



Short Communication

Adaptability of Canola (*Brassica juncea*) Varieties in Different Regions of Oman

HAMID GALOUB ALI¹, SALEEM K. NADAF¹, SAIF A. ALKHAMISI AND AHMED N. AL-BAKRI

Directorate General of Agricultural and Livestock Research, Ministry of Agriculture, PO Box 50; Seeb PC 121, Sultanate of Oman

¹Corresponding author's e-mail: hamid_chaloub@hotmail.com; saleem_nadaf@yahoo.com

ABSTRACT

Three varieties of canola (Canola 1, Hyola 43 & Hyola 60) were tested in four regions-three in northern Oman viz. Al-Kamil Research Station in Sharqia, Wadi Hibi Research Station in Sohar and Jimah Research Station in Interior region and one at Salalah Research Station in Dhofar province (Southern Oman) to comprehend their response and adaptability to different agro-climate regions of Oman. Experiments were conducted consecutively for three years from 2004/2005 to 2006/2007 during winter (November to April) season. The results demonstrated that there were significant differences for location (Region) with respect to both seed yield and plant height. There were no significant differences among the varieties in seed yield during 2004/2005 and 2005/2006 in Jimah, Sohar and Salalah, while interestingly significant differences were found during 2004/2005 in Al-Kamil and during 2006/2007 in Salalah and Sohar. These results indicated that canola is highly adaptable to different regions of Oman with relative advantage for certain regions for both seed yield productivity and oil content. However, canola can be exploited in all the regions as a source of nectar for honey bees during the period of its blooming. © 2011 Friends Science Publishers

Key Words: Productivity; Seed yield; Plant height; Oil content; Canola; Agro-climatic regions

INTRODUCTION

Canola (*Brassica juncea* L.) is a new introduced crop in Oman from Australia. It is an oil crop and was developed through conventional breeding from rapeseed. Canola is recognized as one of the best edible vegetable oils for human consumption as it contains the lowest level of saturated fat (40-45%) and 36-40% protein in the seed (Alberta Agriculture, 1984). It contains oil. Canola oil and meal are now readily acceptable as alternatives to soybean oil and meal (Amin & Khalil, 2005; Mohammad *et al.*, 2007). In addition to oil production, canola provides high quality forage because of its low fiber and high protein content in its stem and leaves (Wiedenhoeft & Bharton, 1994).

Canola has become a major crop in many countries around the world like Canada, Australia, China, USA, etc for its significant contribution to the national economy. In Canada for instance, Canola industry adds over \$11 billion to its national economy. It can be comparable to one of these crops having high water-use efficiency and tolerance to drought (Howell, 2000) and salinity (A-Thabet, 2003). Research efforts show that canola can be grown successfully as winter annual with machinery required and production cost similar to those for wheat and with profit potential equal or better than wheat (Raymer *et al.*, 1996). Sana

et al. (2003) found that some varieties of canola may be susceptible while others may be tolerant to environmental factors. Several studies found variability in plant stature (Maestro, 1995; Reddy & Reddy, 1998), while Munir and McNeilly (1992) found no significant difference for the number of seeds per siliqua and significant differences for 1000-seed weight among different *Brassica* varieties.

In Canola, no information is available on its performance or agronomic requirements related to the arid environments. The information on the effect of different varieties and different regions on seed yield and oil content would help in inclusion of canola in the present cropping system of Oman. Hence present study was undertaken to determine the performance of newly introduced Australian canola varieties and their adaptability to the soil and climatic conditions of different regions of Oman.

