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Role of Agronomic Interventions on Quality and Yield of Oil in Transplanted Canola (*Brassica napus* L.)

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ABSTRACT

Canola is an important oilseed crop throughout the world and is grown in more than fifty-three countries. Planting geometry plays an important role in achieving higher production, because of an optimum number of crop plants per unit area and efficient utilization of available nutrients. Planting geometry has an effect on yield through its influence on light interception, rooting pattern and moisture extraction. Besides the research for best plant geometry, it is also essential to screen suitable varieties for procuring a higher yield of seed as well as oil. A field experiment entitled "Role of agronomic interventions on quality and yield of oil in transplanted canola (*Brassica napus* L.)" was carried out at Student's Research Farm, P.G. Department of Agriculture, Khalsa College, Amritsar during winter (*rabi*) season of 2021-2022 on sandy loam soil. The experiment was laid out in split plot design (SPD) with three replications and twelve treatment combinations comprising of three different varieties in main-plots *viz.,* V_1 (Kenola-1001), V_2 (Hyola Adv-45) and V_3 (GSC-7) with four planting geometries *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) allotted in sub-plots. Among the varieties, GSC-7 recorded significantly higher oil yield and oil content (8.63 q ha^{-1} and 42.31%) as compared to Hyola Adv-45 (6.85 q ha^{-1} and 40.17%) and Kenola-1001 (5.70 q ha^{-1} and 38.33%). Among various planting geometries, S_1 (45 cm × 10 cm) recorded significantly higher oil yield and oil content (8.44 q ha^{-1} and 42.92%). Significantly higher content of stearic acid (2.69%), palmitic acid (5.04%), linoleic acid (16.39%), linolenic acid (7.57%) and erucic acid (1.73%) were recorded in GSC-7 variety. Sub-plot treatment S_1 recorded arithmetically improved stearic acid (2.51%), palmitic acid (4.60%), linoleic acid (15.72%), linolenic acid (7.21%) and erucic acid (1.62%) content compared to other treatments. Statistically improved protein content (24.72%) and NPandK (3.97%, 0.73% and 0.95%) was recorded in GSC-7.

Key words: Canola, Oil yield, Planting geometry, Transplanted, Varieties.

Canola (*Brassica napus* L.) is an essential oil seed crop in the world. Its oil is used as biofuel, for human consumption, for feeding animals, used in chemical and pharmaceutical industries (Friedt and Snowdon, 2009). It belongs to family *Cruciferae,* which is becoming one of the major sources of vegetable oil in the world (Bhagdadi *et al.,* 2012). The crop has commercial importance because with having a high oil content of about 30-45% (Oad *et al.,* 2001). It has low erucic acid and glucosinolates also known as "double zero" varieties which had made canola oil more popular (Saleem *et al.,* 2001). The global production of rapeseed oil reached nearly 29.2 million metric tonnes. Canada is the leading rapeseed-producing country in the world with a production of 19.49 million metric tonnes followed by the 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 the world followed by Australia (Asaduzzaman *et al.,* 2020). India is the fourth largest producer of rapeseed in the world with a production of 8.5 million metric tonnes in 2020-2021 (Shahbandeh, 2022). In Punjab, rapeseed and mustard were grown on 31.0 thousand hectares of land with a production of 46.5 thousand tonnes in 2019-2020. The average yield was 14.82 q ha^{-1} (Anonymous, 2021).

Among the different agronomic practices, planting geometry plays an important role in achieving higher yield potential, because of an optimum number of crop plants per unit of area and efficient utilization of available nutrients and other resources. Besides, the research on best plant geometry, it is also essential to screen the suitable varieties planted under a suitable geometry for producing higher yield of seed as well as oil. Since, canola achieves maximum yield at a relatively low plant density, any increase in the plant density above the necessary level to reach the yield plateau serves only in escalated production costs without increasing the yield. However, very low plant densities may not enable attainment of the yield plateau (Hay and Walker, 1989). The planting pattern has an effect on crop yield through its influence on light interception, rooting pattern and moisture extraction (Kler, 1988). A uniform distribution of plants per unit area is a prerequisite

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for yield stability (Diepenbrock, 2000). Hence, finding out the optimum plant geometry is essential for realizing the higher productivity of oilseed rape to a great extent.

