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EFFECTIVITY OF DIFFERENT SOWING DATES ON CHEMICAL, BIOCHEMICAL, YIELD AND YIELD TRAITS IN MUSTARD GENOTYPES

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ABSTRACT

The study was conducted during *rabi* 2020-21 to evaluate the ten genotypes of mustard *viz.,*ACN-240, SKM-1626, ACN-226, ACN-244, ACN-250, ACN-255, T-9, ACN-237, PM-26 and TAM 108-1 under two sowing dates i.e. 30th October and 30th November for chemical, biochemical, yield and yield contributing parameters. The experiment was laid out in FRBD with three replications. Data 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 chlorophyll, N, P, K content in leaves, oil content in seeds, number of siliquae plant^{-1}, number of seeds siliqua^{-1}, test weight and seed yield ha^{-1}. In terms of chemical, biochemical, yield and yield contributing characters 30th October sowing date with genotype ACN-250 proved to best among the interactions. These all characters showed positive and highly significant correlation with yield.

(Key words: Mustard genotypes, sowing dates, chemical, biochemical, yield contributing parameters, yield, correlation, interaction)

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.

Mustard seeds are considered as excellent source of dietary protein i.e. 27%, with desired amino acid profile.It is common medium for pickling and food preservation. In fact, mustard oil is nutritionally far superior than any other vegetable oil due to low level of saturated fatty acids i.e. 8%, moderate level of poly unsaturated fatty acid and appreciable amount of omega-3 and omega-6 fatty acid in very right proportion. Keeping these things in mind varieties with low erucic acid (less than 3%) have been developed and presently such varieties are under cultivation. Indian mustard seed meal contains 3% to 8% glycosylates, which is an anti-nutritional factor which decreases probability of cake.

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 1g 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).

Sowing time is the most vital non-monetary input to achieve target yields in mustard. Production efficiency of different genotypes greatly differs under different planting dates. Soil temperature and moisture influences the sowing time of rapeseed-mustard in various zones of the country (Singh *et al.,* 2018).The optimum time of sowing can provide congenial conditions to have maximum light interception, best utilization of moisture and nutrients from early growth stage to seed filling stage. Sowing time is very important for mustard production (Mondal *et al.,* 1999). Hence, considering the fact, present investigation was undertaken to study the effect of sowing dates on chemical, biochemical, yield and yield traits in mustard genotypes.

MATERIALS AND METHODS

Field experiment was carried out at research farm AICRP on linseed and mustard, college of agriculture, Nagpur during *rabi* 2020-21 in FRBD replicated thrice.

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Experimental gross plot size was 3.15 m × 2.20 m and net plot size was 2.25 m × 2.00 m. Sowing was done on 30th October and 30th November with spacing of 45 cm × 10 cm. The ten genotypes including checks *viz.*, ACN-240, SKM-1626, ACN-226, ACN-244, ACN-250, ACN-255, T-9, ACN-237, PM-26 and TAM 108-1 were tested in two dates of sowing i.e. 30th October and 30th November. Chlorophyll content in leaves was estimated by colorimetric method suggested by Bruinsma (1982). N content in leaves was determined by micro-kjeldahl'smethod as given by Somichi *et al.* (1972). P content in leaves was determined by venado-molybate yellow colour method given by Jackson (1967). K content in leaves was determined by flame photometer by di-acid extract method given by Jackson (1976). The estimation of oil content of seed was done by Soxhlet's procedure described by Shankaran (1965). Observations on number of siliquae plant^{-1}, number of seeds siliqua^{-1}, test weight and seed yield ha^{-1} were also recorded at the time of harvesting. Simple correlation was calculated by using the formula given by Singh and Choudhary (1994).

RESULTS AND DISCUSSION

Chlorophyll content in leaves

Chlorophyll content in leaves at 25, 45 and 65 DAS was significantly higher in 30th October sown crop (0.667, 1.510 and 1.284 mg g^{-1} respectively) as compared to 30th November sown crop (0.419, 1.228 and 1.098 mg g^{-1} respectively). This might be due to reason that favourable temperature and bright sunshine at vegetative phase enhanced the chlorophyll synthesis in leaves during 30th October sowing whereas, relatively low temperature and lower sunshine at grand growth phase led to decrease in chlorophyll content during 30th November sowing. Chlorophyll was increased from 25-45 DAS but later it was decreased. It might be due to leaf senescence which led to degradation of chlorophyll.

