J. Soils and Crops 32 (2) 378-382, December 2022

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

EFFECT OF INTRA ROW SPACING ON GROWTH AND YIELD OF DIFFERENT CULTIVARS OF TRANSPLANTED CANOLA (*Brassica napus* L.)

Mehakpreet Kaur[1] and Rakesh Kumar[2]

ABSTRACT

A field experiment was conducted during *rabi* season of 2021-2022 entitled "Effect of intra row spacing on growth and yield of different cultivars of transplanted canola (*Brassica napus*L.)" at Student's Research Farm, P.G. Department of Agriculture, Khalsa College, Amritsar. The field experiment was laid out in split plot design (SPD) with three replications. There were twelve treatment combinations comprising of three different cultivars C_1 (Kenola-1001), C_2 (Hyola Adv-45) and C_3 (GSC-7) in main plot and four intra row spacing treatments in sub plot *viz*., S_1 (45 cm×10 cm), S_2 (45 cm×20 cm), S_3 (45 cm×30 cm) and S_4 (45 cm×40 cm). The results revealed that cultivar Cƒ (GSC-7) recorded significantly higher plant height (175.25 cm), leaf area index (2.96) and dry matter accumulation (166.81 q ha^{-1}) at 90 DAT which was at par with other two cultivars. Among the canola cultivars, C_3 (GSC-7) recorded significantly higher seed (20.63 q ha^{-1}), stover (74.00 q ha^{-1}) and biological yield (94.63 q ha^{-1}) as compared to cultivars C_2 (Hyola Adv-45) *viz.,* 16.26, 57.33 and 73.76 q ha^{-1} and C_1 (Kenola-1001) *viz.,* 14.30, 50.08 and 64.37 q ha^{-1} respectively. Among the intra row spacing treatments, S_1 (45 cm×10 cm) recorded significantly higher plant height (174.33 cm), leaf area index (3.14) and dry matter accumulation (175.03 q ha^{-1}) at 90 DAT which was at par with other intra row spacing treatments. Significantly higher seed (19.04 q ha^{-1}), stover (66.88 q ha^{-1}) and biological yield (85.93 q ha^{-1}) were recorded in treatment S_1 (45 cm×10 cm). Among the sub plot treatments, significant increase in seed yield of 9.4, 15.3 and 24.2 per cent was recorded in treatment S_1 (45 cm×10 cm) as compared to S_2 (45 cm×20 cm), S_3 (45 cm×30 cm) and S_4 (45 cm×40 cm) respectively.

(Key words: Canola, cultivars, intra row spacing, seed yield, transplanted)

INTRODUCTION

Rapeseed (*Brassica napus* L.) also termed as 'rape' or 'seed rape' is bright yellow flowering member of family Crucifereae, grown for its oil rich seeds, which yields canola.Canola is a pioneering crop for oil production. It has commercial importance with having high oil content of about 30-45 per cent (Oad *et al.,* 2001). It has less than 2 per cent erucic acid in the oil and less than 30 micro moles glucosinolates gram^{-1} defatted meal (Anonymous, 2021). The global production of rapeseed oil reached nearly 29.2 million metric tonnes. Canada is the leading rapeseed producing country in the world with the production of 19.49 million metric tonnes followed by European Union *viz.,* 16.29 million metric tonnes and China *viz.,* 14.05 million metric tonnes in 2020-2021 (Shahbandeh, 2022). Canada is the largest exporter of canola seed in world followed by Australia (Asaduzzaman *et al.,* 2020). India is the fourth leading producer of rapeseed in the world with the production potential of 8.5 million metric tonnes in 2020-2021 (Shahbandeh, 2022). In Punjab, rapeseed and mustard were grown on 31.0 thousand hectares with the production of 46.5 thousand tonnes during 2019-2020. The average yield was 14.82 q ha^{-1} (Anonymous, 2021).

