Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(2): 2388-2393
Received: 22-01-2019
Accepted: 24-02-2019

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Growth, yield and quality of hybrid mustard as affected by crop geometry and varieties

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Abstract
A field experiment was carried out in the CR Farm of Gayeshpur, BCKV, Nadia, West Bengal, India during *Rabi* season of 2015-16 and 2016-17 to find out suitable hybrid variety and optimum spacing for different hybrids. Three hybrid varieties of mustard *viz.* Kesari 5111(V_1), Kesari 5222(V_2) and Kesari Gold(V_3) were taken as treatments in the main plot, whereas, four spacing - 30cm ×10cm (S_1), 30cm × 20cm (S_2), 40cm × 20cm (S_3) and 40cm × 30cm (S_4) were imposed as subplot treatment. The experiment was conducted in split plot design with 3 replications and repeated in *rabi* seasons for two consecutive years (2015-16 and 2016-17). The results of the experiment revealed that the maximum seed yield was recorded in Kesari Gold (1746 and 2153 kg ha^{-1} respectively in 1st and 2nd year) followed by Kesari 5111. Regarding plant geometry significantly higher yield was noticed in 30 cm × 20 cm (1689 and 2244 kg ha^{-1} respectively in 1st and 2nd year). The oil content and oil yield was greatly influenced by hybrid variety. It was observed that Kesari Gold variety recorded higher oil content (40.89 % and 41.45 % respectively in 1st and 2nd year) and oil yield of (713.97 kg/ha and 892.40 kg/ha respectively in 1st and 2nd year). The hybrid varieties of mustard are highly suitable in Gangetic plains of West Bengal due to their higher yields and oil content. Slightly wider spacing (30 cm × 20 cm) is suitable for hybrids because of their bigger canopy.

Keywords: Mustard, genotype, crop geometry, oil content, oil yield

Introduction
Oilseed crops are the second most important determinant of agricultural economy, next only to cereals within the segment of field crops. Indian mustard (*Brassica juncea* L.) belonging to family *Cruciferae* is one of the most important winter oilseed crops in India in terms of oil yield and ranked second after soybean in terms of production. Despite being the fifth largest oilseed crop producing country in the world, India is also one of the largest importers of vegetable oils today. The demand-supply gap in the edible oils has necessitated huge imports accounting for 60 per cent of the country's requirement (2016-17: import 14.01 million tonnes; cost Rs. 73,048crore, DGCIS, Department of Commerce, 2016-17) [3]. Despite commendable performance of domestic oilseeds production of the nine annual crops (Compound Annual Growth Rate of 3.89%), it could not match with the galloping rate of per capita demand (~6%) due to enhanced per capita consumption (18 kg oil per annum) driven by increase in population and enhanced per capita income. Rapeseed mustard production of India is 6.33 mt (2017-18) and cultivated over 6.41 mha of land. For increasing the productivity and oil content of mustard crop the improved varieties which are capable of giving high yields and oil need to be cultivated. Planting geometry i.e. row spacing is one of the very important practices for mustard production (Mondal *et al.* 1999) [8]. Suboptimal planting geometry, wider rows and plant spacing lead to low population which in turn fail to compensate the yield obtained in optimum plant stand while narrower row and plant spacing increase the inter and intra-plant competition leading to poor growth and development and dry matter accumulation resulting in poor yield. Improved varieties of mustard or hybrid are capable of higher yields when grown under optimum row spacing and fertility level. Decreasing crop yield in improper spacing has been reported by many workers (Degenhardt and Kondra, 1981 and McDonald *et al.* 1983) [6]. The improper row spacing of mustard decreased seed yield through synchronization of siliqua filling period with high temperature, the decreased in assimilates production, drought stress occurrence, shortened siliqua filling period and acceleration of plant maturity (Mendham *et el* . 1981) [7]. Taking into consideration the above perspectives, the current study was done to assess the effect of different varieties and crop geometry on the yield and oil content of mustard.