Significant increase in amount of both nitrogen and potassium in plant shoot play an important role in increasing the number of chloroplasts cell^{-1}, cell size, number of unit^{-1} area, as well as increased synthesis of chlorophyll (Possinghum, 1980). This might be the reason for increase in chlorophyll content in the present study.

Tripathi *et al.* (2006) studied the leaf appearance and chlorophyll content in Indian mustard under different crop environments. Treatment considered three sowing dates *viz.,* S_1 (5th October), S_2 (20th October) and S_3 (5th November). They reported that the chlorophyll content was significantly higher in S_1 and S_2 as compared to S_3. The higher value of chlorophyll content in early sowing may be due to warmer growing environment which supported better plant physiological characters. However, under late sown conditions temperature declined during grand growth period. The reduction in temperature during vegetative and flowering phases may have decreased chlorophyll content.

At 25, 45 and 65 DAS significantly higher chlorophyll content was recorded in genotypes ACN-250, ACN-237 and ACN-226 which were superior over the checks (PM-26 and TAM 108-1) and other genotypes (ACN-244, SKM-1626, ACN-255, T-9 and ACN-240). Data revealed that significantly highest chlorophyll content was observed in genotype ACN-250 at all stages of observations (i.e. 0.82, 1.85 and 1.65 mg g^{-1} at 25, 45, and 65 DAS respectively), while lower in genotype ACN-240 at all stages of observations (i.e. 0.28, 0.84 and 0.68 mg g^{-1} at 25, 45 and 65 DAS respectively). This might be due to their genetic potential among the genotypes studied.

Uddin *et al.* (2012) found that the variation in chlorophyll content during flowering and fruiting stage was significant among the mutants. The highest chlorophyll content was recorded in RM05 and the lower was recorded in RM01. This might be due to genetic makeup of mutants.

Results revealed that significantly highest chlorophyll content was observed under 30th October sowing (D_1) with genotype ACN-250 (G_5) when compared to other interactions, while lower chlorophyll content was recorded under 30th November sowing (D_2) with genotype ACN-240 (G_1) at all the stages of observations (25, 45 and 65 DAS).

At all stages of observations significantly strong and positive association was noticed between chlorophyll content in leaves and seed yield (0.946**, 0.944** and 0.923** at 25, 45 and 65 DAS respectively).Raut *et al.* (2012) and Deotale *et al.* (2019) had recorded significantly positive association of chlorophyll content with seed yield in mustard.

Nitrogen content in leaves

At 25, 45 and 65 DAS significantly higher nitrogen content in leaves was noticed in 30th October sown crop (3.16, 3.05 and 2.94 % respectively) as compared to 30th November sown crop (2.47, 2.35 and 2.24 % respectively). This might be due to reason that relatively warmer temperature during vegetative growth which led higher accumulation of nitrogen in leaves during 30th October sowing, while relatively low temperature at grand growth stage led to decrease in nitrogen content during 30th November sowing. Leaf nitrogen contents decreased progressively at 45-65 DAS. It might be due to development of new organs of the plant i.e., flowers and developing seeds which drew the nitrogen from leaves.

Gardner *et al.* (1988) observed that leaf nitrogen content was decreased at 45 and 65 DAS when compared with 25 DAS stage. The decrease in nitrogen content might be due to fact that younger leaves and developing organs, such as seeds act as strong sink demand and may draw heavily nitrogen from older leaves.Results recorded by Poonkodi (2003) also stated that decrease in nitrogen content at later stage might be due to translocation and utilization of nutrient for flower and pod formation.

At 25, 45 and 65 DAS significantly highest nitrogen content was recorded in genotypes ACN-250, ACN-237 and ACN-226 when compared with checks (PM-26 and TAM 108-1) and other genotypes (SKM-1626, ACN-244, ACN-

255, T-9 and ACN-240).Data showed that significantly higher nitrogen content in leaf was observed in genotype ACN-250 at all stages of observations (i.e. 3.57, 3.47 and 3.35 % at 25, 45 and 65 DAS respectively), while lower in genotype ACN-240 at all stages of observations (i.e. 1.89, 1.77 and 1.66 % at 25, 45 and 65 DAS respectively). This might be due to genotype-to-genotype variation in their genetic potential.