MATERIALS AND METHODS

Three varieties of canola crop (Canola 1, Hyola 43 & Hyola 60) were tested in four regions, three in northern Oman viz. Alkamil Research Station in Sharqia, Wadi Hibi Research Station in Sohar and Jimah Research Station in Interior region and one at Salalah Research Station Dhofar province (Southern Oman). Experiments were conducted for three consecutive years (2004/2005, 2005/2006 &

2006/2007) during winter season (November to April) at sandy loam experimental sites. The pH and EC of soil and water at the experimental sites of four locations are presented in Table I. Three varieties of canola were laid out in a Randomized Completely Block Design with four replications. Two to three seeds of each variety were sown at 15 cm plant to plant spacing, in 3 m long 30 cm apart six rows in a plot (2 m × 3 m) just within 2.50 cm depth of soil. Systemic insecticide, Carbofuron (Furadon: 10-15 granules) was broadcasted around each hill to protect seeds from ants. The plots were fertilized with 125 kg N, 100kg P₂O₅ and 60 kg K₂O in the form of urea, triple super phosphate and potassium sulphate for N, P and K, respectively. The entire quantities of K and P fertilizers with 1/2 nitrogen were applied after one month of germination. The crop was grown under sprinkler irrigation. The observations on plant height (cm) and seed yield per plot were recorded at harvest and seed samples of each plot were sent to the laboratory for determination of oil content (%) using Soxhlet instrument with n-hexane (60°C) as organic solvent (AOAC, 1980). The data on only two characters viz. plant height and seed yield were subjected to analysis of variance according to Gomez and Gomez (1984) using MSTAT- C whereas seed oil contents were not analyzed statistically as the pooled samples of three replicates were used for determination.

RESULTS AND DISCUSSION

Table II shows the ANOVA with respect to plant height and seed yield. In respect of both the characters only location effect was highly significant ($p < 0.01$), while the effects of variety and interaction were not significant ($p > 0.05$). The results of the investigation indicated the existence of differential expression of the two characters in three canola varieties under four locations, which are discussed below.

Seed yield: Results showed that only the locations (regions) were significantly different for this character. Salalah had the highest mean seed yield of 2.6 t/ha because of its favorable climatic conditions in Dhofar region as compared to other regions. Al-Kamil had the lowest seed yield (0.95 t/ha). Varieties of canola were significantly different in only Al-Kamil region only during 2004-2005 for seed yield but not during other years and locations, which is evidenced by the absence of interaction effect (Table II). This reflected the response of each variety to different locations. However, behavior of these varieties towards seed yield was comparable. In 2005/2006, there were no significant differences among the three varieties for seed yield in all locations (Table II). The highest seed yield was obtained from Hyola 43 variety (2.35 t/ha) in Salalah followed by Hyola 60 in Al-Kamil (Table III). In 2006/2007, seed yield among the varieties was significantly different only in Jimah, which indicated that Jimah had responded favorably to this year in comparison with the other locations followed by Al-Kamil. The variety Hyola 43 produced highest seed

yield of 3.5 t/ha in comparison with varieties during this year.

In 2004/2005, the highest seed yield was given by Hyola 43 in Salalah (2.74 t/ha) and in 2006/2007 (3.50 t/ha) in Jimah, which indicated the superiority of the variety Hyola-43 in both these regions (Interior & Al-Sharqiya) in respect of seed yield. The variety Canola-1 produced the highest seed yield (2.27 t/ha) in Al-Kamil region. The mean seed yield levels of canola in the present study were variable between the locations/regions ranging from 1.62 to 1.68 t/ha in Al-Kamil (in Al-Sharqiya region), 1.87 to 2.19 t/ha in Jimah (in Interior region), 1.21 to 1.81 t/ha in Sohar (in North Batinah region) and from 1.96 to 2.17 t/ha in Salalah (Southern Dhofar region).

Plant height: Like seed yield, significant differences were found between the locations (regions) (Table II) indicating that this character was influenced by location while no significant interaction was found between variety × location. Although insignificant, the varieties responded differently to each location. Comparison of the varieties in respect of plant height (Table III) revealed significant differences in Al-Kamil and Jimah. In 2004-2005, Hyola 60 was the taller in Al-Kamil (156.75 cm) followed by Canola-1 (151.25 cm) in Al-Kamil, whereas in Jimah Hyola 43 was the tallest (188.50 cm) followed by Canola-1 (179.00 cm). However, at other locations canola varieties did not exceed 167 cm height in any year (Table III). Such differences among canola varieties in plant height might be due to the differences in genetic background (Sana *et al.*, 2003) and the genetic × environment interaction effects in Al-Kamil and Jimah vs Sohar and Salalah. As a result, certain varieties might have responded favorably to certain environmental factors and get adapted to those environments while other maybe not respond well and not adapted (Sana *et al.*, 2003). Maestro (1995) and Reddy and Reddy (1998) found that different *Brassica* varieties differed significantly regarding their plant height.