A field experiment was carried out during the winter (*rabi*) season of 2021-22 at Student's Research Farm, Department of Agronomy, Khalsa College, Amritsar, Punjab, India. The geographical distribution of the experimental site is 31.63°N, 74.87°E and height above mean sea is 224.33m. The climate of the study area is classified as tropical, semi-arid and hot which is mainly dry with very hot summer**s** and cold winter**s** except during southwest monsoon season. The average annual rainfall in the district is 541.9 mm. The soil of experimental site was sandy loam in texture, having a normal pH (8.2), normal EC (0.34 dSm^{-1}), low organic carbon (0.40%), low in available N (180.2 kg ha^{-1}), medium in available P (16.8 kg ha^{-1}) and medium in available K (258 kg ha^{-1}), respectively during the study. The sand, silt and clay were 74, 15 and 11%, respectively. The experiment was laid out in split plot design with three replications. There were thirty-six plots with twelve treatment combinations comprising three different canola varieties V_1 (Kenola-1001), V_2 (Hyola Adv-45) and V_3 (GSC-7) assigned as main-plots and four planting geometries 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) set as subplots. The observations on different quality parameters *viz.,* oil yield, oil content, protein content, nitrogen content, phosphorus content and potassium content were recorded. The content of saturated and unsaturated fatty acids was also noted. The oil was extracted and collected in glass vials as per treatment by an automatic press machine. Nitrogen, phosphorus and potassium content were determined by the modified Micro-Kjeldahl method, 0.5 N $NaHCO_3$ extractable method (pH:8.5) and ammonium acetate extractable K using Flame Photometer, respectively. The total saturated and unsaturated fatty acids in oil were estimated by FT-NIR (Fourier transform near-infrared spectroscopy). The crop was raised according to recommended package of practices of Punjab Agricultural University, Ludhiana. Statistical analysis of the data recorded was done as per split-plot design using EDA 1.1 software. Critical difference (CD) at 5% probability was used to compare the differences among treatments.

The analysis of data presented in Table 1 reveals that among different varieties significantly highest oil yield was recorded in variety V_3 (8.63 q ha^{-1}) in comparison with V_2 (6.85 q ha^{-1}) and lowest oil yield was recorded in variety V_1 (5.70 q ha^{-1}). Among different planting geometries, S_1 recorded significantly higher oil yield (8.44 q ha^{-1}) compared to S_2 (7.33 q ha^{-1}) and S_3 (6.49 q ha^{-1}), respectively. However, minimum oil yield was recorded in planting geometry of S_4 (5.98 q ha^{-1}). Similar results were also reported by Patel *et al.,* (2017), Shergill *et al.,* (2012) and Sandhu *et al.,* (2015).

The data interpretation of oil content in different varieties of canola in different planting geometries under transplanting conditions is given in Table 1. Significantly highest oil content was recorded in V_3 variety (42.31%) compared to V_2 (40.17%). However, in variety, V_1 minimum oil content (38.33%) was recorded. Among different planting geometries, significantly higher oil content was recorded in treatment S_1 (42.92%) compared to treatments S_2 (41.34%) and S_3 (39.22%). Minimum oil content was recorded in planting geometry S_4 (37.61%). This is in line with the findings of Wahid *et al*., (2009), Singh *et al*., (2021) and Shahin *et al*., (2009).

The data reveals that statistically higher protein content was recorded in variety V_3 (24.72%) followed by V_2 (24.67%) and V_1 (23.48%), respectively. But the data doesn't varied significantly. Among different planting geometries, statistically improved protein content was recorded in S_1 (24.62%) followed by S_2 (24.58%), S_3 (23.75%) and S_4 (23.69%) respectively but statistically, the data was non-significant. The results corroborated the findings of Patel *et al.,* (2017) and Wahid *et al.,* (2009).

The data presented revealed that statistically improved nitrogen content in both seed and stover was recorded in variety V_3 (3.97 and 0.54%) followed by V_2 (3.95 and 0.52%) and V_1 (3.79 and 0.51%) but the data was non-significant. Further, among the different planting geometries, the nitrogen content in seed and stover was statistically improved in S_1 (3.93 and 0.52%) followed by S_2 (3.88 and 0.51%), S_3 (3.79 and 0.49%) and S_4 (3.78 and 0.48%) but the values were non-significant when compared with each other. The results were in agreement with the findings of Patel *et al.,* (2017) and Alka, (2019).