Interaction between sowing dates and genotypes for nitrogen content in leaves was found non-significant at all stages of observations (25, 45 and 65 DAS).

Nitrogen content in leaves was found to be significant and positively correlated with seed yield at all stages of observations (0.974**, 0.976** and 0.976** at 25, 45 and 65 DAS respectively). Uke *et al.* (2011), Raut *et al.* (2012) and Deotale *et al.* (2019) had also noted significantly positive association of nitrogen content with seed yield in mustard.

Phosphorus content in leaves

At 25, 45 and 65 DAS significantly higher phosphorus content in leaves was found in 30th October sown crop (0.38, 0.46 and 0.42 % respectively) when compared with 30th November sown crop (0.32, 0.39 and 0.36 % respectively) at all stages of observations. This might be due to relatively high soil temperature during vegetative growth which enhances the availability and efficiency of phosphorus uptake led to higher accumulation of phosphorus in leaves during 30th October sowing. Whereas, relatively low soil temperature at grand growth phase led to decrease in uptake and accumulation of phosphorus content during 30th November sowing.

The inferences drawn from the data, it is clear that leaf phosphorus content was gradually increased up to 45 DAS and reduced thereafter, at 65 DAS. The decrease in phosphorus content might be due to translocation of leaf phosphorus and its utilization for development of food storage organ. (Deotale *et al.,* 2018).

Low temperature in the root zone reduced the availability of P for wheat (Power *et al.,* 1961). Barber (1986) studied the soil-plant interaction in the phosphorus nutrition of plant. They stated that temperature influenced mechanisms involved in plant phosphorus (P) uptake and phosphorus deficient plants have been associated sometimes with low soil temperatures, suggesting that P supply to the root is restricted with low soil temperature.

At 25, 45 and 65 DAS significantly higher phosphorus content was observed in genotypes ACN-250, ACN-237 and ACN-226 as compared to checks(PM-26 and TAM 108-1) and other genotypes (SKM-1626, ACN-244, ACN-255, T-9 and ACN-240).Results revealed that significantly highest phosphorus content in leaves was observed in genotype ACN-250 at all stages of observations (i.e. 0.52, 0.60 and 0.56 % at 25, 45 and 65 DAS respectively), whereas, it was lowered in genotype ACN-240 at all stages of observations (i.e. 0.14, 0.18 and 0.16 % at 25, 45 and 65 DAS respectively). This might be due to their genetic potential among the genotypes studied.

Interaction between sowing dates and genotypes for phosphorus content in leaves was found non-significant at all stages of observations (25, 45 and 65 DAS).

Phosphorus content in leaves was significantly and positively correlated with seed yield at all stages of observations (0.910**, 0.907** and 0.911** at 25, 45 and 65 DAS respectively). Uke *et al.* (2011) and Raut *et al.* (2012) also observed significant and positive correlation of phosphorus content with seed yield in mustard.

Potassium content in leaves

Potassium content in leaves at 25, 45 and 65 DAS was significantly higher in 30th October sowing (0.66, 1.35 and 1.17 % respectively) as compared to 30th November sowing (0.52, 1.16 and 1.04 % respectively). It might be due to higher soil moisture which enhances the availability of potassium led to higher uptake and accumulation of potassium in the leaves in 30th October sown crop. Whereas, relatively low temperature at grand growth stage led to decrease in potassium content in leaves in 30th November sown crop.

Kumar *et al.* (2020) investigated the effect of sowing dates on nutrient availability and nutrient uptake of Indian mustard (*Brassica juncea*). Treatments consisted of three sowing dates *viz.,* 17th November, 27th November and 07th December and eight nutrient sources. Results revealed that the crop sown on November 17th, total potassium uptake was recorded 87.38 kg ha^{-1} on the basis of pooled analysis as compared to crop sown on November 27th and December 7th. Lower potassium content at latter two dates of sowing might be due to relatively low soil temperature at grand growth phase led to decrease in uptake and accumulation of potassium content in leaves.