Although Punjab has huge production potential for production of canola as per agro-climatic conditions of the state, but low productivity of canola compared to developed nations is unable to fetch the attention of farmers. There are a large number of factors responsible for poor yield of canola of which weed infestation, climatic conditions, high cost inputs etc. are common but among agronomic interventions, selection of suitable cultivar and intra row spacing are considered prominent ones for procuring high production and productivity. The cultivar selected should be able to yield high oil content, seed, stover and biological yield. On the other hand, maintaining optimum plant population is also important to realize higher yield. In general, canola may be sown at 45 cm×10-15 cm under transplanting conditions (Anonymous, 2021). The plants grown at high density had fewer siliquae bearing branches plant^{-1} (Leach *et al.,* 1999). The plant density above optimum have negative effect on growth and yield due to competition for light, nutrients and space, whereas plant density below optimum affects the growth and yield due to less utilization of nutrients for light (Brar *et al.*, 1998). Planting pattern has effect on crop yield through its influence on light interception, rooting pattern and moisture extraction (Kler, 1988).

1. P.G. Student, P.G. Dept. of Agriculture, Khalsa College, Amritsar-143001, Punjab, India
2. Assoc. Professor, P.G. Dept. of Agriculture, Khalsa College, Amritsar-143001, Punjab, India (Corresponding author)

MATERIALS AND METHODS

Field experiment was carried out during *rabi* season of 2021-2022 at Student's Research Farm, P.G. Department of Agriculture, Khalsa College, Amritsar, Punjab, India. The geographical coordinates of the experimental site are 31.63p N, 74.87p E and height above mean sea level is 224.33 m. The climate of the Amritsar district is classified as tropical, semi-arid and hot which is mainly dry with very hot summer and cold winter except during south west monsoon season. The average annual rainfall in the district is 541.9 mm. The soil of experimental field was sandy loam in texture, having normal pH (8.2), normal EC (0.34 dSm^{-1}), low organic carbon (0.40%), low available N (180.2 kg ha^{-1}), medium available P (16.8 kg ha^{-1}) and medium available K (258 kg ha^{-1}) respectively during study. The sand, silt and clay were 74, 15 and 11 per cent respectively. The experiment was laid out in split plot design (SPD) with three replications. There were thirty six plots with twelve treatment combinations comprising of three different canola cultivars C_1 (Kenola-1001), C_2 (Hyola Adv-45) and C_3 (GSC-7) assigned as main plots and four intra row spacing treatments S_1 (45 cm ×10 cm), S_2 (45 cm×20 cm), S_3 (45 cm×30 cm) and S_4 (45 cm×40 cm) assigned as sub plots. Observations on periodic plant height, leaf area index and dry matter accumulation were recorded at 30, 60 and 90 DAT. Observations on seed yield, stover yield, biological yield and harvest index were also recorded. Harvest index (HI) was calculated by formula:

HI (%) = Economic (seed) yield / Biological yield × 100

RESULTS AND DISCUSSION

Growth parameters

Plant height

Plant height is an important morphological characters related to the vegetative phase. It gives an idea to predict growth rate and yield of the crop. The perusal of data on periodic plant height are given in Table 1.

Among the different cultivars, C_3 (GSC-7) recorded significantly higher plant height at 30, 60 and 90 DAT *viz.,* 42.98, 82.39 and 175.25 cm respectively which was at par with cultivar C_2 (Hyola Adv-45) *viz.,*39.62, 77.35 and 168.16 cm at 30, 60 and 90 DAT respectively. Significantly lowest plant height was recorded in cultivar C_1 (Kenola-1001) *viz.,* 37.54, 74.93 and 162.58 at 30, 60 and 90 DAT respectively.

The results recorded for plant height was significantly affected by intra row spacing treatments except at 30 DAT. At 90 DAT, maximum plant height was recorded in treatment S_1 (45 cm×10 cm) *viz.,*174.33 cm which was significantly superior over treatments S_2 (45 cm×20 cm) *viz.,*170.77 cm, S_3 (45 cm×30 cm) *viz.,*166.66 cm and S_4 (45 cm×40 cm) *viz.,*162.88 cm respectively. The treatment S_1 produced more plant height at closer spacing was due to comparatively lesser availability of space around the plant for lateral development, so the limitation of space makes plant to grow vertically. It was observed that reduction in plant height under wider intra row spacing was due to suppression of apical dominance as against closer spacing which induced more vertical growth due to congestion of plant $unit^{-1}$ area. The results corroborated the findings of Dhongade *et al.* (2019), Gopale *et al.* (2021) and Sapkal *et al.* (2021), who recorded similar average mean height of different mustard cultivars and the results were also significant. Similarly, Pal (2001) and Singh (2019) reported significantly higher plant height at narrow intra row spacing treatment as compared to other wider row spacing treatments and significant difference in plant height of different canola cultivars.