Materials and method

A field experiment was conducted at Regional Research station, New Alluvial Zone, Bidhan Chandra Krishi Vishwavidyalaya, Gayeshpur, Nadia. The experimental site is situated at 23º8'N latitude and 88ºE' longitude having an average altitude of 9.75m above mean sea level. The soil of the experimental site was Gangetic alluvial with sandy clay loam texture, good water holding capacity, well drained and moderate fertility status. The experimental site located in sub-humid, sub-tropical zone and lies in Indo-Gangetic alluvial agro-ecological zone. The average annual rainfall ranged from 1300 to 1450mm and major portion of rainfall is generally received during the month of June to middle of October. The mean monthly temperature ranged from 9ºC to 36ºC. During the crop growing period maximum temperature varied from 31.9ºC to 31.3ºC (2015-16), 29.7ºC to 28ºC (2016-17) and minimum temperature varied between 21.8ºC to 18.8ºC (2015-16), 20.5 to 17.7ºC (2016-17). The mean maximum relative humidity was highest in the month of November (93.3% in 2015 and 93.4% in 2016), whereas the mean minimum relative humidity was in March (47.5% in 2016 and 45.6% in 2017). Three mustard hybrid variety namely V1-Kesari 5111, V2-Kesari 5222, V3- Kesari Gold as main plot treatment and S1- 30 cm x 10 cm, S2- 30 cm x 20 cm, S3- 40 cm x 20 cm, S4- 40 cm x 30 cm as sub-plot treatment were included in the experiment. Land was prepared by 4 ploughing followed by planking after each ploughing. The land was made free from weeds and stubble of previous crop. After proper levelling the whole experimental field was divided into 3 equal blocks. Then each of the blocks was divided into 3 main-plots and ultimately each of the main-plot was again split into 4 equal sub-plots. Mustard crop was sown in line with the help of tyne as per treatment. The crop was fertilized with a uniform amount of nitrogen, phosphorus and potassium at the rate of 80, 40 and 40 kg/ha respectively. The 50% dose of N and full dose of P_2O_5 and K_2O were applied as basal. The rest amount of nitrogen was applied in two splits with the equal amount at 21 DAS and at 42 DAS. Five plants were randomly selected from each plot and tagged. The height was measured in cm with the help of measuring tape from the base of the plant to top of the plant and mean value was computed at 25, 50 and 75 DAS. The leaf area index was calculated at 25, 50, 75 DAS manually. In case of mustard 10 circular pieces of 23.74 cm^2 each were punched out. Thus the area of cut portion of the leaves was calculated subsequently. The whole of the cut pieces and leaflets were dried separately and the weight of the samples was recorded. The total leaf area was calculated using the area weight relationship. Since LAI is the area of leaf surface/ unit area of land surface (Watson, 1947). Dry matter accumulation was recorded by taking the dry weight of different plant parts excluding the underground portion of the plant from an area of $1m^2$ and it is expressed in gm/ m^2. Yield was determined from the well dried seeds collected from net plot area excluding the border effect each plot. Then the mean yield was converted into kg/ha. Biological yield from net plot was calculated and expressed as kg/ha. Biological yield was obtained by summing seed yield and stover yield from net plot. Oil content (%) of mustard was determined by taking seed samples of 5 g. For each plot, the seeds were crushed in mortar and transferred together with solvent after washing of the mortar to a soxhlet apparatus for extraction of oil. Petroleum ether (boiling point 60-80ºC) was used as solvent. Petroleum ether was evaporated on boiling water and the weight of the oil was then recorded when it attained a constant weight. Oil content was calculated by using the formula of weight of oil (g) to the weight of samples (g) and it is expressed in percentage. Oil yield was calculated by multiplying the seed yield and oil content divided by 100 and expressed as kg/ha.

Result and discussion

Plant height (cm) of hybrid mustard at various growth stages affected by different planting geometry and varieties has been presented in (Figure-1). Plant height was increased with the increase in the age of the crop. From (Figure-1) it has been observed that plant height was significantly influenced by hybrid variety. At 75 DAS and at the time of harvest highest plant height was attained by variety Kesari Gold during 1st year which was significantly superior to Kesari 5111 and at par with variety Kesari 5222. Spacing has no effect on plant height though in some cases it was found that wider spacing gave higher plant height. Height of a plant is determined by genetical character and under a given set of environment different variety will acquire their height according to their genetical make up. A similar finding was observed by Rana and Pachuari (2001) [9].

