiment was conducted in a randomized block design with three replications and each plot (2.4 m x 3 m). To raise a successful crop, the entire suggested package of practices was followed.

Methodology

Observations were recorded in 5 individual plants from each genotype and from each treatment for the following attributes:

Siliqua density on the main shoot

Siliqua density was worked out by dividing the number of siliquae on the main shoot bythe main shoot length in all five plants from each genotype and averaged.

The number of seeds per siliqua

Five siliquae from the main raceme of each plant were taken at random and after threshing them, the number of seeds was counted and averaged.

Seed yield per plant (g)

Five tagged plants in each genotype were threshed separately, cleaned, weighed and averaged.

Statistical analyses

All the collected data were statistically analyzed by the SPSS software. Analysis of variance from the data was employed to compute variable effects in both the factors and their interaction. Significant differences between means of sowing dates, genotypes and interactions were calculated using the least significant difference and compared the means exercising Tukey's test at $P \leq 0.05$.

Results and Discussion

Heat (high temperature) stress had a significant impact on all of the yield-attributing characters investigated during the early and late sowing.

Number of seeds per siliqua

Based on the analysis of variances (Table 1) number of seeds per siliqua was found to be significant for sowing date, genotypes, and interaction of sowing date with respect to genotypes. With respect to sowing dates, the crop sown on D_2 had the most seeds per siliqua (14.93) and D3 had the least number of seeds per siliqua (12.89). Because of a delay in sowing, and with the earlier starting of the flowering period, the mustard plants enter the stages of pod formation and seed filling. As a result, the amount of seeds contained within a pod reduces. Similar results were obtained by of Andersson and Benglsson (1989) and Sudeep *et al.* (1996) in canola.

Among the important mustard genotypes, a number of seeds per siliqua were reported in JC 33 had higher seeds (14.9). On the other hand, the mini-

Table 1. ANOVA to show the effects of different sowing dates on growth and yield-related traits of mustard Genotype

Dependent Variable	df	Siliqua density on the main shoot	Seed yield/plant (g)	No of seeds/siliqua
Sowing dates (D)	2	0.286**	4495**	26**
Genotypes (G)	7	NS	NS	3.8*
Genotypes× sowing dates	14	NS	NS	3.56*
Error	48	0.01	237.83	3.07

Mean square values presented in the table and *, ** Means Significant at the 0.05 and 0.01 levels, respectively.

mum number of seeds per siliqua was observed in PDZ-5 (11.6) (Fig. 1). It happens because individual genotypes in a population have a tendency to differ for specific qualities of interest (Chimdesa, 2014). The interactions of the JC-33 genotype in timely sown condition coproduced the highest (16.0) seeds per pod, while the interactions of the PDZ-5 genotype in late sown conditions (D3) produced the lowest (10.3) (Fig. 2).

Table 2. Effect of sowing dates on yield attributing characters of Indian mustard

Date of sowing	Number of seeds per siliqua	Siliqua density on the main shoot	Seed yield per plant (g)
D1	14.3	0.652	20.5
D2	14.9	0.767	30.1
D3	12.9	0.549	17.3

Siliqua density on the main shoot

The variances analysis (Table 1) showed that the main effect of the sowing date on siliqua density was found to be significant however the main effect of genotypes and interaction impact of the date of sowings and the seeds of different genotypes was found non-significant. The highest siliqua density was on the main shoot (0.767), whereas D3 had the lowest siliqua density on the main shoot (0.549). It happens because late sowing (D3) provides unfavourable conditions to plant growth hence the lowest performance on siliqua density was recorded.

Seed yield per plant

When it comes to the seed yield per plant, analysis of variances shows that only the main effect of the sowing date was statistically different (Table 1). D_2 had the highest (40.19 g) seed yield per plant, while

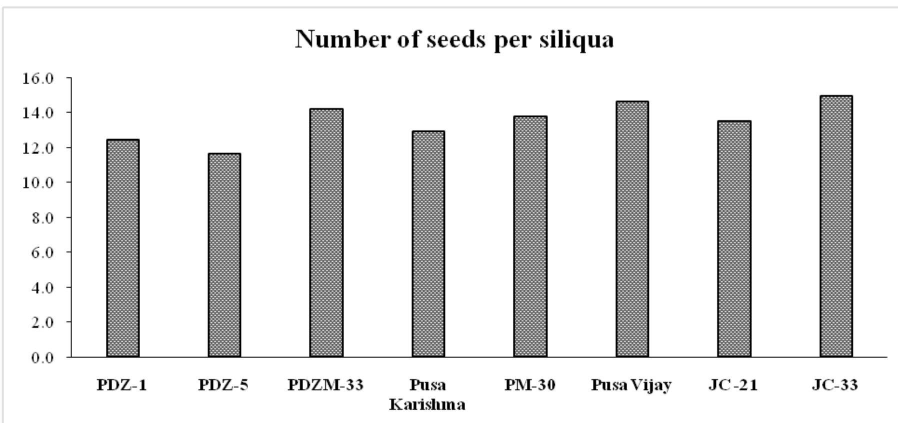

Fig. 1. The main effect of genotypes on number of seeds per siliqua

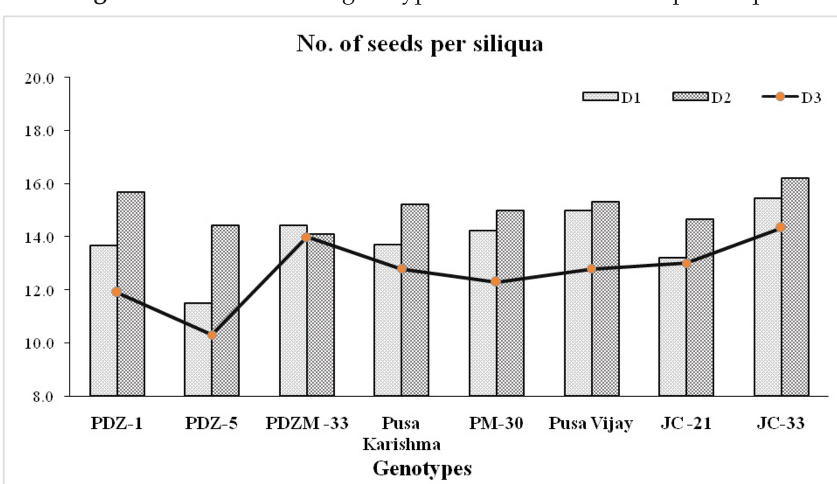

Fig. 2. Interaction effect of mustard genotypes and sowing dates on the number of seeds per siliqua

D_3 (16.22 g) had the lowest seed yield per plant (Table 2). Delaying sowing time resulted in a lower seed yield, which could be related to temperature variations in the late-planted crop. On canola, Bukhtiar *et al*. (1992) and Sattar *et al*. (2013) reported similar conclusions.

Conclusion

From the results, it may be concluded that mustard genotypes responded differently to different sowing times. Sowing time is the most important factor to consider in order to obtain a desirable seed yield. Yield traits decreased were found to be decreased with sowing dates. Among the 8 genotypes all quality mustard genotypes had maximum seeds per siliqua than of conventional genotypes in heat stress conditions. The current study aims to investigate the effects of high temperatures on seed yield, its components, for high-temperature tolerance in order to find potential donors for use in breeding programmes.

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