Oil content: The results for oil contents revealed numerical differences between the varieties with respect to percentage of oil in all the years, under study. The variety Hyola-43 was found superior in the oil content in three regions viz. Al-Kamil, Jimah and Salalah with range of 37.5 to 43.00%, whereas in Sohar region Canola-1 had highest the oil percentage to the extent of 40% in 2004/2005. Sana *et al.* (2003) mentioned that the maximum oil contents in the variety Hyola 43 might be due to the variation in the genetic makeup of the variety. These differences in oil content among canola varieties could be attributed to the genotypic differences (Santonoceto *et al.*, 2002).

In introducing the cultivation of the new crop canola in Omani agriculture, wide adaptability of the crop to four different agro-climatic environments (regions) in giving sustainable economic seed yield to further pursue for possible development of indigenous canola-based oil industry in Oman was considered (MAF, 2007). The realized seed yield levels of canola from 1.21 to 2.19 t/ha in

Table I: pH and electrical conductivity (EC, dS m⁻¹) of experimental soil and water in four locations

Soil properties	Al-Kamil		Jimah		Sohar		Salalah	
	Soil	Water	Soil	Water	Soil	Water	Soil	Water
pH	7.9	7.8 to 8.00	8.1	7.5 to 8.0	7.9	7.0 to 7.5	7.8	7.5 to 8.0
EC	2.0	1.5 to 3.0	2.1	0.93 to 1.0	2.5	1.0 to 2.0	0.7	1.5 to 2.0

Table II: Components of analysis of variance for seed yield (t/ha) and plant height (cm) as represented by the mean square (MS)

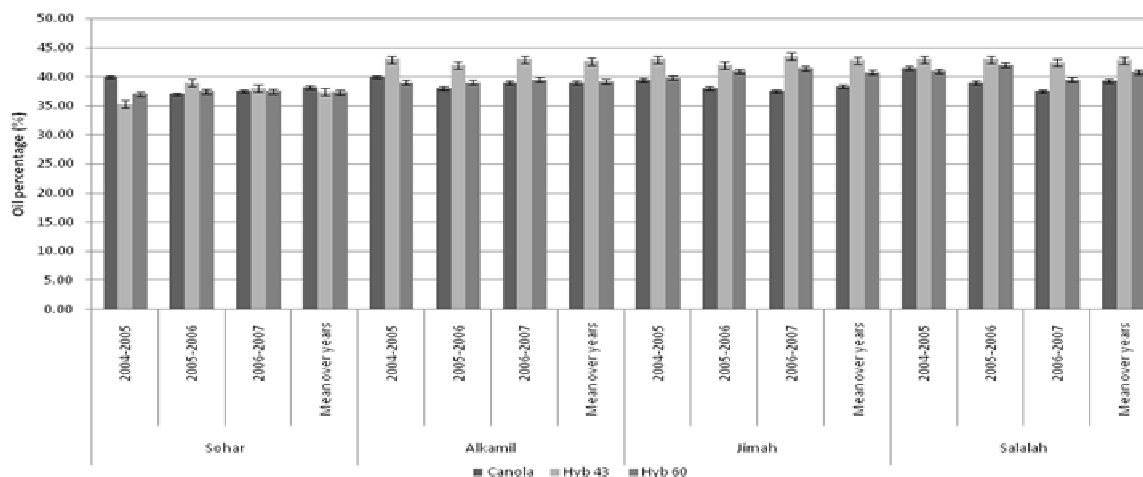
Source of Variation	df	Plant height	Seed yield
Replication	3	57.93	0.3
Variety	2	437.21 NS	0.19 NS
Location	3	15532.48**	3.07 **
Variety × Location	6	337.67	0.08
Error	33	209.27	0.14