At 25, 45 and 65 DAS significantly higher potassium content was observed in genotypes ACN-250, ACN-237 and ACN-226 which were superior over the checks (PM-26 and TAM 108-1) and other genotypes (ACN-244, SKM-1626, ACN-255, T-9 and ACN-240).Results showed that significantly higher potassium content in leaves was observed in genotype ACN-250 at all stages of observations (i.e. 0.76, 1.47 and 1.33 % at 25, 45 and 65 DAS respectively), whereas, it was lowered in genotype ACN-240 at all stages of observations (i.e. 0.41, 0.95 and 0.76 % at 25, 45 and 65 DAS respectively). This is because of variation in different genotypes in their genetic makeup.

Interaction between sowing dates and genotypes for potassium content in leaves was found non-significant at all stages of observations (25, 45 and 65 DAS).

Significantly positive correlation was noticed between potassium content in leaves and seed yield at all stages of observations (0.970**, 0.953** and 0.911** at 25, 45 and 65 DAS respectively). Uke *et al.* (2011), Raut *et al.* (2012) and Deotale *et al.* (2019) also reported positive association of potassium content in leaves with seed yield in mustard.

Oil content in seeds

Significantly more oil content in seed was observed in 1st date of sowing i.e. 30th October (38.73 %) when compared with 2nd date of sowing i.e. 30th November (34.52 %). This might be due to reason that optimum temperature during siliqua and grain filing stage under 30th October sown crop led to higher accumulation of fatty acids in seed. Whereas, lower oil content under 30th November sown crop might be due to higher temperature during maturity adversely affected the fatty acids accumulation in seeds and enforced the maturity earlier.

Canvin (2011) studied the effect of temperature on the oil content and fatty acid composition of the rapeseed and revealed that highest oil content in rapeseed was found at the lowest temperature and a continual decrease was observed with the increase in temperature. This might be due to decrease in the amount of highly unsaturated fatty acids when the temperature was increased.

Keerthi *et al.* (2017) investigated the yield attributes, yield and quality of Indian mustard (*Brassica juncea* L.) in genotype RH-749 having four different dates of sowing *viz.,* 15th October, 25th October, 5th November and 15th November. Results revealed that sowing on 15th October gave highest oil content against the minimum oil content recorded with 15th November sown crop. The significant increase in oil content in early sown crop was due to increased nitrogen content in seed.

Significantly higher oil content was recorded in genotypes ACN-250, ACN-237 and ACN-226 when compared with checks (PM-26 and TAM 108-1) and other genotypes (ACN-244, SKM-1626, ACN-255, T-9 and ACN-240).Data revealed that significantly highest oil content was observed in genotype ACN-250 (41.63%) might be due to their higher genetic potential to accumulate higher amount fatty acids in the seeds, while lower oil content was observed in genotype ACN-240 (30.12%) might be due to their lower genetic potential when compared among the genotypes studied.

Patel *et al.* (2017) investigated the effect of different sowing dates on growth, yield and quality of Indian mustard varieties. Treatments consisted of four sowing dates *viz.,* 15th October, 30th October, 14th November and 29th November and three varieties Varuna, Narendra Rai-1 and Kranti. They found that among the varieties, Varuna recorded significantly higher oil yield as compared to Narendra Rai-1 and Kranti. This might be due to their genetic makeup.

Among the interactions the highest oil content was observed in genotype ACN-250 (G_5) with 30th October (D_1) sown condition, while lower oil content was observed in genotype ACN-240 (G_1) with 30th November sowing date (D_2).

Oil content of seed exhibited significantly strong and positive correlation with seed yield (0.969**). Ramanjanuyulu and Giri (2007), Uke *et al.* (2011), Raut *et al.* (2012) and Deotale *et al.* (2019) had also observed significant and positive correlation of oil content with seed yield in mustard.

Number of siliquae plant^{-1} and number of seeds siliqua^{-1}

Significantly more number of siliquae plant^{-1} and number of seeds siliqua^{-1} was found in 30th October sown crop (255.54 and 15.52) when compared with 30th November sown crop (204.10 and 11.88). This might be due to reason that favourable environment for growth during the 30th October sowing leads to proper grain filing. Whereas, 30th November sown crop expose to higher temperature and water deficit condition during terminal stage caused flower and siliqua abscission as well as shortening of reproductive period led lower number of siliquae plant^{-1} and number of seeds siliqua^{-1}.