Interaction effect of different cultivars and intra row spacing treatments with respect to plant height was found to be non-significant.

Leaf area index (LAI)

Leaf area index is of paramount importance in all crop plants, as optimum leaf area is necessary component for light interception by plants which results in photosynthesis and has marked influence on growth and yield of crop. Data regarding the leaf area index as affected by different canola cultivars and intra row spacing treatments are presented in Table 1.

Significantly higher leaf area index at 30, 60 and 90 DAT was reported in cultivar C_3 (GSC-7) *viz.,* 0.97, 2.10 and 2.96 respectively and was at par with cultivar C_2 (Hyola Adv-45) *viz.,* 0.85, 2.02 and 2.82 at 30, 60 and 90 DAT respectively. Lowest leaf area index was recorded in cultivar C_1 (Kenola-1001) *viz.,* 0.73, 1.89 and 2.69 at 30, 60 and 90 DAT respectively.

Further among intra row treatments, maximum LAI was recorded in S_1 (45 cm×10 cm) *viz.,* 1.26, 2.46 and 3.14 at 30, 60 and 90 DAT respectively which was significantly superior over treatments S_2 (45 cm×20 cm) *viz.,* 0.80, 2.04 and 2.90 at 30, 60 and 90 DAT respectively, S_3 (45 cm×30 cm) *viz.,* 0.74, 1.81 and 2.74 at 30, 60 and 90 DAT respectively and S_4 (45 cm×40 cm) *viz.,* 0.59, 1.70 and 2.52 at 30, 60 and 90 DAT respectively. This dramatic increase in LAI with reduced intra row spacing or with increase in plant population density might be due to occupation of more unit area by green canopy of the plants. On the other hand, increasing LAI is one of the ways of increasing the capture of solar radiations within the canopy and accumulation of dry matter. The results corroborated the findings of Pal (2001) and Singh (2019), who reported significantly higher leaf area index at narrow intra row spacing treatment as compared to other wider row spacing treatments and canola cultivars.

Interaction effect of different cultivars and intra row spacing treatments with respect to leaf area index was found to be non-significant.

Dry matter accumulation (DMA)

Dry matter accumulation (DMA) is another important character to express the growth and metabolic efficiency of the plant which ultimately influences the yield bearing capacity of the plant. The data of dry matter accumulation was recorded at 30, 60 and 90 DAT and are presented in Table 1.

Dry matter accumulation among different cultivars of canola at different stages of crop growth showed significant results. Significantly higher DMA at 30, 60 and 90 DAT was recorded in cultivar C_3 (GSC-7) *viz.,*10.3, 114.8 and 166.8 q ha $^{-1}$respectively and was at par with cultivar C_2 (Hyola Adv-45) at 30, 60 and 90 *viz.,* 8.61, 109.77 and 158.25 q ha^{-1} respectively. Lowest DMA was recorded in cultivar C_1(Kenola-1001) at 30, 60 and 90 DAT *viz.,* 8.13, 104.57 and 150.66 q ha^{-1} respectively. It may be due to the fact that cultivar C_3 (GSC-7) has more number of leaves, branches and plant density unit^{-1} area.

Among intra row spacing treatments, S_1(45 cm×10 cm), recorded significantly higher dry matter accumulation (30, 60 and 90 DAT *i.e.* 11.6, 145.8 and 175.0 q ha^{-1} respectively) throughout the crop growth and was at par the wider row spacing treatments *viz.,* S_2 (45 cm×20 cm), S_3 (45 cm×30 cm) and S_4 (45 cm×40 cm) respectively. The high dry matter at narrow spacing could be attributed to higher plant population unit^{-1} area. The lowest dry matter accumulation was recorded in treatment S_4 (5 cm×40 cm) and was due to lower number of plants unit^{-1} area. The increase in dry matter with increasing plant density or decreasing of intra row spacing indicates the favorable response of canola biomass produced to increase plant density. It is perhaps related to accelerating the photosynthesis activity due to higher leaf area index caused increase in dry matter accumulation. This is in line with the findings of Pal (2001) and Singh (2019), who reported significantly higher dry matter accumulation at narrow intra row spacing treatment as compared to other wider row spacing treatments and canola cultivars.

