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STUDIES ON RESPONSE OF MUSTARD VARIETIES TO DIFFERENT SOWING DATES UNDER ALLUVIAL SOILS OF INDO-GENGETIC PLAINS

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ABSTRACT

Field experiments were conducted to assess the influence of different varieties and dates of sowing on growth and yield of mustard (*Brassica juncea* L). Mustard experiment was conducted with four dates of sowing and two varieties viz. Pusa Bold and Pusa Jaikisan (Bio-902). Four dates of sowings viz., 21st October, 31st October, 10th of November and 20th of November were used to evaluate their effect on growth and yield of different varieties tested. Highest yield was produced by mustard cv. Pusa Bold among the two varieties tested whereas first date of sowing i.e. 21st October was adjudged as the best time for mustard seeding since substantial decrease in grain yield was observed with delayed sowing. The analysis of variance showed that the difference in seed yield were statistically significant for both the varieties and different dates of sowing in both the years. Mean seed yield reduction, averaged over varieties, were of the order of 16.4, 39.9 and 65.3 percent with second, third and fourth date of sowing in comparison to first sowing. On an average, mean reduction in the straw yield over first sowing with second, third and fourth sowings was 15.2, 37.3 and 53.1 per cent, respectively. In general, duration of each phenological stage was more in the first sowing as compared to other three sowing dates as a fortnight delay in sowing brought about a decrease in duration of phenological events.

KEYWORDS: Dates of Sowing; Varieties, Biomass, LAI, Yield, Harvest Index

INTRODUCTION

Mustard (*Brassica sp*.) is one of the most important oil crops of the world. Oil of plant origin constitute important component of human diet, ranking third after cereals & animal products and are nutritionally superior to animal oil (Alam *et al*., 2015). About 13.2 percent of the annual world edible oil supply comes from this crop (FAO, 2007). Amongst important annual oilseed crops grown in the country, rapeseed and mustard occupy the second place in terms of average production after groundnut and contribute about 25 per cent to the oilseed production of the country. The country has been facing the problem of shortage of oils coupled with continuous increase in their prices. Improved varieties have been evolved, which can yield better with the use of high inputs of fertilizers, irrigation and suitable dates for sowing with other agronomic management practices. Generally, rapeseed and mustard are grown under rainfed conditions on receding soil moisture during *rabi* season. There is wide fluctuation in production owing to the vagaries of monsoon.

Rapeseed and mustard are generally grown on marginal lands with poor fertility status. Hence, they also suffer from nutrient stress. Sowing time is one of the most important nonmonetary input which influences the productivity of seed and oil to a great extent (Pavlista *et. Al.*, 2011). Rapeseed and mustard are generally sown by first week of October to middle of November in north India. High diurnal temperature during early sown crops resulted in poor germination, improper growth and development of plants. Besides, pests viz., pointed bug (*Bagrada hilaris*), cut worm (*Agrotis* sps.),

sow fly (*Athalialugens proxima*). Late sown crop on the other hand, suffers from low temperature during its germination and early growth phases and damages due to aphids (*Lipophis* sps.) during flowering and pod development stages (Bhuiyan *et al.,* 2008; Aziz *et al.,* 2011). With the development of new varieties of crop and adoption of multiple cropping systems under irrigated conditions it has become essential to extend its sowing from October to mid-November or even later. Considering the above facts, field experiments were conducted to study the impact of different sowing dates on two commonly grown mustard varieties of mustard in north India.

MATARIAL AND METHODS

The field experiments reported in the present investigation were carried out at the research farm of the Indian Agricultural Research Institute, New Delhi situated at a latitude of $28^0$35'N, a longitude of $77^0$10'E and elevation of 228 m above the mean sea level. The soil belongs to Mehrauli series classified as sandy loam, non-acid and mixed hyperthermic to typic ustochrept. It is characterized as yellowish, well drained and deep soil with 0.42 percent organic carbon, 233 kg N, 19.5 kg P and 233 kg available K/ha. Delhi has a semi-arid climate with dry hot summers and cold winters. The normal annual rainfall is about 714 mm, most of which is received during the south-west monsoon season from July to September. Winter showers are occasionally received during the months from December to February from the western disturbances. May and June are hottest months with mean maximum temperature varying from 40-42^{0}C and January is coldest month with mean minimum temperature ranging from 6 to 8^{0}C. The daily minimum and maximum temperatures increase from February onwards up to June. With the onset of the south-west monsoon temperature generally decrease from July to September and thereafter, attains the seasonal minimum values in January.