The data revealed that among the different varieties, the phosphorus content in seed and stover was statistically highest improved in variety V_3 (0.73 and 0.34%) compared to V_2 (0.72 and 0.32%) and V_1 (0.70 and 0.31%), but the data was non-significant. Among different planting geometries, phosphorus content in both seed and stover was non-significantly. However, satistically improved phosphorus content in seed and stover was realized in geometry S_1 (0.71 and 0.33%) compared to S_2 (0.71 and 0.32%), S_3 (0.69 and 0.30%) and S_4 (0.68 and 0.30%). The results are in line with the findings of Alka (2019).

The data pertaining to potassium content in seed and stover of different varieties and planting geometries of transplanted canola. Among the different varieties, the potassium content in seed and stover was statistically improved in variety V_3 (0.95 and 1.90%) followed by V_2 (0.94 and 1.88%) and V_1 (0.89 and 1.85%) but the data was non-significant. Statistically improved potassium content in seed and stover was recorded in planting geometry S_1 (0.93 and 1.87%) as compared to S_2, S_3 and S_4 but the data varied non-significantly.

The palmitic acid (16:0) and stearic acid (18:0) contents differed significantly in the different varieties of transplanted canola. Whereas, variety V_3 had recorded significantly higher content of stearic acid and palmitic acid (2.69% and 5.04%) compared to V_2 (2.50% and 4.53%). Significantly lower content of stearic acid and palmitic acid (2.33% and 4.25%) were noticed variety V_1. Statistically higher content of stearic acid and palmitic acid (2.51% and 4.60%) were

Table 1: Quality parameters of canola as influenced by different varieties and planting geometries.

Treatment	Oil yield (q ha^{-1})	Oil content (%)	Protein content (%)	Nitrogen content (%)		Phosphorus content (%)		Potassium content (%)		Saturated fatty acids (%)		Unsaturated fattyacids (%)		
				Seed	Stover	Seed	Stover	Seed	Stover	Stearic acid (18:0)	Palmitic acid (16:0)	Linoleic acid (18:2)	Linolenic acid (18:3)	Erucic acid (22:1)
Varieties														
V_1	5.70	38.33	23.48	3.79	0.51	0.70	0.31	0.89	1.85	2.33	4.25	14.54	6.71	1.34
V_2	6.85	40.17	24.67	3.95	0.52	0.72	0.32	0.94	1.88	2.50	4.53	15.89	7.02	1.52
V_3	8.63	42.31	24.72	3.97	0.54	0.73	0.34	0.95	1.90	2.69	5.04	16.39	7.57	1.73
SEm±	0.36	0.98	0.40	0.05	0.008	0.008	0.008	0.01	0.01	0.10	0.23	0.55	0.25	0.11
CD (p=0.05)	1.05	2.87	NS	NS	NS	NS	NS	NS	NS	0.26	0.66	1.5	0.72	0.31
Planting geometry														
S_1	8.44	42.92	24.62	3.93	0.52	0.71	0.33	0.93	1.87	2.51	4.60	15.72	7.21	1.62
S_2	7.33	41.34	24.58	3.88	0.51	0.71	0.32	0.93	1.86	2.42	4.42	15.58	6.83	1.59
S_3	6.49	39.22	23.75	3.79	0.49	0.69	0.30	0.91	1.83	2.31	4.41	15.57	6.81	1.58
S_4	5.98	37.61	23.69	3.78	0.48	0.68	0.30	0.90	1.82	2.30	4.39	14.97	6.80	1.54
SEm±	0.27	0.92	0.28	0.03	0.008	0.008	0.006	0.008	0.01	0.04	0.04	0.16	0.09	0.01
CD (p=0.05)	0.80	2.68	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

recorded in treatment S_1 compared to other treatments. The results corroborated the findings of Alka, (2019), Farahmandfar *et al.,* (2015) and Sandhu *et al.,* (2015).

The data pertaining to contents of linoleic acid (18:2), linolenic acid (18:3) and erucic acid (22:1) were influenced significantly by the different varieties of transplanted canola. Among the different varieties, significantly superior content of linoleic acid, linolenic acid and erucic acid (16.39, 7.57 and 1.73%) was recorded in variety V_3 compared to V_2 (15.89, 7.02 and 1.52%). The lower amount of linoleic acid, linolenic acid and erucic acid (14.54, 6.71 and 1.34%) were found in variety V_1. The perusal of data revealed that the amount of unsaturated fatty acids under different planting geometries was found non-significant. Statistically improved content of linoleic acid, linolenic acid and erucic acid (15.72, 7.21 and 1.62%) was recorded in planting geometry S_1. Results agreed with the study of Alka, (2019), Farahmandfar *et al.,* (2015) and Sandhu *et al.,* (2015).