Wright *et al.* (1996) also opined that water deficit at flowering stage of mustard caused shortening of the reproductive growth duration, infertility of some flowers and their abscission and finally lower number of seeds siliqua^{-1}.

Singh *et al.* (2014) reported the highest number of siliquae plant^{-1}and number of seeds siliqua^{-1} under normal sown condition (26th October), while lower number of siliquae plant^{-1}and number of seeds siliqua^{-1} was found under late sown condition (26th November). This might be due to high temperature during terminal stage. Moreover, the exposure to higher temperature during flowering and siliqua formation stage resulted in considerable reduction in number of siliquae plant^{-1} and number of seeds siliqua^{-1} with more severe flower and siliqua abscission.

Significantly higher number of siliquae plant^{-1}and number of seeds siliqaua^{-1} was observed in genotypes ACN-250, ACN-237 and ACN-226 which were superior over the checks (PM-26 and TAM 108-1) and other genotypes (ACN-244, SKM-1626, ACN-255, T-9 and ACN-240). The significantly highest number of siliquae plant^{-1}and number of seeds siliqua^{-1} was observed in genotype ACN-250 (350.83 and 17.11), whereas significantly lower number of siliquae plant^{-1} and number of seeds siliqua^{-1} was observed in genotype ACN-240 (126.67 and 9.16). This might be due to their genetic potential when compared with remaining genotypes studied.

Kumar *et al.* (2018) reported higher number of siliquae plant^{-1} and number of seeds siliqua^{-1} in genotype RH-0116 and minimum in RH-1019. This might be because of variation in different genotypes in their genetic makeup.

Results revealed that significantly highest number of siliquae plant^{-1} and number of seeds siliqua^{-1} was recorded at 30th October sowing (D_1) with genotype ACN-250 (G_5), while lower number siliquae plant^{-1}and number of seeds siliqua^{-1} was found in 30th November sowing (D_2) with genotype ACN-240 (G_1).

Correlation studies revealed highly significant and positive association of number of siliquae plant^{-1} and number of seeds siliqua^{-1} with seed yield (0.937** and 964**). Uke *et al.* (2011), Raut *et al.*(2012) and Dhongade *et al.* (2019)

also reported significantly positive association of number of siliquae plant^{-1} and number of seeds siliqua^{-1} with seed yield in mustard.

Test weight

Significantly higher test weight was noticed at 1stdate of sowing i.e. 30th October (4.63 g) as compared to 2nd date of sowing i.e. 30th November (3.21 g). This might be due to higher interception of PAR on leaf canopy during 30th October sowing as compared to 30th November sowing which helps in assembling better source sink relationship.

Jain *et al.* (2019) investigated the radiation interception and growth dynamics in mustard under different dates of sowing. They found that the PAR interception was higher in 10th October sowing as compared to 5th November and 1st December sowing at the flowering and siliqua formation stage. This might be due to higher leaf area index under 10th October sowing. The PAR interception by the canopy influences the leaf photosynthesis efficiency as well as source to sink strength of the photosynthetic system leads to higher accumulation of assimilates to the sink.

Significantly higher test weight was recorded in genotypes ACN-250, ACN-237 and ACN-226 when compared with checks (PM-26 and TAM 108-1) and other genotypes (SKM-1626, ACN-244, ACN-255, T-9 and ACN-240).Significantly highest test weight was recorded in genotype ACN-250 (5.98 g) might be due to their genetic behaviour and better source sink system to produce high quality seeds. While, significantly lower test weight was found in genotype ACN-240 (1.71 g) might be due to their lower genetic potential when compared with other genotypes.

Patel *et al.* (2017) conducted an experiment to study the effect of different sowing dates on growth of Indian mustard varieties. They reported that the variety Varuna produced higher value of seed as compared to Narendra Rai-1 and Kranti which might be due to aggressive growth characters and better source sink relationship.

Among the interactions significantly highest test weight was observed during 30th October sowing (D_1) with genotype ACN-250 (G_5), while significantly lower test weight was found at 30th November sowing (D_2) with genotype ACN-240 (G_1).

Highly significant and positive correlation was observed in test weight with seed yield (0.949**). Raut *et al.* (2012) and Dhongade *et al.* (2019) had also noted a positive and significant association of test weight with seed yield in mustard.