Two medium duration *Brassica juncea* cultivars namely Pusa Bold and Pusa Jaikisan (Bio 902) were sown during rabi season at 10 days' intervals on four dates of sowing beginning 21st October in both the years. The field experiment was conducted in a split plot design in which two varieties and four sowing dates were replicated four times. Fertilizers were applied as per recommended agronomic package of practices for the experiment i.e. nitrogen @ 120 kg/ha, P_2O_5 60 kg/ha and K_2O 40 kg/ha and 20 kg Sulphur. Seeds were sown at the rate of 5 kg seed per hectare in rows spaced 30 cm apart and 3-4 cm deep by a hand drawn drill. Weeding was carried out manually at about 40 days after seeding and thinning was done to maintain plant population of about 2,50,000 plants per hectare uniformly in all the plots.

The crop was irrigated during the two most critical growth stages viz. flowering and pod formation stages, as per recommended irrigation package of practices for the crop under Delhi conditions. Additional irrigations were also given whenever the gravimetric samples showed that the soil moisture had depleted to a value below 50 per cent of available water (on volume basis) in the 15 to 60 cm depth. The purpose of these additional irrigations was to ensure the maintenance of 'not short of water' conditions and to retain the soil moisture in the root zone fairly within the available water range.

RESULTS AND DISCUSSIONS

Crop Growth

Effect of different sowing dates on duration of test varieties' phenological stages is graphically depicted in figure 1. In general, duration of each phenological stage was more in the first sowing as compared to other three. This could be attributed to the fact that thermal regime prevailing at the later sowings hastened the crop growth period. The occurrence of different phenological events observed in this study are within the range reported by earlier workers for

Pusa Bold and other cultivars under Delhi conditions (Prasad, 1989; Panda *et. al.*, 2004). A fortnight delay in sowing brought about a decrease in duration of phenological events. These findings are in agreement with those reported by Khushu and Singh (2005).

The above ground, total biomass production for Pusa Bold in first year were of the order of 1450, 1240, 1020 and 880 gm m^{-2} in 21st Oct, 31st Oct, 10th Nov and 20th Nov sowings, respectively (Figure 2). Due to delay in sowing the final biomass was reduced by 14.5, 29.6 and 60.6 percent in 31st Oct, 10th Nov and 20th Nov sowings, respectively. During 2nd year, total biomass recorded was of the order of 1530, 1280, 1100 and 900 gm m^{-2} in the four sowings, respectively. Comparing both the years, it was observed that in case of 21st Oct, 31st Oct, 10th Nov the total biomass production increased by 5.5 per cent, 9.6 per cent and 7.8 per cent, respectively, while in 20th Nov sowing it was at par. In the second year, favorable climatic condition enhanced the growth. Reduction in biomass accumulation in Bio-902 during first year varied from 14.8 to 34.4 per cent in all other dates as compared to 21st Oct sown crop whereas it varied from 15.1 to 34.5 per cent in the second year. Analysis of data also revealed the fact that Pusa Bold was the higher producer of biomass in comparison to Bio-902. Pusa Bold has profuse growth habit in respect of podding which contributes significantly in attaining more biomass. When the treatment of dates of sowings is taken into account, it is clear that as the date of sowing were delayed from normal one; the amount of biomass production got reduced. This may be due to the fact that in delayed sowings, crops are subjected to relatively high thermal regime, which hastens the completion of phenological stages giving very short time for crop growth resulting in less biomass and yield. Pavlista *et. al.,* (2011), also reported a reduction of biomass due to delayed sowing. The reduction in biomass due to late sowing is accompanied by reduction in stem height, branching, leaf area index and pod numbers (Bhuiyan *et. al.*, 2008; Hokmalipour *et al.*, 2011).