Leaf area index as affected (LAI) by crop geometry and varieties is presented in (Figure-2). Leaf area index of mustard was increased progressively with the increase in the age up to 50 DAS, after that the LAI was decreased. At 25 DAS maximum LAI is recorded by Kesari 5222, which is at par with Kesari Gold. At 50 and 75 DAS Kesari Gold recorded highest LAI. Crop geometry significantly influences the LAI. Maximum LAI was recorded when the crop sown at 30 cm x 20 cm. At early age mustard plant growth was not fully expressed, as a result higher number of plants per unit recorded higher LAI. But later at full grown stage optimum spacing is necessary for manifestation of higher LAI. In similar experiment higher LAI were recorded from 30 cm × 15 cm spacing (2.4) (Khichear *et al*. 2000) [5].

Dry matter accumulation (g/m^2) as influenced by plant geometry and hybrid varieties has been presented in (Figure-3). There is no significant difference found among the varieties except 50 and 75 DAS. It has been observed that crop geometry significantly influence the dry matter content of the plant. Highest dry matter accumulation at 25 DAS recorded in S1 spacing during both the year. At 50 DAS, during 1st year maximum dry matter recorded at S1 spacing and during 2nd year maximum dry matter accumulated at S2 spacing. At 75 DAS, during 1st year S3 spacing accumulated the highest dry matter and during 2nd year S2 recorded the highest dry matter content. At early age mustard plant growth was not fully expressed, as a result higher number of plants per unit recorded higher dry matter. But later at full grown stage optimum spacing is necessary for manifestation of higher dry matter. The findings of this experiment were confirmed by Khichar et al. (2000) [5], where he reported that higher dry matter was recorded from 30 cm × 15 cm pacing.

Seed yield (kg/ha) as affected by varieties and crop geometry have been presented in (Table-3). A perusal of data showed that different crop geometry influenced significantly to the seed yield. Among the varieties highest seed yield (1746 kg/ha and 2153kg/ha respectively 1st and 2nd year) was recorded by Kesari Gold which was significantly higher than Kesari 5111 (V1) and Kesari 5222(V2). The minimum seed yield (1358 kg/ha and 1623 kg/ha respectively 1st and 2nd year) was recorded in V2 variety i.e Kesari 5222. Maximum seed yield (1689 kg/ha and 2244 kg/ha respectively in 1st and 2nd year) was recorded when the crop was shown on 30 cm x

20 cm, which was superior over other spacing. The minimum seed yield (1503 kg/ha) was obtained when sowing was done at 30 cm x 10 cm. The seed yield was significantly affected by different varieties. As discussed earlier, the different hybrids have different yield potential, which is the reason for yield variation among different varieties. In contrast to the traditional OP varieties hybrids have bigger canopy structure and to explore optimum yield potential this hybrids needs wider spacing in comparison to OP varieties. Rana and Pachauri (2001) [9] observed that the seed yield recorded higher with 30 cm ×10 cm spacing (1670 kg/ha) as compared to 45 cm ×15 cm spacing (1280 kg/ha).

Biological yield (kg/ha) as affected by varieties and crop geometry have been presented in (Table-1). A perusal of data showed that the biological yield (kg/ha) was significantly affected by different varieties. Maximum biological yield (8584.63 kg/ha and 6922.91 kg/ha respectively in 1st and 2nd year) was recorded by Kesari Gold, followed by Kesari 5222 and then Kesari 5111. Different crop geometry significantly influenced the biological yield. Maximum biological yield (7949.36 kg/ha)) was recorded in 1st year when the crop was shown on 40 cm x 30 cm, and in 2nd year maximum biological yield (7393.11 kg/ha) was obtained when the crop sown at 30 cm x 20 cm. The highest biological yield of Kesari Gold might be on account of maximum seed yield than the other varieties.

Oil content as affected by variety and crop geometry has been presented in (Table-2). It has been observed from the table that oil content of mustard was greatly influenced by variety. Maximum oil content was recorded by Kesari Gold variety in both the year (40.89% and 41.45% during 1st year and 2nd year respectively). Spacing did not show any significant effect in oil content. Oil content of mustard is mostly governed by the genetical make up of a particular variety and to some extent nutrient management. Physical environment like spacing has very little effect on oil content. Rana and Pachuari (2001)[9] conducted an experiment and quoted that cultivar TERI (OE) R 15 recorded higher oil content of 42% compared to cultivar Bio 902 (37.9%).

