INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2001/03–2–214–216
http://www.ijab.org

Biological Expression of Raya (*Brassica juncea* L.) Grown Under Different Planting Patterns and Inter-Plant Spacing

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ABSTRACT

Effects of different planting patterns (30 cm apart single rows, 45 cm apart single rows, 40/20 cm apart paired rows, 60/30 cm apart paired rows) and inter-plant spacings (10, 15 and 20 cm) on growth, seed and oil yield of Raya (*B. juncea* L.) were studied at the Agronomic Research Area, University of Agriculture, Faisalabad during 1999/2000 on a sandy clay loam soil. Number of plants (m^{-2}), plant height at maturity (cm), number of pods $plant^{-1}$, 1000-seed weight and seed oil content were significantly affected both by varying planting pattern and inter plant spacing. However, varying inter-plant spacing had non-significant effect on seed yield ha^{-1}. While, the inter-active effect of planting pattern and inter-plant spacing was only found to be significant on number of plants m^{-2}, seed yield (t ha^{-1}) and seed oil content (%).

Key Words: Raya planting; Inter-plant spacing; Seed yield; Seed oil content

INTRODUCTION

Next to food grain crops, oil seeds claim highest share in the world's economy. Oil seed crops are cultivated all over the world for edible and non-edible purposes. Rapeseed and mustards play an important role in oil seed production as they are the major group of winter oil seed crops and contribute about 21% in the domestic edible oil production (Anonymous, 1997). Domestic edible oil production from all sources has grown at a rate of 2.56% annually over the last 24 years; whereas, the domestic oil consumption is increasing at an annual rate of 9.0% (Anonymous, 1999). Assuming the present growth rate and huge consumption of edible oil, it is imperative to enhance domestic oil production either by modifying traditional methods of cultivation or by including traditional oil-seeds with greater yield potential and wider adaptability to agro-climatic conditions. Among traditional oil seeds, rapeseed and mustards play an important role in oil seed production and hold good promise. Of the many agronomic factors responsible for realizing good yields, appropriate plant population and its adjustment over the field are of prime importance.

Singh *et al*. (1985) compared two mustard cultivars planted at spacings of 30 x 10, 30 x 20, 60 x 10 and 60 x 20 cm. The maximum seed yield ha^{-1} was obtained, when it was planted at spacing of 30 x 20 and 60 x 10 cm. All yield components were improved significantly with increase in plant spacing from 300-1200 cm^2 $plant^{-1}$. Similarly, Guo and Yuan (1987) reported that number of filled pods per plant of rape decreased significantly with increase in plant population. But contrary to this, Chaudhary and Maukar (1991) recorded the highest seed yield of 1.27 t ha^{-1}, when mustard crop was sown in 30 cm apart rows compared with 1.13 t ha^{-1} produced from 45 cm apart rows. Seed yield was significantly reduced when inter-row spacing was increased. Similarly, Misra and Rana (1992) planted *B. napus* var. Sarson in rows 30, 45 or 60 cm apart and reported that seed yield decreased with increase in row spacing. Seed oil content and 1000-seed weight were, however, not significantly affected by row spacing. Whereas, Reddy and Naryana (1994) planted *B. juncea* cv. Varuna in rows, 20, 30 or 40 cm apart and reported that seed yield was not affected by different spacings. While, Dosdall *et al*. (1998) grew rape *(B. napus*) at three row spacings (10, 20 or 30 cm) and reported that at wider row spacings (20 and 30 cm) had less root damage and higher yields than at the narrowest spacing (10 cm).

MATERIALS AND METHODS

Experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during 1999-2000. The seed of Raya cv. Anmol was sown on a well prepared seed bed on October 14, 1999 using RCBD in split-plot arrangement with seed rate 5 kg ha^{-1}. Four planting patterns viz. 30 cm apart single rows, 45 cm apart single rows, 40/20 cm apart paired rows and 60/30 cm apart paired rows were randomized in the main plots and three inter-plant spacings viz. 10, 15 and 20 cm were super imposed as sub-plot treatment. The field was fertilized at the rate of 80 kg ha^{-1} each of N and P_2O_5, respectively. All phosphorus and half nitrogen were applied as a basal dose at the time of sowing, while the remaining nitrogen was applied with first irrigation (40 days after sowing). Two irrigations were applied during the growth period of the crop (40 and 70 days after sowing). All other cultural and plant protection measures were followed as per standard recommendations. The crop was harvested on March 10, 2000 and threshed manually. The data collected were analyzed statistically by using Fisher's analysis of variance technique and least significant difference (LSD) test at 0.05 probability level was employed to compare the differences among the treatment means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Both planting pattern and inter-plant spacing individually and in combination significantly affected number of plants m^{-2} (Table I). Crop sown in 30 cm apart single rows or 40/20 cm apart paired rows produced significantly higher number of plants m^{-2} than the crop grown in 45 cm apart single rows or 60/30 cm apart paired rows. Increasing the inter-plant distance resulted in a decrease in number of plants m^{-2} (Table I). Different combinations of planting pattern and inter-plant spacing had also significant effect on number of plants m^{-2}. The treatments where crop was sown in 30 cm apart single rows with 10 cm inter-plant spacing or one sown in 40/20 cm apart paired rows with 10 cm inter-plant spacing being statistically at par, produced the maximum plants and differed significantly from rest of all the combinations. Generally, it was observed that wider the spacing lower the number of plants m^{-2} and vice versa. Both planting patterns and inter-plant spacing also affected significantly plant height. However their inter-action was found to be non-significant (Table I).