Leaf area index (LAI) is an important crop growth parameter. It expresses the total leaf area development in relation to the total ground area on which the crop is grown. LAI development in mustard is influenced not only by the dates of sowing but also due to varieties since leaf producing habit varies between varieties. Variations of LAI for two cultivars at harvest are shown in table 1. In general, LAI values in cultivar 'Pusa Bold' started increasing from 40 to 50 DAS and reached the peak around 90 to 100 DAS and then started decreasing sharply whereas the LAI value in case of Bio-902 started rising sharply around 60 DAS and then a sharp reduction after 90-100 DAS (data not shown). Other important observation was related to dates of sowing and it was noted that the first sowing got 2 to 3 units more in LAI values in comparison to later sowings and the development of leaf area was faster in earlier sowings than in later sowings. The maximum value of LAI occurred either during pod formation or early to middle of seed filling stages (Shargi *et al.*, 2011, Walton *et. al.*, 2011and Rafiei *et. al.*, 2011).

Yield and Yield Attributes

The analysis of variance revealed that the difference in seed and stover yield were statistically significant due to different varieties and sowing dates. In both the years, highest seed yield was recorded with the crop sown on 21st October i.e. first date of sowing whereas lowest yield was noted in the crop sown on 20th November i.e. last date of seeding, irrespective of varieties. Average reduction in the seed yield when sown on second, third and fourth date in comparison to first sowing were of the order of 16.4, 39.9 and 65.3 percent in the two varieties as shown in table 1. These results suggest that pre-anthesis growth and development of mustard were adversely affected by cold frosty nights and reduced sunshine in the crop sown late after second fortnight of October in these areas. Singh *et al.,* (2014) observed the similar trend and reported that late sown crop experienced sub-optimal temperature regime which retarded their growth compared to normal

date or mid-sown crops on earlier dates. Also, post fertilization development suffered from forced maturity due to rapid rising in temperature (Iraddi 2008; Kushwaha *et al*., 2009).

Similar to seed yield, test varieties differed significantly in their stover yield in both the years. Mustard cv. Pusa Bold produced, on an average, about 10% more stover yield than Bio-902. The stover yield of the crop was significantly influenced by different dates of sowing in both years of experimentation. In general, the highest amount of biomass was recorded for October 21st sown crop and a progressive substantial decrease thereafter, was recorded with successive dates of sowings. On an average, mean reduction in the stover yield over first sowing with second, third and fourth sowings was 15.2, 37.3 and 53.1 per cent, respectively.

Harvest index varied due to different sowing dates though varieties failed to influence it significantly. The 1000-seed weight of the Pusa Bold was significantly higher than Bio-902 in both the years. The seeds of the former on an average were heavier by 5.6 and 6.5 per cent compared to later one in the first year and second year of experimentation, respectively. The crop sown on 21st October showed higher value of 1000-seed weight and it was gradually and significantly, decreased with delay in sowing. Lowest seed weight was recorded in the crop sown on 20th November. These results support the finding of Shargi *et. al.*, (2011) and Rafiei *et. al.*, (2011). The reduction in 1000 seed weight in second, third and fourth sowing in both the varieties is probably due to very short grain filling period and seeds could not develop fully in late sowings (Akhter *et. al.*, 2015).

CONCLUSIONS

It may be concluded from the results of the study that productivity of the mustard is influenced by both genotypes as well as by the time of sowing. However, interactions between varieties and sowing time were found to be non-significant. In both the years, first date of sowing i.e. 21st October was adjudged as the best time for mustard seeding and gradual decrease was noted in the seed yield when sown on second, third and fourth date.