Oil yield (kg/ha) as affected by variety and crop geometry has been presented in (Table-2). It has been observed from the table that oil yield of hybrid mustard is significantly influenced by variety and crop geometry. Maximum oil yield was recorded by Kesari Gold (713.97and 892.40kg/ha respectively in 1st and 2nd year) followed by Kesari 5111 and then Kesari 5222. Maximum oil yield (670.89 kg/ha and 896.77 kg/ha respectively in 1st and 2nd year) was recorded when sown at 30 cm x 20 cm. The highest oil yield of Kesari Gold might be on account of maximum seed yield and seed oil content than the other varieties. These findings are in lines with those of Getinet *et al.* (1996) [4], Das (1998) [2] and Baraynk and Zukalova (2000) [1] who found differences in oil yields of different brassica species.

Conclusion

The study concluded that among different varieties maximum plant height, LAI and dry matter accumulation was recorded in Kesari Gold. Seed yield and biological yield was also recorded by Kesari Gold followed by Kesari 5111 and then Kesari 5222 and seed yield was significantly affected by planting geometry. So, wider spacing is essential for hybrid mustard cultivation. In terms of quality, oil content and oil yield was also recorded highest in variety Kesari Gold. The hybrid mustard should preferably be grown with wider spacing (30 cm x 20 cm / 40 cm x 20 cm), under the agro ecological conditions of new alluvial zone of West Bengal for obtaining maximum seed and oil yield/ha. However, further confirmation of the trends seen in this experiment needs to be further studied in future before more specific recommendations can be made.

Table 1: Effects of varieties and spacing on seed yield and biological yield of hybrid mustard

Treatments	Seed yield(kg/ha)		Biological yield (kg/ha)	
	2015-16	2016-17	2015-16	2016-17
V1	1532	1816	6179.93	5188.52
V2	1358	1623	8087.09	6466.94
V3	1746	2153	8584.63	6922.91
S.Em (±)	55.47	98.04	289.97	289.58
CD at 5%	217.73	384.84	1138.21	1136.67
S1	1349	1705	7171.45	6088.58
S2	1689	2244	7677.68	7393.11
S3	1641	1886	7670.37	6070.49
S4	1502	1620	7949.36	5218.99
S.Em(±)	68.28	96.99	250.24	296.08
CD at 5%	202.84	288.15	743.41	879.61

Table 2: Effects of varieties and spacing on oil and oil yield content of hybrid mustard

Treatment	Oil content (%)		Oil yield (kg/ha)	
	2015-16	2016-17	2015-16	2016-17
V1	39.57	39.44	605.83	716.23
V2	38.51	38.36	523.16	622.82
V3	40.89	41.45	713.97	892.40
S.Em(±)	0.22	0.16	20.10	37.46
CD at 5 %	0.88	0.62	78.88	147.05
S1	39.60	39.68	535.15	677.02
S2	39.61	39.71	670.89	896.77
S3	39.69	39.83	653.29	755.26
S4	39.74	39.79	597.95	646.22
S.Em(±)	0.05	0.06	27.58	38.11
CD at 5%	NS	NS	81.93	113.21

