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Annals of Biological Research, 2012, 3 (8):4039-4044
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Morphological traits of Indian mustard (Brasica juncea (L.) as influenced by sowing date and manure fertilizers

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ABSTRACT

To investigate the effect of sowing date and manure fertilizers on morphological traits of indian mustard (Brasica juncea L.) , an experiment was carried out at the field experiment of ghazvin, iran. A factorial experiment based on randomized complete blocks design (RCBD) with three replications was followed in the study. Results represented that morpholological traits were significantly affected by different sowing dates and manure fertilizers. the highest and lowest plant height was gained by sowing date of 1th October and 1th November. sowing date of 11th October, 21th October and 1th November decreased 20.26%, 40.53% and 60.98% on plant height in compare with sowing date of 1th October. maximum and the lowest branch number was gained by application of 45 ton/ha manure fertilizer and non-application of manure fertilizer treatment. utilization of 15 ton/ha, 30 ton/ha and 45 ton/ha manure fertilizers increased 11.65%, 19.74% and 24.91% on branch number in compare with control. Sowing date of 11th October, 21th October and 1th November decreased 18.31%, 36.37% and 55.57% on stem diameter in compare with sowing date of 1th October. Means comparison of interaction between sowing date and manure fertilizer treatment represented that in sowing date of 1th October, application of 30 ton/ha and 45 ton/ha manure fertilizer had similar effect on pod length however maximum of pod length was obtained by sowing date of 1th October together with application of 45 ton/ha manure fertilizer. the lowest pod length was witnessed by sowing date of 1th November and non-application of manure fertilizer.

Keywords: indian mustard, sowing date, manure fertilizer, morphological traits,

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INTRODUCTION

Rapeseed and mustard belong to Cruciferae family and genus *Brassica*. Rapeseed is locally called as sarson, toria, yellow toria, whereas,. Though, rapeseed and mustard belong to the same family and genus, they differ with respect to their plant characteristics. Rapeseed is a herbaceous annual plant. The height of the plant ranges between 45 and 150 cm. The stems are generally covered with a waxy deposit. Plants are easily distinguished from mustard (rai) plants by the character of leaves. In rapeseed, leaves are borne sessile and are glabrous and hairy. The lower part of the blade (lamina) grasps the stalk partially or completely. Fruits are thicker than those of mustard (rai) and are

laterally compressed with a beak one third to half of their length. Seeds are either yellow or brown with a smooth seed coat. Mustard is cultivated in mostly under temperate climates. It is also grown in certain tropical and subtropical regions as a cold weather crop. Indian mustard (*Brassica juncea L.)* reported to tolerate annual precipitation of 500 to 4200 mm, annual temperature of 6 to 27◦ C, and pH of 4.3 to 8.3. Rapeseed-mustard follows C3 pathway for carbon assimilation. Therefore, it has efficient photosynthetic response at 15–20◦C temperature. At this temperature the plant achieve maximum CO2 exchange range which declines thereafter. For successful production of crop many factors, such as, quality seed, weed control, proper fertilization, irrigation, method of sowing, optimum sowing time, seed rate, and time of harvest are indispensable. Yield decreases progressively with the delay in planting from optimum time of sowing (Cane, 1949). Environmental factors greatly affect plant growth and yield. Sowing date is an important determinant of crop yield. Sowing date depends on the onset of significant rainfall, temperature and humidity of a region. Decreasing crop yield in delayed sowing date has been reported by many workers (Kohn & Storrier, 1970, Doly & Marcellos, 1974; Degenhardt & Kondra, 1981; McDonald *et al*., 1983). Organic soil amendments, such as legume green manures, cover crops, animal manures, and composts, are fundamental components of low-external-input cropping systems that may also be valuable for weed management (Liebman and Davis 2000). Traditionally, one of the most common uses of organic soil amendments has been as a means of increasing soil fertility and improving soil physical characteristics (Pieters 1927). Fertilization increases total biomass production in the field, and that can occur as either increased crop or weed biomass or both. Many weed species are more effective than crops in capturing nutrients added as fertilizers (Blackshaw et al. 2003; DiTomaso 1995), so addition of fertilizer can sometimes reduce crop yield if it increases weed growth and competition more than it increases crop growth. On the other hand, in some situations crops can be more efficient in taking up fertilizers than weeds (Dhima and Eleftherohorinos 2001; Jørnsgard et al. 1996). . the aims of this research were assessment of relationships among morphological traits and application of different levels of manure fertilizer in different sowing date

MATERIAL AND METHODS

This experiment was carried out in 2009-2010 at the field experiment of ghazvin (36°18´N and 49°57´E; 1314 elevation). The pH of soil field experiment was 7.8 with sandy loam texture ,physical and chemical properties of soil in experimental field were presented in (table 1). Experiment was conducted in factorial within a randomized complete block design with three replications. Sowing date in 4 levels included: 1th October, 11th October, 21th October and 1th November together with 4 level of manure fertilizer: non-application, utilization of 15 ton/ha, 30 ton/ha and 45 ton/ha manure fertilizer was conducted in this experiment. Seeds were sown at depth of 3 to 4 cm. weed control was conducted during growing season. All operations were done regularly during the growing season. Morphological characteristics including plant height, branch number, stem diameter, pod length, secondary pod length and primary pod length were determined. Data analysis was done by using SAS .The ANOVA test was used to determine significant ($p\leq0.01$ or $p\leq0.05$) treatment effect and Duncan Multiple Range Test to determine significant difference between individual means.

