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Effect of date of sowing and crop geometry on growth and yield parameters of forage mustard (Var. *Chinese Cabbage*)

S. C. Gawariya[1]*, N. K. Chopra[2], N. Chopra[2] and A. S. Harika[1]

[1]Department of Agronomy (Forage production), NDRI Karnal-132001, India.
[2]Regional Research Station, IARI, Karnal (Haryana), India.

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A field experiment was conducted during *rabi* 2011-2012 at Forage Management and Research Centre, National Dairy Research Institute, Karnal to study the "Effect of date of sowing and crop geometry on seed yield and quality of forage mustard (var. Chinese cabbage)". The soil texture of the experimental site was clay loam with available nitrogen, phosphorus, potassium were 212, 20 and 256 kg/ha, respectively. There were 24 treatment combinations consisting of four dates of sowing (1st October, 16th October, 31st October and 15th November) and six crop geometry (60×15, 45×15, 45×20, 45×25, 30×20 and 30×25 cm) and the experiment was laid out in split plot design with four replications. From the result, sowing during 1st October recorded significantly higher crop yield attributing characters viz. no. of primary, secondary and tertiary branches, number and weight of siliquae /plant and ultimately seed yield (2013 kg/ha) with better growth and higher dry matter accumulation in yield components compared to 31st October and 15th November. Crop geometry of 30×20 cm recorded significantly higher seed yield (1829 kg/ha) with better utilization of space, nutrients, water and sunshine resulting in higher dry matter translocation to yield components as compared to 60×15, 45×15, 45×20, 45×25 and 30×25 cm crop geometry.

Key word: Crop geometry, date of sowing, forage mustard, seed yield.

INTRODUCTION

Mustard [*Brassica juncea* L.], an important edible oil seed crop of India belongs to family Brassicaceae. It is known to Greeks, Romans, Indians and Chinese 2000 years ago. Genus *Brassica* comprises of five cultivated species *viz., Brassica juncea* (Indian mustard), *Brassica campestris* (Toria), *Brassica nigra* (Banarasi rye), *Brassica napus* (Gobhi sarson) and *Brassica carinata* (Abyesinian mustard) predominantly grown in China, India ,Canada, Pakistan, USSR and Europe. Among these, *Brassica compestris* (Toria) var. Chinese cabbage is grown as fodder crop in India. Rapeseed mustard crop in India is grown in diverse agro climatic conditions ranging from northeastern / north western hills to down south under irrigated/rainfed, timely/late sown, saline

*Corresponding author. E-mail: scgawariya200@gmail.com

soils and mixed cropping. In India, Chara Sarson (Chinese cabbage) occupies 10,000 ha area and productivity is 15 to 35 tonnes/ha green fodder (Handbook of Agriculture, 2010). Rapeseed-mustard follows C_3 pathway for carbon assimilation. Therefore, it has efficient photosynthetic response at 15 to 20°C temperature. At this temperature the plant achieve maximum CO_2 exchange range which declines thereafter (Singh et al., 2001). Mustard oilseed cake is used as livestock feed and green leaves and stem are used as a green fodder for livestock. The competitive ability of a rapeseed- mustard plant depends greatly upon the density of plants per unit area and soil fertility status. The optimum plant population density/unit area varies with the environment, the genotype, the seeding time and the season. Uniform distribution of crop plants over an area results in efficient use of nutrients, moisture and suppression of weeds leading to high yield (Sonani et al., 2002). Mustard sown on 14th and 21st October took significantly more days to 50% flowering (55 and 57) and maturity (154 and 156) compared to 7th October planting (Kumar et al., 2001). Delayed sowing resulted in poor growth, low yield and oil content. Date of sowing influence the incidence of insect-pest and disease also. Sowing on 21st October resulted in least *Sclerotina* incidence (Gupta et al., 2004). So in this backdrop the present investigation was undertaken to study the effect of date of sowing on growth and seed yield of forage mustard (var. Chinese cabbage).

MATERIALS AND METHODS

A field experiment was conducted at Forage Research and Management Centre (FRMC), National Dairy Research Institute, Karnal, India during *rabi* 2011-2012. The soil was clay loam in texture, low in available N, medium in organic carbon, available P, and available K. The experimental treatment consist of 4 date of sowing (1stOct.,16 th Oct.,30st Oct.,15th Nov.) and 6 crop geometry (60×15, 45×15, 45×20, 45×25, 30×20, 30×25 cm). The experiment was laid out in a split plot design with 24 treatment combinations with four replications. The forage mustard was raised by following recommended agronomic cultural practices. The growth and yield parameters were taken for at different date of sowing. During October 2011 to March 2012, mean weekly maximum temperature ranged from 33.1°C (10-16th October) to 15.5°C (16-22nd January), while the mean weekly minimum temperature ranged from 20.8°C (3-9th October) to 3.8°C (19-25th December).