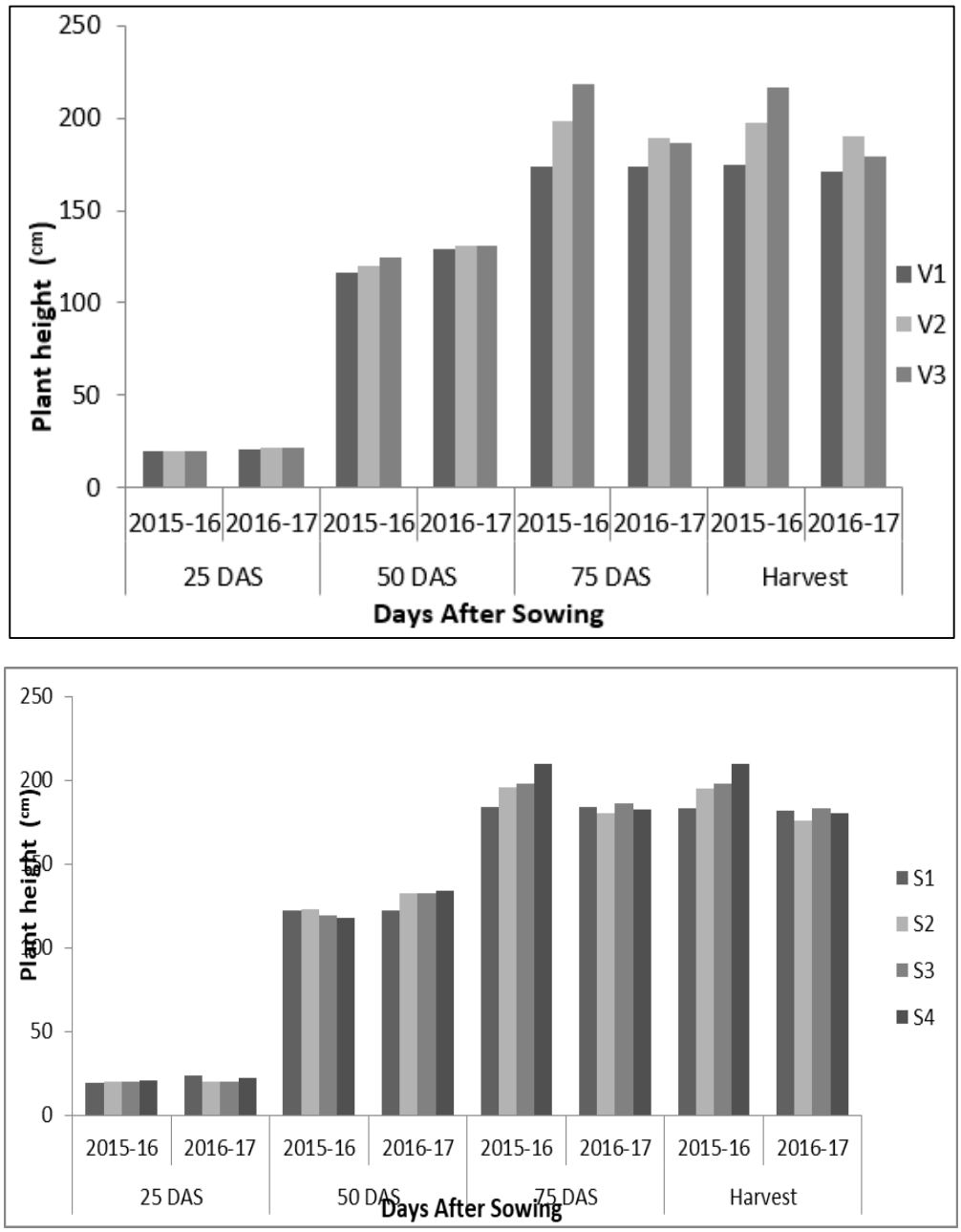
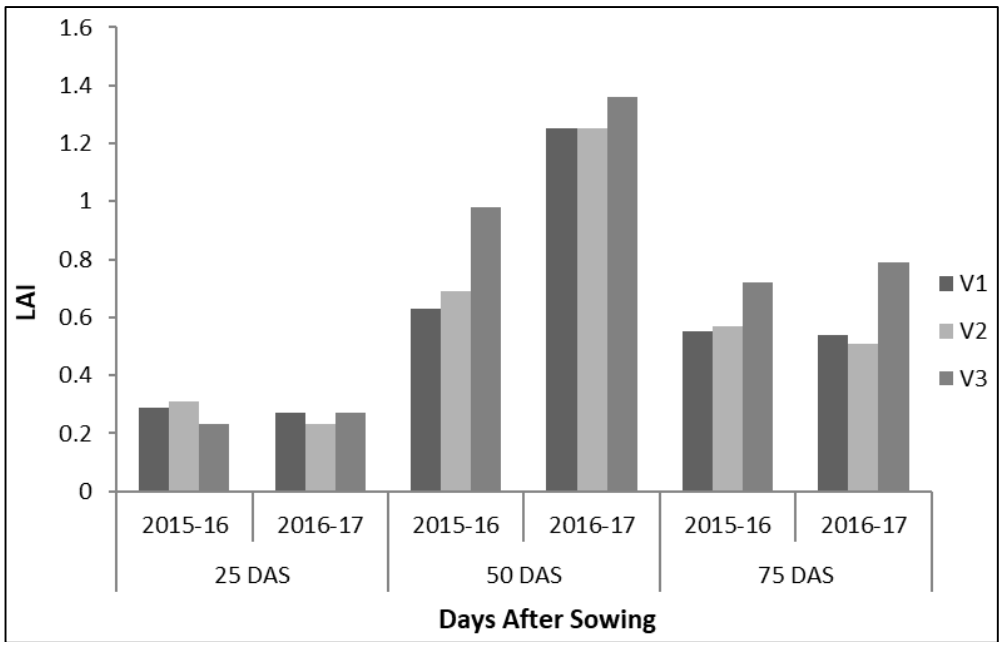