Interaction effect of different cultivars and intra row spacing treatments with respect to dry matter accumulation was found to be non-significant.

Seed, stover and biological yield

Seed yield

Data regarding the seed yield of transplanted canola cultivars as influenced by intra row spacing treatments are presented in Table 1.

Among the main plot treatments, significantly highest mean seed yield was recorded in cultivar C_3 (GSC-7) *viz.,*20.63 q ha^{-1}which was at par with cultivar C_2 (Hyola Adv-45) *viz.,* 16.26 q ha^{-1} and C_1(Kenola-1001) *viz.,* 14.30 q ha^{-1}. Different cultivars significantly influenced the seed yield of canola. The per cent increase in seed yield of cultivar C_3 (GSC-7) over C_2 (Hyola Adv-45) and C_1 (Kenola-1001) was 26.87 and 44.26 respectively.

Further data revealed that among different sub plot treatments, highest seed yield was recorded in treatment S_1 (45 cm×10 cm) *viz.,* 19.04 q ha^{-1} which was significantly superior over treatment S_2 (45 cm×20 cm) *viz.,* 17.40 q ha^{-1}and S_3 (45 cm×30 cm) *viz.,* 16.50 q ha^{-1}. Minimum seed yield was recorded in intra-row spacing treatment S_4 (45 cm×40 cm) *viz.,*15.33 q ha^{-1}. The increase in seed yield at closer spacing was mainly due to increase in plant population unit^{-1} area. The yield of individual plant may be low but the overall yield is higher due to more number of plants unit^{-1} area. The results corroborated the findings of Patel *et al.* (2017) and Jaiswal *et al.* (2019), who revealed significant difference in seed yield of different cultivars of Indian mustard. Singh *et al.* (2021) reported similar average seed yield of canola cultivar GSC-7. Similarly, Yadav *et al.* (2018) and Das *et al.* (2019) reported significantly higher seed yield at narrow intra row spacing treatment as compared to other wider row spacing treatments and in different cultivars of mustard.

Interaction effect of different cultivars and intra row spacing treatments with respect to seed yield was found to be non-significant.

Stover yield

The vegetative growth of the plant which is reflected into dry matter accumulation at the time of harvest is known as stover yield. The data on stover yield as influenced by different cultivars and intra-row spacing treatments in transplanted canola are presented in Table 1.

The perusal of data showed that different cultivars influenced significantly stover yield. Significantly highest mean stover yield was recorded in cultivar C_3 (GSC-7) *viz.,* 74.00 q ha^{-1} which was at par with C_2 (Hyola Adv-45) *viz.,* 57.33 q ha^{-1}. However, in cultivar C_1(Kenola-1001) minimum stover yield *viz.,* 50.08 q ha^{-1}was recorded. The per cent increase in stover yield of cultivar C_3 (GSC-7) over C_2 (Hyola Adv-45) and C_1(Kenola-1001) was 29.07 and 47.76 respectively.

Among different sub plot treatments, S_1(45 cm×10 cm) recorded significantly higher straw yield *viz.,* 66.88 q ha^{-1} which was at par with other intra row spacing treatments S_2 (45 cm×20 cm) *viz.,* 61.22 q ha^{-1}, S_3 (45 cm ×30 cm) *viz.,* 58.77 q ha^{-1} and S_4 (45 cm×40 cm) *viz.,* 55.00 q ha^{-1}. The higher stover yield in S_1 could be taken as a function of more number of plants unit^{-1} area. The results corroborated the findings of Patel *et al.* (2017) and Jaiswal *et al.* (2019), who recorded significant difference in stover yield of different cultivars of Indian mustard. Similarly, Yadav *et al.* (2018) and Das *et al.* (2019) reported significantly higher stover yield of mustard at narrow intra row spacing treatment as compared to other wider row spacing treatments and in different cultivars of mustard.

Interaction effect of different cultivars and intra row spacing treatments with respect to stover yield was found to be non-significant.

Biological yield

Before threshing of harvested crop, the biomass yield composing of seed and stover of crop under each treatment net^{-1} plot was recorded. Data regarding biological yield as affected by different cultivars and intra row spacing treatments under transplanted conditions are presented in Table 1.