RESULTS AND DISCUSSION

Date of sowing as well as crop geometry affected yield and yield parameters in forage mustard (Var. Chinese Cabbage). No. of siliquae/plant, weight of siliquae/plant significantly affected Sowing during 1st October (1391.47/plant) recorded significantly higher No. of siliquae/plant as compared to 16th October (1227.96/plant) and, 31st October (847.41/plant) and 15th November (656.75/plant) sowing, respectively (Table 1). These were mainly due to favorable temperature and nutrient dynamics (Dotaniya and Meena, 2013) enhanced higher number of primary, secondary and tertiary branches at harvest (Kurmi, 2002). Whereas crop geometry of 60×15 cm (1526.52/plant) recorded significantly higher number of siliquae/plant as compared to 45×15 cm (906.58/plant), 45×20 cm (988.90/plant), 45×25 cm (1291.41/plant), 30×20 cm (745.76/plant) and 30×25 cm (727.21/plant), respectively. This was mainly due to wider spacing less competition for space and nutrients. Increasing spacing enhanced the root extension and better uptake of nutrients by crop roots (Singh et al*.,* 2001*,* 2002; Shivani and Kumar*,* 2002). The weight of siliqua/plant and weight of siliqua/m^2 was found significantly with respect to dates of sowing and crop geometry. Sowing during 1st Oct. significantly higher value in (D1)> (D2)> (D3) > (D4). These results are in conformity with results of Panda et al. (2004).

Stover yield was found significant with respect to dates of sowing and crop geometry. Stover yield remained at par between 1st and 16th October sowings and recorded significantly higher yield as compared to 31st October (D3) (6217.20 kg/ha) and 15th November (D4) (4774.3 kg/ha) sowing, respectively. Whereas, crop geometry of 30×20 cm (8125 kg/ha) recorded significantly higher Stover yield as compared to 45×20 cm (7418.98 kg/ha), 45×25 cm (7410.3 kg/ha) and 30×25 cm (8043.98 kg/ha), respectively. It may be due to higher plant height at 30, 60 DAS and at harvest, number of primary, secondary and tertiary branches. Singh and Singh (2002) also reported higher Stover yield in the early sowings. It might be due to higher GDD, PTU, and day taken to attain physiological maturity stage in these sowing dates. The detrimental effect of heat at a later stage of crop development and earing in delayed sowing had an adverse effect on grain yield (Amrawat et al., 2014). This was mainly due to higher plant density. These results are in conformity with the results of Kumar et al. (1997).

The Stover seed yield was found significant with respect to dates of sowing and crop geometry. Sowing during on (D1) recorded significantly higher grain yield as compared to (D3), (D4). There was 18% increase in seed yield with 1st October sowing over 31st October sowing. The decrease in seed yield with delay in sowing occurred coupled with primarily due to poor dry matter built up which led to reduced bearing capacity. Slower growth at low temperature during early vegetative growth phase and the overall shorter crop duration. Reduced seed-filling duration caused by forced maturity because of sudden rise in temperature during maturity phase, resulted in poor sink strength (Angrej et al., 2002). Crop geometry of 30×20 cm (1829.16 kg/ha) recorded significantly higher seed yield as compared to 60×15 cm (1504.65 kg/ha), 45×15 cm (1640.28 kg/ha) and 45×20 cm (1659.43 kg/ha) spacing, respectively. Wider spacing could not fully utilized the available soil nutrients, moisture and light consequently reducing the seed yield

Table 1. Effect of date of sowing and crop geometry on crop growth and yield parameters.

Treatments		No. of siliquae/ plant	wt. of siliquae/plant (g)	wt. of siliquae/m^2 (g)	Stover yield (kg/ha)	Seed yield (kg/ha)
Date of sowing						
D1	1st Oct.	1391.47	96.89	988.50	10021.21	2013.48
D2	16th Oct.	1227.96	86.08	889.46	10147.57	1837.96
D3	31st Oct.	847.41	64.66	659.71	6217.20	1649.69
D4	15th Nov.	656.75	43.12	467.45	4774.30	1216.62
CD (5%)		16.74	10.41	106.01	318.48	240.09
Crop geometry (cm)						
S1	60x15	1526.52	97.63	785.80	8000.58	1504.65
S2	45x15	906.58	65.96	806.16	7741.60	1640.28
S3	45x20	988.90	71.27	689.93	7418.98	1659.43
S4	45x25	1291.41	89.32	677.00	7410.30	1706.36
S5	30x20	745.76	56.71	848.64	8125.00	1829.16
S6	30x25	727.21	55.24	700.16	8043.98	1736.74
CD (5%)		25.94	8.18	91.98	266.98	146.09

(Momoh et al., 2004). Increased competition in higher density plants caused reduction in the number of pods on all branches. However high density resulted in higher yield compared to wider spacing whereas per plant branches and no. of pods were high. The results are in conformity with the findings of Sahoo et al. (2000) and Chaniyara et al. (2002).

Conclusion

In conclusion, sowing of forage mustard as early as in the present study (1st October) seems to be a feasible strategy for increasing yield and controlling weeds and conservation of soil moisture and, better nutrient dynamics during crop growth. Crop geometry affected the crop physiology and yield parameters. Ideal spacing (30×25 cm) provide better aeration, soil moisture, plant nutrient and improved the microclimate for crop growth and ultimately seed yield.

Conflict of Interest

The authors have not declared any conflict of interest.

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