Seed yield ha^{-1}

Seed yield ha^{-1} was significantly highest in 30th October sowing (14.23 q) when compared with 30th November sowing (10.56 q) This might be due to reason that early sowing facilitates optimum environmental conditions for better crop growth in terms of maximum assimilating surface (leaf area) that enhances the rate of photosynthesis which led to higher dry matter accumulation, higher plant height, more number of branches plant^{-1} and ultimately resulted into higher seed yield.The greenness of the leaf generally considered to be a parameter contributing to yield ability of cultivar. Leaves constitute most important aerial organ of the plants, playing the major role in the anabolic activities through chlorophyll pigments and photosynthetic system. There was significant increase in chlorophyll content, nitrogen, phosphorus and potassium content in leaves which were observed during 1st date of sowing (30th October) which might increase the yield in present investigation.

Keerthi *et al.* (2017) tested the Indian mustard (*Brassica juncea* L.) genotype RH-749 having four different dates of sowing *viz.,* 15th October, 25th October, 5th November and 15th November for yield attributes, yield and quality. They reported that early (October 15th and 25th) sown crop received the optimum environmental conditions required for better crop growth in terms of higher dry matter accumulation and maximum number of seeds siliqua^{-1} led to higher seed yield. Whereas, late (November 5th and 15th) sown crop expose to higher temperature at the time of harvesting resulted into less number of primary and secondary branches and siliquae plant^{-1} led to lower seed yield.

Significantly higher seed yield ha^{-1} was reported in genotypes ACN-205, ACN-237 and ACN-226 as compared to checks (PM-26 and TAM 108-1) and other genotypes (ACN-244, SKM-1626, ACN-255, T-9 and ACN-244).Data revealed that significantly highest seed yield ha^{-1} was found in genotype ACN-250 (16.54 q) than other genotypes, while significantly lower in genotype ACN-240 (8.82 q). This might be due to genetic potential of genotype ACN-250 to produce higher leaf area which enhances the photosynthetic rate, dry matter accumulation and ultimately yield of the crop.

Jiotode *et al.* (2017) reported that different varieties had significant influenced on the seed yield. The variety V1 (Pusa Bold) recorded higher seed yield than V2 (ACN-9). This might be due to variety-to-variety variation between their genetic potential to produce more seed yield.

Among the interactions significantly highest seed yield ha^{-1} was recorded at 30th October sowing (D_1) with genotype ACN-250 (G_5), while lower in 30th November sowing (D_2) with genotype ACN-240 (G_1).

Table 1.Effectivity of different sowing dates on chlorophyll and nitrogen content in leaves in mustard genotypes