RESULTS AND DISCUSSION

Plant height

Results indicated that plant height was significantly affected by sowing dates and manure fertilizers. Interaction between treatments had significant effect on this morphological trait (table 2). means comparison (table 3) indicated that the highest and lowest plant height was gained by sowing date of 1th October and 1th November. sowing date of 11th October, 21th October and 1th November decreased 20.26%, 40.53% and 60.98% on plant height in compare with sowing date of 1th October. means comparison (table 3) represented that there was significant difference between application of manure fertilizers on plant height. Maximum and the lowest plant height was obtained by utilization of 45 ton/ha and non-application of manure fertilizer treatments. Utilization of 45 ton/ha, 30 ton/ha and 15 ton/ha manure fertilizers increased 33.52%, 27.46% and 17.69% on plant height in compare with control (non-application of manure fertilizer) (table 3). Means comparison of Interaction between application of manure fertilizers and sowing date (table 4) showed that however application of 30 ton/ha and 45 ton /ha manure fertilizers had similar effect on plant height in the first sowing date (1th October) but the highest plant height was obtained by utilization of 45 ton/ha manure fertilizer in sowing date of 1th October . the lowest plant height was witnessed in sowing date of 1th November and non-application of manure fertilizer treatment (table 4).In Bathinda (Punjab), Butter and Aulakh (1999) conducted a field experiment and reported that plant height was higher with early sowing of 25th October. In Jodhpur, Raj Singh *et al*. (2001) observed that crop sown on October second week recorded

significantly higher plant height (188 cm) as compared to November first week (17 cm). Khichar *et al.* (2000) reported that greater plant height was recorded from 20th October sowing (185 cm). In Faizabad (Uttar Pradesh), Singh and Singh (2002) conducted a field experiment suggested that higher plant height recorded with October sowing as compared to 29th October, 13th November and 28th November sowing. In Ludhiana, Angrej Singh *et al.* (2002) conducted a experiment in sandy loam soil and quoted that early sowing on 10th and 30th October recorded higher plant height as compared with 20th November and 10th December sowings.

Branch number

(Table 2) represented that different level of manure fertilizers and sowing date had significant effect on branch number however interaction between application of manure fertilizer and sowing date wasn't significant. according to means comparison of sowing date treatments (table 3) , the highest and lowest branch number was obtained by sowing date of 1th November and 1th October and sowing dates of 11th October, 21th October and 1th November decreased 24.82%, 49.30% and 69.85% on branch number in compare with sowing date of 1th October. branch number was significantly affected by utilization of manure fertilizers and means comparison of fertilizer treatments (table 3) indicated that maximum and the lowest branch number was gained by application of 45 ton/ha manure fertilizer and non-application of manure fertilizer treatment. utilization of 15 ton/ha, 30 ton/ha and 45 ton/ha manure fertilizers increased 11.65%, 19.74% and 24.91% on branch number in compare with control (non-application of manure fertilizer treatment) (table 3). Anil Kumar *et al.* (2004) conducted an experiment at Bawat, Haryana and quoted that crop sown on 21st October recorded higher number of primary and secondary branches per plant as compared to 7th and 17th October sowing. In New Delhi at Indian Agricultural Research Institute, Panda *et al.* (2004) suggested that delayed sowing beyond 16th October reduced the number of primary and secondary branches per plant. In Kangra (Himachal Pradesh), Thakur and Singh (1998) reported that number of primary and secondary branches per plant recorded higher under 5th October sowing (6.7 and 14.1) as compared to 19th November sowing (5.5 and 7.7 branches/plant). In Bathinda (Punjab), Buttar and Aulakh (1999) quoted that the number of secondary branches per plant were higher with early sowing of 25th October.