Fig 1: Effect of varieties and crop geometry on Plant height (cm)



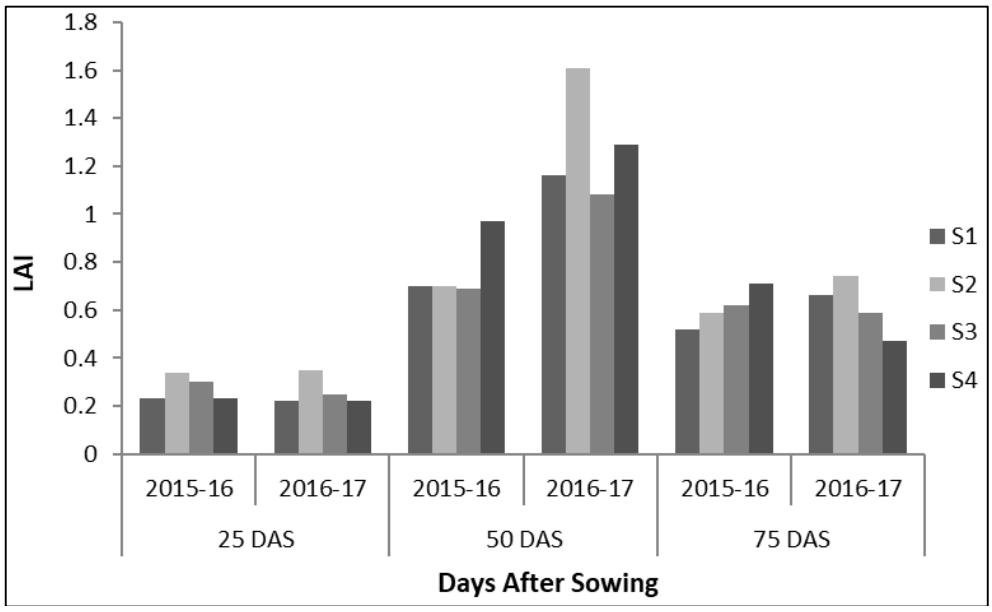
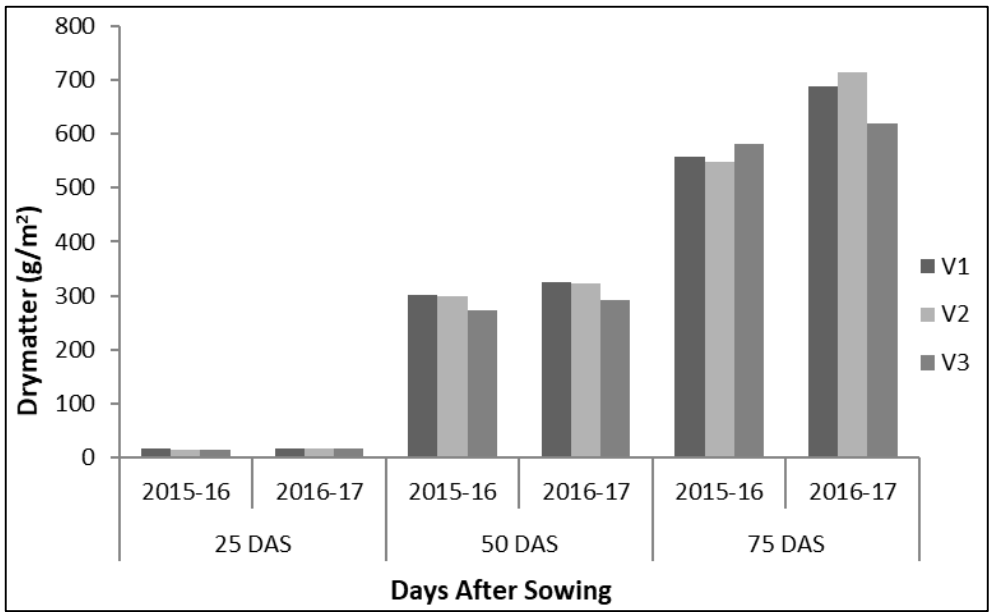