NS: No significant difference

**: Significant at 1%

Table III: Canola seed yield and plant height (cm) at 4 locations in 2004-2005, 2005-2006 and 2006-2007

Variety	Alkamil				Jimah				Sohar				Salalah																			
	Plant height (cm)		Seed yield (t/ha)		Plant height (cm)		Seed yield (t/ha)		Plant height (cm)		Seed yield (t/ha)		Plant height (cm)		Seed yield (t/ha)																	
	2004-05	2005-06	2006-07	Mean	2004-05	2005-06	2006-07	Mean	2004-05	2005-06	2006-07	Mean	2004-05	2005-06	2006-07	Mean																
Canola 1	151.25	184.30	188.83	174.79	0.88	1.89	2.27	1.68	179.00	217.00	180.83	192.28	1.37	1.60	2.63	1.87	138.33	135.00	137.50	136.94	0.87	1.74	1.59	1.40	166.51	147.40	154.10	156.00	2.76	2.03	1.47	2.09
Hyola 43	124.50	154.30	145.33	141.38	1.18	1.45	2.22	1.62	188.50	213.50	189.67	197.22	1.21	1.86	3.50	2.19	125.92	130.00	131.06	128.99	1.79	1.62	2.02	1.81	162.35	142.50	144.20	149.68	2.74	2.35	1.42	2.17
Hyola 60	156.75	198.00	218.62	191.12	0.78	2.19	2.23	1.73	176.00	212.00	164.83	184.28	1.44	1.85	3.09	2.13	136.08	140.00	135.00	137.03	0.85	1.54	1.23	1.21	149.60	138.60	152.30	146.83	2.42	2.08	1.37	1.96
Mean	144.17	178.87	184.26		0.95	1.84	2.24		181.17	214.17	178.44		1.34	1.77	3.07		133.44	135.00	134.52		1.17	1.63	1.61		159.49	142.83	150.20		2.64	2.15	1.42	
LSD (5%)	* 2.5	* 10.55	* 8.62		* 0.13	NS	NS		* 9.82	NS	* 12.71		NS	NS	* 0.66		NS	NS	NS		NS	NS	NS		NS	NS	NS		NS	NS	NS	

Fig. 1: Oil content (%) of three canola varieties at four locations in three years, 2004-2005, 2005-2006 and 2006-2007

the present study are comparable with the seed yield levels reported elsewhere in the world, which are quite varying ranging from 1.2 t/ha to 1.3 t/ha under African (Kenya) conditions (Mahasi *et al.*, 2008), from 1.4 t/ha to 2.5 t/ha under Asian (Pakistan) conditions (Sana *et al.*, 2003; Wahid *et al.*, 2009) and from 2.0 to 3.0 under Mexico conditions (Munoz-Valenzuela *et al.*, 2002) among the superior genotypes studied. However, under the conditions of Arabian Peninsula such as in Saudi Arabia, seed yield levels of 0.9 to 1.4 t/ha have been reported (El-Nakhlawy & Bakhshwain, 2009). Thus, canola seed can be exploited for oil production in Oman.

Besides, canola has additional merits of providing forage to the domestic animals and beautiful attractive colored flowers potentially useful as a source of nectar for honey bees during the period of its blooming, in the existing popular honey industry in Oman. Thus, in view of the adaptability of canola for its possible application in oil and honey industry with fodder as a by-product, canola could be conveniently introduced for general cultivation in Oman.

Acknowledgements: We are grateful to the Director General of Agriculture and Livestock Research and Director of Plant Production Research Center, for their assistance and encouragement in conducting experiments. Thanks are also to the staff of Food Technology Research Lab. for their help in determination of oil content.