Stem diameter

Results indicated that showed that stem diameter was significantly affected by application of different manure fertilizer and sowing date and interaction between treatments was significant (table 2). according to means comparison of sowing date treatments (table 3), different sowing dates had significant effect on stem diameter. Maximum and the lowest stem diameter was gained by sowing date of 1th October and 1th November. Sowing date of 11th October, 21th October and 1th November decreased 18.31%, 36.37% and 55.57% on stem diameter in compare with sowing date of 1th October (table 3). means comparison of manure fertilizer treatments (table 3) indicated that different level of manure fertilizers had significant effect on stem diameter. the highest and lowest stem diameter was obtained by utilization of 45 ton/ha manure fertilizer and non-application of manure fertilizer treatment (control). utilization of 15 ton/ha, 30 ton/ha and 45 ton/ha manure fertilizer increased 17.72%, 24.82% and 28.67% on stem diameter in compare with control (non-application of manure fertilizer treatment) (table 3). means comparison of Interaction between application of manure fertilizers and sowing dates (table 4) represented that however there wasn't significant difference between application of 30 ton/ha and 45 ton/ha manure fertilizers on stem diameter in sowing date of 1th October but maximum of stem diameter was obtained by sowing date of 1th October together with utilization of 45 ton/ha manure fertilizer. the lowest stem diameter was witnessed in sowing date of 1th November and non-application of manure fertilizer (table 4).

Pod length

(table 2) indicated that different levels of manure fertilizer and sowing date had significant effect on pod length and interaction between treatments was significant. Means comparison of sowing date treatments (table 3) represented that this morphological trait was significantly affected by sowing dates. The highest and lowest pond length was obtained by sowing date of 1th October and 1th November. sowing date of 11th October, 21th October and 1th November decreased 22.19%, 49.46% and 75.26% on pod length in compare with sowing date of 1th October (table 3). Means comparison of manure fertilizer treatment (table 3) indicated that different levels of manure fertilizer had significant effect on pod length. Maximum and the lowest pod length was gained by utilization of 30 ton/ha manure fertilizer and non-application of manure fertilizer treatment. Utilization of 15 ton/ha, 30 ton/ha and 45 ton/ha manure fertilizer increased 22.22%, 35.49% and 43.25% on pod length in compare with control (non-application of manure fertilizer treatment) (table 3). Means comparison of interaction between sowing date and manure fertilizer treatment (table 4) represented that in sowing date of 1th October, application of 30 ton/ha and 45 ton/ha manure fertilizer had similar effect on pod length however maximum of pod length was obtained by sowing date of 1th October together

with application of 45 ton/ha manure fertilizer. the lowest pod length was witnessed by sowing date of 1th November and non-application of manure fertilizer (table 4).

Secondary pod length

Results showed that secondary pod length was significantly affected by different sowing dates and manure fertilizer treatments. Interaction between different levels of manure fertilizer and sowing date was significant (table 2). According to means comparison of sowing date treatment (table 3), sowing date had significant effect on secondary pod length. maximum and the lowest secondary pod length was obtained by sowing date of 1th October and 1th November. Delay with sowing date reduced secondary pod length .sowing date of 11th October, 21th October and 1th November decreased 22.18%, 47.78% and 77.81% on secondary pod length in compare with sowing date of 1th October (table 3). Means comparison of manure fertilizer treatment (table 3) represented that different levels of manure fertilizer had significant effect on secondary pod length. The highest and lowest secondary pod length was gained by utilization of 30 ton/ha manure fertilizer and non-application of manure fertilizer treatments. Utilization of 15 ton/ha, 30 ton/ha and 45 ton/ha manure fertilizer increased 24.82%, 37.93% and 46.96% on secondary pod length in compare with control (non-application of manure fertilizer treatment) (table 3). According to means comparison of interaction between treatments (table 4), there wasn't significant difference between application of 30 ton/ha and 45 ton/ha manure fertilizers on secondary pod length in different sowing dates however the highest secondary pod length was obtained by sowing date of 1th October together with application of 45 ton/ha manure fertilizer. The lowest secondary pod length was witnessed by sowing date of 1th November and non-application of manure fertilizer (table 4).

Primary pod length

result represented that different levels of manure fertilizer and sowing dates had significant effect on primary pod length. Interaction between treatments was significant (table 2). Means comparison of sowing date treatments (table 3) indicated that primary pod length was significantly affected by different sowing dates. the highest and lowest primary pod length was obtained by sowing date of 1th October and 1th November. Sowing date of 11th October, 21th October and 1th November decreased 22.38%, 50.74% and 73.13% on primary pod length in compare with sowing date of 1th November (table 3). According to means comparison between manure fertilizer treatments (table 3), different levels of manure fertilizer had significant effect on primary pod length. Maximum and the lowest primary pod length was gained by application of 30 ton/ha manure fertilizer and non-application of manure fertilizer treatment. Utilization of 15 ton/ha, 30 ton/ha and 45 ton/ha manure fertilizer increased 19.76%, 33.72% and 40.69% on primary pod length in compare with control (non-application of manure fertilizer treatment) (table 3). According to Means comparison of interaction between treatments (table 4) in sowing date of 1th October, utilization of 30 ton/ha and 45 ton/ha manure fertilizer had similar effect on primary pod length and maximum of primary pod length was obtained by sowing date of 1th October together with application of 45 ton/ha manure fertilizers. The lowest primary pod length was witnessed by sowing date of 1th November and non-application of manure fertilizer (table 4). Singh (2002) reported that length of siliqua recorded higher when crop sown on 14th October as compared to 29th October, 13th November and 28th November sown crop.