Fig 2: Effect of varieties and crop geometry on LAI



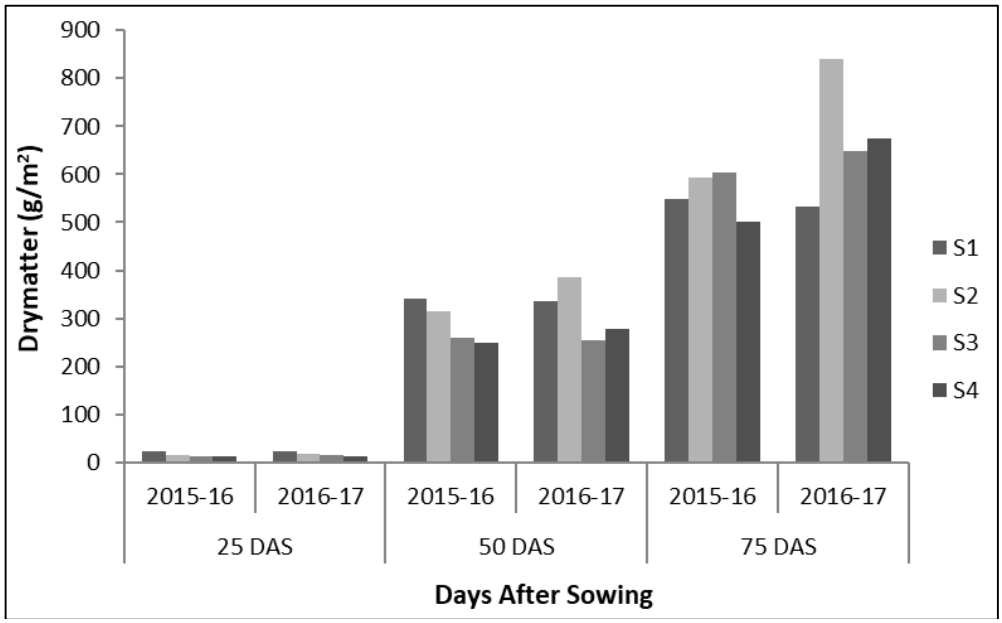


Fig 3: Effect of varieties and crop geometry on Dry Matter (g/m^2) content

Reference

1. Baranyk P, H Zukalova. Seed yield, oil content and oil yield of hybrid oilseed rape in the condition of Czech Republic. Rostlina Vyroba. 2000; 46:521-526.
2. Das TK. Studies on the performance on the performance of some new mustard genotypes under irrigated condition. Journal of Oilseed Research. 1998; 15:310-314.
3. DGCIS. Department of Commerce, Government of India, 2016-17.
4. Getinet A, Rakow G, Roney JP, Downey RK. Agronomic performance and seed quality of Ethiopian mustard in Saskatchewan. Canadian Journal of Plant Science. 1996; 76:387-392.
5. Khichar ML, Yadav YC, Bishnoi OP, Ramniwas. Radiation use efficiency of mustard as influenced by sowing dates, plant spacing and cultivars. Journal of Agrometeorology. 2000; 2(1): 97-99.
6. McDonald GK, Sutton BG, Ellison FW. The effect of time of sowing on the seed yield of mustard in the Namoi valley, New South Wales. Australian journal experimental agriculture and animal husbandry. 1983; 34: 229-240.
7. Mendham NJ, Salisbury PA. Physiology: Crop development, growth and yield in Brassica Oilseeds; Production and Utilization. (Ed. Kimber, D. and McGregor, D.I.). CAB International. 1995, 11-64.
8. Mondal RI, Biswas M, Hydar-Ali MK, Akbar MA. Response of rapeseed genotype Dhali to seed rate and seeding date. Bangladesh J Agril. Res. 1999; 24(1):83-90.
9. Mondal RI, Biswas M, Hydar-Ali MK, Akbar MA. Response of rapeseed genotype Dhali to seed, 1999.
10. Mondal RI, Biswas M, Hydar-Ali MK, Akbar MA. Response of rapeseed genotype Dhali to seed rate and seedling date. Bangladesh Journal of Agricultural Research, 1999; 24(1):83-90.
11. Rana DS, Pachauri DK. Sensitivity of zero erucic acid genotypes of Oleiferous Brassica to plant population and planting geometry. Indian Journal of Agronomy. 2001; 46(4):736-740.