REFERENCES

- Alberta Agriculture, 1984. *Irrigation Canola Production*. Agdex No. 149/561-1. Alberta Agriculture, Edmonton, Alberta
- Amin, R. and S.K. Khalil, 2005. Effect of pre- and post emergence herbicides and row spacing on canola. *Sarhad J. Agric.*, 21: 165–170
- AOAC, 1980. Association of official agriculture chemists. *Official and Tentative Methods of Analysis*, 13th edition. Washington, DC
- A-Thabet, S.S., 2003. Growth and yield of Canola in response to water salinity. *J. Agric. Sci. Mansoura University*, 28: 761–769
- El-Nakhlawy, F.S. and A.A. Bakhshwain, 2009. Performance of canola (*Brassica napus* L.) seed yield, yield components and seed quality under the effects of four genotypes and nitrogen fertilizer rates. *JKAU: Met., Env. Arid Land Agric. Sci.*, 20: 33–47
- Gomez, K.A. and A.A. Gomez, 1984. *Statistical Procedures for Agriculture Research*, 2nd edition. John Wiley and Sons. New York
- Howell, T.A., 2000. Irrigation role in enhancing water use efficiency. In: *Proceedings of the Fourth Decennial National Irrigation Symposium*, pp: 66–80. November 14-16, Phoenix, AZ., American Society of Agricultural Engineers, St. Joseph, MI
- MAF, 2007. *Performance of Canola Varieties in Oman*, pp: 107–109. Annual Report of Agriculture and Livestock Research-2007. Directorate General of Agriculture and Livestock Research, Ministry of Agriculture and Fisheries. Sultanate of Oman
- Maestro, G., 1995. Rape, Metapontum area. *Informatore Agrario.*, 51: 26–27
- Mahasi, M.J., P. Mbbehero and J.W. Kamundia, 2008. Adaptation of oilseed mustard under Kenyan conditions. *African J. Agric. Res.*, 3: 520–522
- Mohammad, N., M.A. Cheema, M.A. Wahid, N. Ahmad and M. Zaman, 2007. Effect of source and method of nitrogen fertilizer application on seed yield and quality of canola (*Brassica napus* L.). *Pakistan J. Agric. Sci.*, 44: 74–78
- Munir, M. and T. McNeilly, 1992. Comparison of variation in yield and yield components in forage and wild oilseed rape. *Pakistan J. Agric. Sci.*, 13: 289–292
- Munoz-Valenzuela, S., G. Buzza and R. Avalos-Perez, 2002. Performance of canola in Southern Sonora, Mexico. In: Janick, A. and A. Whipkey (eds), *Trends in New Crops and New Uses*. ASHS Press, Alexandria, VA
- Raymer, P.L., J.L. Day and A.E. Coy, 1996. *1995-1996 Canola Performance Tests*. Georgia Agriculture Exp. Sta. The University Georgia, Athens
- Reddy, C.S. and P.R. Reddy, 1998. Performance of mustard varieties on alfisols of Rayataseema Region of Andhra Pradesh. *J. Oilseeds Res.*, 15: 379–380
- Sana, M.A., M. Ali, A. Malik, M.F. Saleem and M. Rafiq, 2003. Comparative yield potential and oil contents of different canola cultivars (*Brassica napus* L.). *Pakistan J. Agron.*, 2: 1–7
- Santonoceto, C., U. Anastasi, E. Riggy and V. Abbate, 2002. Accumulation dynamics of dry matter, oil and major fatty acids in sunflower seeds in relation to genotype and water regime. *Italy J. Agron.*, 7: 3–14
- Wahid, M.A., M.A. Cheema, M.A. Malik and M. Ashraf, 2009. Comparative performance of canola hybrids in response to different phosphatic fertilizers. *Int. J. Agric. Biol.*, 11: 305–310
- Wiedenhoeft, M. and B.A. Barton, 1994. Management and environment effects on Brassica forage quality. *Agron. J.*, 86: 227–237

(Received 05 March 2011; Accepted 10 May 2011)