Table 1. physical and chemical features of soil test

OC (%)	EC (dS/m)	pH	Oc (%)	K (ppm)	P (ppm)	texture	sand (%)	silt (%)	clay (%)
0.83	1.33	7.8	0.07	165	14.2	Sandy-loam	26	45	29

Table 2. Analysis of variance for measured traits in indian mustard (Brasica juncea (L.)

S.O.V	DF	Plant height	Branch number	Stem diameter	Pod length	Secondary pod length	Primary pod length
Replication (r)	2	184.047**	3.252**	3.020**	3.170**	2.627**	3.607**
Sowing date (d)	3	25597.547**	55.732**	92.252**	79.071**	72.342**	86.313**
Manure fertilizer (m)	3	2695.032**	5.387**	9.905**	6.784**	6.562**	7.148**
d × m	9	18.506**	0.035ns	0.070*	0.069*	0.060*	0.139*
Error	30	10.124	0.039	0.050	0.028	0.038	0.031
Cv	-	2.60	4.29	2.64	3.34	4.23	3.34

*ns= Non significant, ** = p < 0.01 and * = p < 0.05*

table 3 .Means comparison of effects of sowing date and manure fertilizer treatments on morphological traits of indian mustard (Brasica juncea (L.)

treatments		plant height (cm)	Branch number (No.plant^{-1})	Stem diameter (mm)	Pod length (cm)	Secondary pod length (cm)	Primary pod length (cm)
Sowing dates (d)	1th October (d1)	175.9a	7.150a	11.63a	7.850a	7.325a	8.375a
	11th October (d2)	140.6b	5.375b	9.50b	6.108b	5.70b	6.50b
	21th October (d3)	104.6c	3.625c	7.40c	3.967c	3.825c	4.125c
	1th November (d4)	68.63d	2.175d	5.167d	1.942d	1.625d	2.25d
Manure fertilizers (m)	Non-application(m1)	102.3d	3.675d	7.150d	3.967d	3.625d	4.30d
	15 ton/ha (m2)	120.4c	4.50c	8.147c	4.842c	4.525c	5.150c
	30 ton/ha (m3)	130.4b	4.95b	8.925b	5.375a	5.00a	5.75a
	45 ton/ha (m4)	136.6a	5.20a	9.20a	5.683b	5.325b	6.05b

table 4 .Means comparison of interaction between sowing date and manure fertilizer on morphological traits of indian mustard (Brasica juncea (L.)

Interaction between treatment Sowing date (d) × manure fertilizer (m)		plant height (cm)	Branch number (No.plant^{-1})	Stem diameter (mm)	Pod length (cm)	Secondary pod length (cm)	Primary pod length (cm)
1th October (d1)	Non-application (m1)	152.6c	6.200c	10.40c	7.10c	6.60c	7.60c
	15 ton/ha (m2)	175.2b	7.100b	11.70b	7.733b	7.20b	8.30b
	30 ton/ha (m3)	186.4a	7.600a	12.10a	8.167a	7.60a	8.70a
	45 ton/ha (m4)	189.3a	7.700a	12.30a	8.40a	7.90a	8.90a
11th October (d2)	Non-application (m1)	121.3e	4.300f	8.40f	4.90f	4.70f	5.10f
	15 ton/ha (m2)	140.9d	5.300e	9.50e	5.967e	5.60e	6.30e
	30 ton/ha (m3)	147.6c	5.800d	9.90d	6.60d	6.10d	7.10d
	45 ton/ha (m4)	152.5c	6.100cd	10.20cd	6.967c	6.40cd	7.50c
21th October (d3)	Non-application (m1)	83.70h	2.900i	6.20i	2.833i	2.60i	3.10i
	15 ton/ha (m2)	101.3g	3.500h	7.30h	3.867h	3.80h	3.90h
	30 ton/ha (m3)	112.2f	3.900g	7.90g	3.433g	4.30g	4.60g
	45 ton/ha (m4)	121.1e	4.200fg	8.20fg	4.733f	4.60fg	4.90f
1th November (d4)	Non-application (m1)	51.50k	1.300l	3.60l	1.033l	0.60l	1.40l
	15 ton/ha (m2)	64.30j	2.100k	5.167k	1.80k	1.50k	2.10k
	30 ton/ha (m3)	75.20i	2.500j	5.80j	2.30j	2.0j	2.60j
	45 ton/ha (m4)	83.50h	2.800ij	6.10ij	2.635i	2.40i	2.90i

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