CONCLUSION

The findings of the present study revealed that among the different varieties, V_3 had recorded significantly higher oil yield and oil content (8.63 q ha^{-1} and 42.31%) in comparison to other varieties of canola. Similarly, higher content of stearic acid (2.69%), palmitic acid (5.04%), linoleic acid (16.39%), linolenic acid (7.57%) and erucic acid (1.73%) were also noticed with the same variety (GSC-7). Statistically improved content of protein (24.72%) and macronutrients (N; 3.97% seed and 0.54% stover, P; 0.73% seed and 0.34% stover, K; 0.95% seed and 1.90% stover) were also registered in variety V_3. Among the subplot treatments, S_1 (45 cm × 10 cm) registered maximum oil yield and oil content (8.44 q ha^{-1} and 42.92%). Maximum content of stearic acid (2.51%), palmitic acid (4.60%), linoleic acid (15.72%), linolenic acid (7.21%) and erucic acid (1.62%) were also recorded in planting geometry S_1. Statistically improved content of protein (24.62%) and macronutrients (N; 3.93% seed and 0.52% stover, P; 0.71% seed and 0.33% stover, K; 0.93% in seed and 1.90% in stover) were also registered in S_1 planting geometry.

Conflict of interest: None.

REFERENCES

Alka, (2019). Enhancing the performance of oilseed *Brassica* through the system of mustard intensification. Unpublished M.Sc. Thesis, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India.

Anonymous, (2021). Package of Practices For Crops Of Punjab, Rabi 2021-22, Punjab Agricultural University, Ludhiana, Punjab, India.

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

Bhagdadi, H., Taspinar, S., Yousefi, M., Hosseinpour, (2012). Influence of different sowing dates on grain yield of canola (*Brassica napus* L.) cultivars in Qazvin area. International Journal of Agricultural Sciences. 2(5): 1092-96.

Diepenbrock, W. (2000). Yield analysis of winter oilseed rape (*Brassica napus* L.): A review. Field Crops Research. 67(1): 35-49.

Farahmandfar, R., Asnaashari, M., Sayyad, R. (2015). Comparison antioxidant activity of *Tarom Mahali* rice bran extracted from different extraction methods and its effects on canola oil stabilization. Journal of Food Science and Technology. 52(10): 6385-94.

Friedt, W., Snowdon, R.J. (2009). Oilseed Rape- In: Handbook of plant breeding. [Vollman, J., Rajcan, I. (eds.)]. Oil crops, Springer, New York, pp. 91-126.

Hay, R.K.M., Walker, A.J. (1989). An introduction to the physiology of crop yield. pp. 163-87.

Kler, D.S. (1988). Better use of solar energy for improving crop yield through bi-directional sowing. Indian Journal of Life Sciences. 8: 121-46.

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

Patel, A., Singh, A.K., Singh, S.V., Sharma, A., Raghuvanshi, N., Singh, A.K. (2017). Effect of different sowing dates on growth, yield and quality of various Indian mustard (*Brassica juncea* L.) varieties. International Journal of Current Microbiology and Applied Sciences. 4: 71-77.

Saleem, M., Cheema, M.A., Malik, M.A. (2001). Agro-economic assessment of canola planted under different levels of nitrogen and row spacing. International Journal of Agricultural Biology. 3: 1560-8530.

Sandhu, P.S., Mahal S.S., Sardana, V. (2015). Performance of promising hybrids of Indian mustard (*Brassica juncea* L. Czern and Coss) under varying levels of nitrogen and row spacing. Journal of Crop and Weed. 11(1): 204-07.

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

Shahin, Y., Valiollah, R. (2009). Effects of row spacing and seeding rates on some agronomical traits of spring canola (*Brassica napus* L.) cultivars. Journal of Central European Agriculture. 10(1): 115-22.

Shergill, L.S., Gill, B.S. (2012). Influence of various levels of nitrogen, cultivars and weed control treatments on quality traits of canola *gobhi sarson* (*Brassica napus* L.). Advance Research Journal of Crop Improvement. 3(1): 1-4.

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

Wahid, M.A., Cheema, M.A., Malik, M.A., Ashraf, M. (2009). Comparative performance of canola hybrids in response to different phosphatic fertilizers. International Journal of Agricultural Biology. 11: 305-10.