Table 1. Growth parameters and yield attributes as influenced by cultivars and intra row spacing treatments

Treatments	Plant height (cm)			Leaf area index			Dry matter accumulation (q ha^{-1})			Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
	30DAT	**60 DAT**	**90DAT**	**30 DAT**	**60 DAT**	**90 DAT**	**30 DAT**	**60DAT**	**90DAT**				
Cultivars													
C_1	37.54	74.93	162.58	0.73	1.89	2.69	8.13	104.57	150.66	14.30	50.08	64.37	22.15
C_2	39.62	77.35	168.16	0.85	2.02	2.82	8.61	109.77	158.25	16.26	57.33	73.76	22.13
C_3	42.98	82.39	175.25	0.97	2.10	2.96	10.39	114.80	166.81	20.63	74.00	94.63	21.72
SE(m)±	0.98	2.01	3.23	0.03	0.05	0.06	0.35	2.59	4.10	0.55	1.49	2.09	0.13
CD (p=0.05)	2.87	5.65	9.07	0.10	0.15	0.19	0.99	7.53	11.90	1.60	4.19	6.08	-
Intra row spacing (cm)													
S_1	41.43	81.68	174.33	1.26	2.46	3.14	11.61	145.83	175.03	19.04	66.88	85.93	22.13
S_2	40.62	79.48	170.77	0.80	2.04	2.90	9.87	121.84	163.35	17.40	61.22	78.62	22.10
S_3	39.95	77.36	166.66	0.74	1.81	2.74	7.77	98.38	153.71	16.50	58.77	75.25	21.91
S_4	38.18	74.35	162.88	0.59	1.70	2.52	6.92	72.8	142.22	15.33	55.00	70.55	21.87
SE(m)±	0.69	1.64	2.75	0.03	0.04	0.05	0.33	3.46	3.27	0.47	1.54	1.99	0.06
CD (p=0.05)	-	4.76	7.70	0.10	0.12	0.16	0.98	10.05	9.50	1.27	4.88	5.59	-
Interaction													
SE(m)±	0.78	1.24	2.02	0.08	0.09	0.07	0.63	8.27	4.16	0.89	3.29	4.17	0.12
CD (p=0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

The biological yield was significantly affected by different Canola cultivars. Significantly higher biological yield was recorded in cultivar C_3 (GSC-7) *viz.,* 94.63 q ha^{-1} which was at par with C_2 (Hyola Adv-45) *viz.,* 73.76 q ha^{-1} and C_1 (Kenola-1001) *viz.,* 64.37 q ha^{-1}. The per cent increase in biological yield of cultivar C_3 (GSC-7) over C_2 (Hyola Adv-45) and C_1 (Kenola-1001) was 28.29 and 47.00 respectively.

Among different intra row spacing treatments, S_1 (45 cm×10 cm) recorded significantly higher biological yield (85.93 q ha^{-1}) which was at par with other intra row spacing treatments S_2 (45 cm×20 cm) *viz.,* 78.62 q ha^{-1}, S_3 (45 cm×30 cm) *viz.,* 75.25 q ha^{-1}. Lowest biological yield was recorded in intra row spacing treatment $_4$ (45 cm×40 cm) *viz.,* 70.55 q ha^{-1}. The increase in biological yield of S_1 (45 cm×10 cm) might be due to higher seed, stover yield and plant population unit^{-1} area. The results are in conformity with Yadav *et al.* (2018), who reported significantly higher biological yield at narrow intra row spacing treatment as compared to other wider row spacing treatments and Jaiswal *et al.* (2019), who reported significant difference in biological yield of different cultivars of Indian mustard.

Interaction effect of different cultivars and intra row spacing treatments with respect to biological yield was found non-significant.

Harvest index (HI)

The harvest index (HI) is the ratio of grain yield to the total biomass and represents the harvest yield of crops. Higher the harvest index better is the economic return from the crop. Data regarding harvest index as affected by different cultivars and intra row spacing treatments under transplanted conditions are presented in Table 1. The perusal of data showed that harvest index (HI) was found non-significantly influenced by different cultivars of canola and intra row spacing treatments under transplanting conditions. The results corroborated the findings of Yadav *et al.* (2018), who reported non-significant results of harvest index in different intra row spacing treatments and cultivars. Similarly, Jaiswal *et al.* (2019) reported non-significant harvest index values in different cultivars of Indian mustard.