Sowing Date	Leaf chlorophyll content (mg g^{-1}) at 25 DAS			Leaf chlorophyll content (mg g^{-1}) at 45 DAS			Leaf chlorophyll content (mg g^{-1}) at 65 DAS			Leaf nitrogen content (%) at 25 DAS			Leaf nitrogen content (%) at 45 DAS			Leaf nitrogen content (%) at 65 DAS		
Genotypes	**D_1**	**D_2**	**Mean(G)**	**D_1**	**D_2**	**Mean(G)**	**D_1**	**D_2**	**Mean(G)**	**D_1**	**D_2**	**Mean(G)**	**D_1**	**D_2**	**Mean(G)**	**D_1**	**D_2**	**Mean(G)**
ACN-240 (G_1)	0.359	0.202	0.280	0.961	0.722	0.841	0.816	0.546	0.681	2.27	1.50	1.89	2.81	1.36	1.77	2.07	1.23	1.66
SKM-1626 (G_2)	0.651	0.318	0.484	1.569	1.108	1.340	1.216	1.014	1.120	3.14	2.26	2.70	3.05	2.11	2.59	2.91	1.98	2.45
ACN-226 (G_3)	0.864	0.569	0.720	1.727	1.413	1.570	1.485	1.378	1.431	3.58	2.99	3.29	3.47	2.87	3.17	3.35	2.76	3.06
ACN-244 (G_4)	0.426	0.383	0.410	1.192	1.235	1.213	1.099	1.173	1.140	2.96	2.40	2.68	2.84	2.29	2.57	2.71	2.18	2.45
ACN-250 (G_5)	0.968	0.671	0.820	2.001	1.700	1.850	1.811	1.493	1.652	3.87	3.26	3.57	3.76	3.16	3.47	3.64	3.05	3.35
ACN-255(G_6)	0.402	0.275	0.340	1.166	0.935	1.050	0.990	0.811	0.900	2.64	2.01	2.33	2.53	1.91	2.22	2.42	1.82	2.13
T-9(G_7)	0.561	0.221	0.391	1.376	0.892	1.134	1.154	0.614	0.884	2.78	1.86	2.32	2.67	1.73	2.20	2.55	1.60	2.08
ACN-237 (G_8)	0.896	0.607	0.751	1.807	1.592	1.700	1.601	1.432	1.520	3.74	3.10	3.42	3.62	2.99	3.31	3.50	2.89	3.20
PM-26 (G_9)	0.815	0.520	0.670	1.672	1.381	1.530	1.388	1.300	1.344	3.39	2.75	3.07	3.27	2.64	2.96	3.16	2.54	2.86
TAM 108-1 (G_{10})	0.730	0.426	0.580	1.628	1.303	1.470	1.279	1.220	1.250	3.27	2.58	2.93	3.16	2.49	2.83	3.07	2.37	2.72
Mean (D)	0.667	0.419		1.510	1.228		1.284	1.098		3.16	2.47		3.05	2.35		2.07	1.23	
	D	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**
SEm ±	**0.010**	**0.022**	**0.038**	**0.019**	**0.042**	**0.073**	**0.021**	**0.048**	**0.084**	**0.063**	**0.142**	**-**	**0.062**	**0.139**	**-**	**0.061**	**0.137**	**-**
CD at 5%	**0.028**	**0.064**	**0.111**	**0.054**	**0.121**	**0.211**	**0.062**	**0.139**	**0.241**	**0.182**	**0.408**	**-**	**0.178**	**0.399**	**-**	**0.176**	**0.395**	**-**

D_1 = 1st Date of sowing (30th October), D_2 = 2nd Date of sowing (30th November), G = Genotype, D = Date of sowing

Table 2.Effectivity of different sowing dates on phosphorus and potassium content in leaves in mustard genotypes

Sowing Date	Leaf phosphorus content (%) at 25 DAS			Leaf phosphorus content (%) at 45 DAS			Leaf phosphorus content (%) at 65 DAS			Leaf potassium content (%) at 25 DAS			Leaf potassium content (%) at 45 DAS			Leaf potassium content (%) at 65 DAS		
Genotypes	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)
ACN-240 (G_1)	0.16	0.11	0.14	0.21	0.14	0.18	0.19	0.13	0.16	0.48	0.33	0.41	1.09	0.81	0.95	0.81	0.70	0.76
SKM-1626 (G_2)	0.37	0.29	0.34	0.45	0.35	0.41	0.41	0.32	0.37	0.64	0.48	0.56	1.35	1.11	1.24	1.17	1.00	1.09
ACN-226 (G_3)	0.47	0.40	0.44	0.52	0.46	0.50	0.50	0.45	0.48	0.77	0.62	0.70	1.49	1.32	1.41	1.33	1.17	1.26
ACN-244 (G_4)	0.34	0.30	0.32	0.43	0.37	0.40	0.40	0.33	0.37	0.62	0.51	0.57	1.30	1.15	1.23	1.11	1.03	1.07
ACN-250 (G_5)	0.56	0.48	0.52	0.64	0.55	0.60	0.59	0.51	0.56	0.83	0.69	0.76	1.56	1.37	1.47	1.41	1.24	1.33
ACN-255(G_6)	0.30	0.25	0.28	0.38	0.33	0.36	0.35	0.29	0.33	0.54	0.43	0.49	1.16	1.04	1.11	0.96	0.91	0.94
T-9(G_7)	0.32	0.21	0.27	0.40	0.29	0.35	0.36	0.25	0.31	0.57	0.40	0.49	1.19	0.99	1.10	1.01	0.88	0.95
ACN-237 (G_8)	0.50	0.43	0.47	0.54	0.49	0.52	0.50	0.46	0.48	0.80	0.64	0.72	1.52	1.35	1.44	1.37	1.20	1.29
PM-26 (G_9)	0.45	0.41	0.43	0.52	0.46	0.49	0.47	0.45	0.47	0.72	0.59	0.66	1.44	1.25	1.35	1.28	1.14	1.21
TAM 108-1 (G_{10})	0.38	0.37	0.36	0.50	0.43	0.47	0.44	0.40	0.42	0.69	0.56	0.63	1.40	1.21	1.31	1.24	1.11	1.18
Mean (D)	0.38	0.32		0.46	0.39		0.42	0.36		0.66	0.52		1.35	1.16		1.17	1.04	
	D	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**
SEm ±	**0.0056**	**0.0125**	-	**0.0053**	**0.0120**	-	**0.0057**	**0.0127**	-	**0.0072**	**0.0162**	-	**0.0085**	**0.0190**	-	**0.0086**	**0.0192**	-
CD at 5%	**0.0160**	**0.0359**	-	**0.0153**	**0.0344**	-	**0.0163**	**0.0365**	-	**0.0208**	**0.0465**	-	**0.0244**	**0.0545**	-	**0.0246**	**0.0550**	-