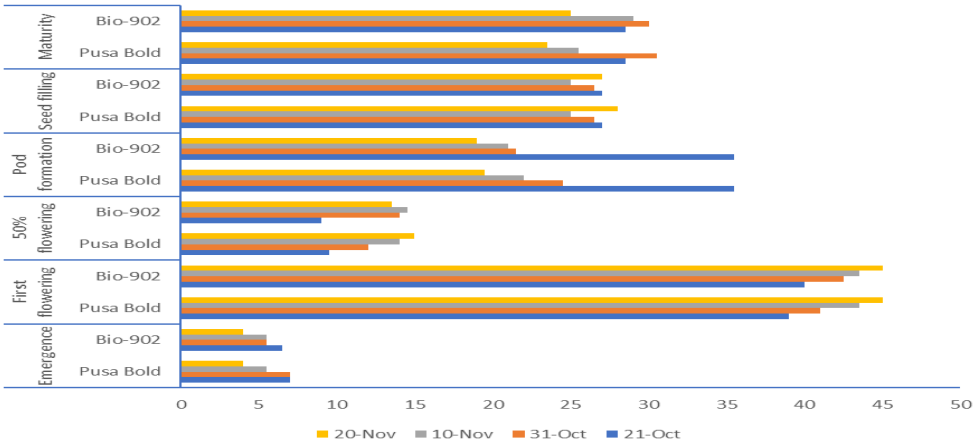

Figure 1: Effect of Sowing Dates on Phenology of Two Mustard Varieties (Mean of 2 Years)

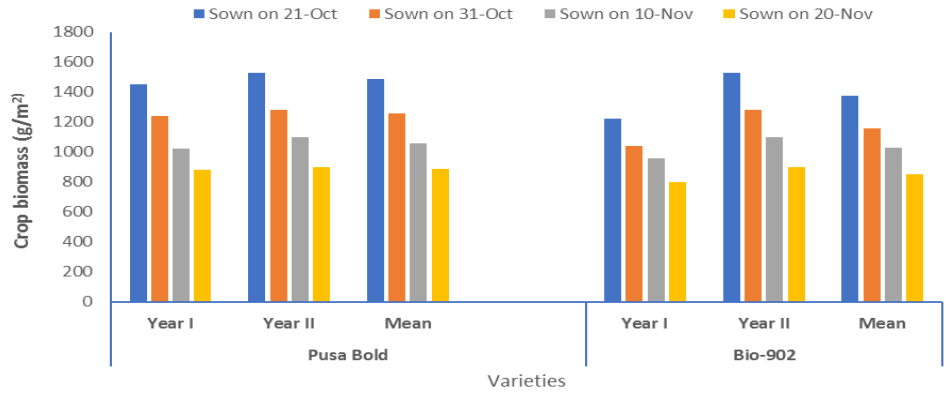

Figure 2: Effect of Different Sowing Dates and Varieties on the crop Biomass at Harvest

Table 1: Effect of Different Varieties and Sowing Dates on Growth, Yield and Yield Attributes of Mustard

Treatment	LAI at Harvest		Grain Yield (q/ha)		Stover Yield (q/ha)		Harvest Index		1000 -Seed Weight (g)	
	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year
Varieties										
Pusa Bold	1.20	1.22	18.76	18.83	46.28	46.42	0.29	0.29	5.75	5.85
Bio-902	1.13	1.21	16.84	17.76	41.71	42.25	0.29	0.30	5.43	5.47
$CD_{(0.05)}$	**ns**	**ns**	**0.21**	**0.54**	**0.93**	**0.85**	**ns**	**ns**	**0.22**	**0.26**
Dates of Sowing										
21-Oct	1.40	1.45	25.66	25.90	59.53	60.6	0.30	0.30	6.35	6.60
31-Oct	1.55	1.60	21.20	21.91	50.81	51.0	0.29	0.30	6.20	6.30
10-Nov	1.05	1.06	15.63	15.40	37.46	37.5	0.29	0.29	5.45	5.35
20-Nov	0.65	0.75	8.70	8.75	28.18	28.25	0.24	0.24	4.35	4.40
$CD_{(0.05)}$	**0.24**	**0.15**	**0.38**	**0.73**	**1.65**	**1.16**	**0.04**	**0.02**	**0.33**	**0.36**

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