Crop sown in 45 cm apart single rows gave statistically higher plant height than the other planting patterns, which were statistically at par with each other (Table I). Increasing inter-plant spacing reduced plant height. Increased plant height in narrow inter-plant spacing could be attributed towards the plant competition for resources under these situations leading to taller plants as a result of malnutrition.

Planting patterns and inter plant spacing produced highly significant effect on number of pods $plant^{-1}$, however, interaction between planting pattern and inter plant spacing was found to be non significant. Highest number of pods $plant^{-1}$ was recorded in plots where crop was sown in 60/30 cm apart paired rows (Table I). An inter plant spacing of 20 cm gave statistically highest number of pods $plant^{-1}$. At wider row spacing, relatively competition free environments prevail, hence more resources like nutrients, light, space etc. are available $plant^{-1}$. Roy and Paul (1991) also reported that number of pods $plant^{-1}$ decreased with increasing stand density.

Both planting patterns and inter-plant spacing individually affected significantly 1000-seed weight while the inter-active effect on the parameter under question was found to be non-significant (Table I). Crop sown in 40/20 cm apart paired rows produced the heaviest seeds. Raya crop planted in 15 or 20 cm inter-plant spacing produced seeds which were statistically similar in 1000-seed weight (3.73 and 3.61 g, respectively) but differed significantly from that produced by the crop sown with 10 cm inter plant spacing (Table I). Gupta (1988) reported that 1000-seed weight was significantly influenced; whereas, Misra and Rana (1992) reported that 1000-seed weight was not significantly affected by row spacing in mustard.

Planting patterns and inter-action between planting pattern with inter plant spacing affected significantly seed yield (t ha^{-1}) while it was not affected by changing inter plant spacing (Table I). Statistically similar seed yield was obtained in plots where crop was sown in 40/20 cm or 60/30

Table I. Growth, seed and oil yield of Raya (*Brassica juncea* L.) as affected by different planting patterns and inter-plant spacing

Treatments	Number of plants m^{-2}	Plant height (cm)	Number of pods $plant^{-1}$	1000-seed weight (g)	Seed yield (t ha^{-1})	Seed oil (%) content
a. Planting pattern (P)						
P_1 = 30 cm apart single rows	25.92a	176.22b	402.56c	3.54bc	1.65a	43.16b
P_2 = 45 cm apart single rows	17.34b	178.89a	483.56b	3.42c	1.48b	43.31b
P_3 = 40/20 cm apart paired rows	26.21a	175.33b	475.67b	3.86a	1.69a	43.24b
P_4 = 60/30 cm apart paired rows	17.45b	175.11b	532.89a	3.65ab	1.66a	43.70a
b. Inter plant spacing (S)						
S_1 = 10 cm	29.55a	176.42ab	415.17b	3.51b	1.64 (NS)	43.23b
S_2 = 15 cm	19.95b	179.25a	475.00ab	3.73a	1.61	43.44a
S_3 = 20 cm	15.69c	173.50b	530.83a	3.61ab	1.61	43.39a
c. Planting pattern x inter-plant spacing (PXS)						
P_1S_1	35.22a	174.33 (NS)	298.00 (NS)	3.49 (NS)	1.63d	43.00ef
P_1S_2	23.59b	182.00	370.67	3.59	1.52e	43.18def
P_1S_3	18.96c	172.33	539.00	3.54	1.80a	43.29de
P_2S_1	23.51b	180.67	460.67	3.38	1.53e	43.19def
P_2S_2	10.10d	180.67	484.67	3.59	1.47e	43.81ab
P_2S_3	12.40e	175.33	505.33	3.28	1.46e	42.94f
P_3S_1	35.85a	175.00	474.00	3.59	1.66d	43.37cd
P_3S_2	24.07b	179.66	487.33	3.99	1.72c	43.13def
P_3S_3	18.70c	171.33	465.67	3.99	1.68cd	43.23def
P_4S_1	23.63b	175.67	428.00	3.60	1.73bc	43.37cd
P_4S_2	10.03d	174.67	557.33	3.73	1.75ab	43.63bc
P_4S_3	12.70e	175.00	613.33	3.62	1.49e	44.10a

cm apart paired rows or 30 cm apart single rows, but significantly differed from that produced by the crop sown in 45 cm apart single rows (Table I). Highest but statistically similar seed yields were recorded when crop was sown in 30 cm apart single rows with 20 cm inter plant spacing or 60/30 cm apart paired rows with inter plant spacings of 10 or 15 cm, respectively (Table I). These results are in agreement with those of Misra and Rana (1992) and Gawai *et al*. (1994) who concluded that seed yield of *Brassica compestris* decreased with increase in row spacing.

Both planting pattern and inter plant spacing individually and in combination significantly affected seed oil content in Raya seeds. A planting pattern of 60/30 cm apart paired rows gave statistically highest seed oil content than all other planting patterns which were statistically similar with each other. Highest but statistically similar seed oil content were recorded, when crop was sown with 15 or 20 cm inter plant spacing (Table I). Crop sown in 60/30 cm apart paired rows with 20 cm inter-plant spacing gave the highest seed oil content than any other arrangement. Hassan and El-Hakeem (1996) also recorded reduction in seed oil content at higher plant densities in *Brassica campestris* L.

CONCLUSION

Though maximum seed yield (1.80 t ha^{-1}) was obtained in case of P_1S_3 (30 x 20 cm arrangement), however, it may be concluded that paired row planting (60/30 cm) with 10 or 15 cm inter plant spacing would be more appropriate for obtaining comparable seed yield and to facilitate inter crop adjustment and also easy handling of the sole crop in this planting geometry under irrigated conditions of Faisalabad.

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(Received 06 November 2001; Accepted 11 February 2001)