D_1 = 1st Date of sowing (30th October), D_2 = 2nd Date of sowing (30th November), G = Genotype, D = Date of sowing

Table 3. Effectivity of different sowing dates on oil content, number of siliquae plant^{-1}, number of seeds siliqua^{-1}, test weight and seed yield ha^{-1}in mustard genotypes

Sowing Date	Oil content (%)			Number of silique plant^{-1}			Number of seeds silique^{-1}			Test weight (g)			Test weight (g)		
Genotypes	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)	D_1	D_2	Mean(G)
ACN-240 (G_1)	32.22	28.02	30.12	147.39	106.05	126.67	11.67	6.65	9.16	2.14	1.27	1.71	10.66	6.18	8.42
SKM-1626 (G_2)	37.79	32.82	35.31	250.67	144.33	197.50	15.45	10.32	12.89	4.17	2.46	3.32	13.73	8.73	11.23
ACN-226 (G_3)	40.91	37.58	39.25	306.34	266.32	286.33	17.56	14.76	16.16	5.44	3.89	4.67	14.67	12.61	13.64
ACN-244 (G_4)	36.86	33.82	35.34	200.34	201.66	201.00	14.23	12.54	13.39	3.67	3.03	3.36	12.98	10.02	11.51
ACN-250 (G_5)	44.55	38.70	41.63	385.06	316.62	350.83	18.65	15.56	17.11	7.04	4.90	5.98	18.63	14.43	16.54
ACN-255(G_6)	35.84	31.48	33.67	175.36	149.64	162.50	12.21	10.34	11.28	3.27	2.55	2.91	12.40	9.29	10.85
T-9(G_7)	35.09	30.80	32.95	208.30	108.60	158.50	14.78	7.21	11.00	3.63	2.03	2.83	13.11	7.55	10.33
ACN-237 (G_8)	43.80	38.24	41.03	318.66	289.34	304.00	17.99	14.99	16.50	6.14	4.98	5.57	17.68	13.29	15.49
PM-26 (G_9)	40.34	36.95	38.65	289.34	241.03	265.17	16.76	13.67	15.22	5.97	3.06	4.52	14.49	12.20	13.35
TAM 108-1 (G_{10})	39.89	36.77	38.33	273.60	217.30	245.50	15.98	12.78	14.39	4.86	3.98	4.42	13.99	11.34	12.67
Mean (D)	38.73	34.52		255.54	204.10		15.52	11.88		4.63	3.21		14.23	10.56	
	D	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**	**D**	**G**	**D×G**
SEm ±	**0.154**	**0.344**	**0.596**	**4.32**	**9.66**	**16.74**	**0.26**	**0.58**	**1.01**	**0.093**	**0.209**	**0.363**	**0.18**	**0.41**	**0.71**
CD at 5%	**0.441**	**0.986**	**1.708**	**12.37**	**27.67**	**47.93**	**0.75**	**1.68**	**2.91**	**0.268**	**0.600**	**1.039**	**0.52**	**1.18**	**2.04**

D_1 = 1st Date of sowing (30th October), D_2 = 2nd Date of sowing (30th November), G = Genotype, D = Date of sowing

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