Interaction effect of different cultivars and intra row spacing treatments with respect to harvest index was found to be non-significant.

REFERENCES

Asaduzzaman, Md., J.E. Pratley, D. Luckett, D. Lemerle and Wu.Hanwen, 2020. Weed management in canola (*Brassica napus* L.): a review of current constraints and future strategies for Australia. Archives Agron. Soil Sci. **66**(4): 427-44.

Anonymous, 2021.Package of practices for crops of Punjab, *Rabi* 2021-22, Punjab Agricultural University, Ludhiana, Punjab, India.

Brar, Z.S., D.S. Bal and A.S. John, 1998. Influences of sowing dates, nitrogen and planting geometry on the performance of Gobhisaron (*Brassica napus* spp.*olifera* var. annua).Indian J. Agron.**43**(1): 133-37.

Das, A., M. Ray and K. Murmu, 2019. Yield and yield attributes of hybrid mustard as affected by crop geometry and varieties. Int. J. Curr. Microbiol. App. Sci. **8**(4): 2160-66.

Dhongade, A.P., R.D. Deotale, B. Nair, N.D. Jadhav and V.A. Guddhe, 2019. Assessment of M_4 Indian mustard mutants for morpho- physiological variability and yield attributes. J. Soils and Crops. **29**(1): 140-45.

Gopale, R., R.D. Deotale, A.N. Raut, S.R. Patil and S.R. Kamdi, 2021.Response of different sowing dates on morpho-physiological parameters and yield in mustard genotypes. J. Soils and Crops. **31**(2): 297-304.

Jaiswal, P., A.N. Mishra, A.K. Singh, S.R. Mishra, R. Kumar, G. Singh and K.D. Sharma, 2019. Studies on mustard (*Brassica juncea* L.) varieties under various crop growing environment in eastern plain zone. Int. J. Chemi. Stud. **7**(4): 1959-63.

Kler, D.S. 1988. Better use of solar energy for improving crop yield through bi-directional sowing. Indian Rev. life Sci. **8**: 121-46.

Leach, J.E., H.L. Stevenson, A.J. Rainbow and L.A. Mullen, 1999. Effects of high plant populations on growth and yield of winter oilseed rape (*Brassica napus*). J. Agric. Sci. **132**: 173-80.

Oad, F.C., B.K. Solangi, M.A. Samo, A.A. Lakho, Zia-Ul-Hassan and N.L. Oad, 2001.Growth, yield and relationship of rapeseed (*Brassica napus* L.) under different row spacing. Int. J. Agric. Bio. **3**: 475-76.

Pal, R. 2001.Comparative performance of transplanted canola (*Brassica napus* L.) genotypes in relation to intra-row spacing and age of seedlings. Unpublished M.Sc. Thesis, Punjab Agricultural University, Ludhiana, India.

Patel, A., A.K. Singh, S.V. Singh, A. Sharma, N. Raghuvanshi and A.K. Singh, 2017. Effect of different sowing dates on growth, yield and quality of various Indian mustard (*Brassica juncea* L.) varieties. Int. J. Curr. Microbiol. App. Sci. **4**: 71-77.

Singh, A. 2019.Performance of canola (*Brassica napus* L.) at different age of seedling under the system of mustard intensification.Unpublished M.Sc. Thesis, Khalsa College, Amritsar, Punjab, India.

Singh, L., R. Sharma and N. Singh, 2021.Effect of foliar application of sulphur and integrated nutrient management on yield, quality and economics of bed transplanted canola (*Brassica juncea* L.). Indian J. Agri. Res. **55**(2): 192-96.

Sapkal, A.D., S.R. Kamdi, B. Nair, R.D. Deotale, P.D. Raut, S.S. Bhure and J.M. Parbat, 2021. Heterosis for seed yield and yield contributing characters in Indian mustard (*Brassica juncea* L.). J. Soils and Crops. **31**(1): 152-57.

Shahbandeh, M. 2022. Rapeseed production volume worldwide 2020-2021, by country.https://www.statistica.com

Yadav, A., A.K. Singh, R. Chaudhari and S.R. Mishra, 2018. Effect of planting geometry on growth and yield of mustard (*Brassica juncea* L.) varieties. J. Pharma. Phytoch.**7**(3): 2624-27.

Rec. on 07.6.2022 & Acc. on 11.07.2022