The potential of canola quality (*Brassica napus* L.) as a new winter oil crop in Egypt

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Abstract

The spring types of *B. napus L.* could be grown successfully under winter season in Egypt. Some genotypes of canola mainly were introduced from abroad were evaluated since 2002 – 2005 at the Experimental Station of National Research Center at Shalakan, Qalubeia Goveronorate, Egypt. Seed yield (kg. /acre), as well as, yield attributes of some canola genotypes were significantly different, except number of seeds / pod and 1000 - seed weight were insignificant. AD201 and also Pactol cvs were surpassed in their yields, while Import 62 and 196 cvs yielded the lowest seed yield. Seed yield / plant (g.) was increased in AD201, Silvo and Serw 6, while the lowest was recorded at Pactol or Import 62 genotypes. Oil percent and also oil yield (Kg. /acre) were significantly different in canola genotypes. The highest oil percent (43.81) and also oil yield (487.806 Kg. / acre) were obtained by AD 201 cv., while the lowest was recorded at Import 196.Fatty acid composition of canola genotypes used were also different, Silvo and Serw 4 cvs had the highest palmitic acid, whereas, Pactol seem to be higher oleic and lower linolenic and erucic acids in comparison to other canola genotypes. At the same time, Silvo cv had the lowest oleic and highest linoleic and linolenic acids, whereas Serw 6 recorded the highest erucic acid (2.66%) compared to other canola genotypes.

Key words: Canola genotypes, yield, seed oil, fatty acid composition.

Introduction

The world area cultivated by *Brassica* species has been increased rapidly during the last ten years due to the intensive work to improve the oil and meal quality of *Brassica* species. Therefore, the winter and spring types of *Brassica napus L.* and *Brassica campestris L.* as well as Indian mustard *Brassica juncea L.* are provide over 13% of global vegetable oil needs (Downey, 1988). In Egypt, the combination of population explosion inadequate of local oil production and increasing consumption rate per capita made it necessary to import large quantities of edible oils every year. Therefore, introducing a new oil crop in winter season seems to be easier due to its lesser water requirements than summer ones.

Since, 1978 some spring types of *Brassica napus L.* have been introduced from Europe and evaluated under Egyptian conditions and the crop has great promise as oilseed crop in the winter season in Egypt (Farag et al, 1986 and Sharaan, 1987). The positive relationship between number of pods, seeds / pod and 1000 – seed weight with seeds / plant and quality of some canola genotypes were reported by other studies (Özer et al., 1999 and Mekki, 2003). The level of erucic acid in rapeseed oil has an important bearing on nutritional and industrial acceptability of the oil. Genetic studies on the inheritance of this fatty acid in rapeseed *Brassica napus L* have established, Downey and Harvey (1963) reported that fatty acid content in species *Brassica napus L.* was under embryonic genes and that erucic acid content is controlled by two genes acting in an additive manner.

Therefore, the main objective of this work aims to evaluation the potential of yield and quality of some canola genotypes under Egyptian conditions.

Materials and methods

Eight canola (*Brassica napus* L.) genotypes were grown in winter seasons 2002 - 2005 at the Experimental Station of National Research Center at Shalakan, Qaluebia Governorate, Egypt in order to evaluation the potential of yield and quality of eight canola genotypes. The canola genotypes were chosen from different sources is shown in Table 1.

Table 1. Sources of canola genotypes

Genotypes	Origin
Pactol	France
Silvo	France
Topas	France
AD 201/ 81 Gi.	Germany
Import 62	Denmark
Import 196	France
Serw 4	Egypt
Serw 6	Egypt

Seeds of eight canola genotypes were drilled in 20cm. between rows at seeding rate of 3.0 Kg./ acre during winter seasons started from November 20, 2002/2003, 2003/2004 and 2004/ 2005. The experimental unit area was 3.0 x 3.5 m., a randomize complete block design with four replication was done. The soil site was analyzed according to Jackson (1970), the texture is clay, EC.dSm^{-1} 0.49, pH 8.26, OM% 1.60, Ca CO_3 % 2.90, available N, P and K,48.10, 13.70 and 98.00 ppm, respectively. Phosphorus and potassium fertilizers were added at sowing at a rate of 200 and 100 Kg / acre of superphshate (15.5 % P_2O_5) and potassium sulphate (48.0 % K_2O), respectively. Nitrogen fertilizer was added at a rate of 60.0 kg N / acre in form of ammonium nitrate (33.5 % N). At harvest time (165 days from sowing) the three inner rows for each unit area were taken for determining the seed yield and yield attributes. Seed oil content was determined according to A.O.C.S (1982), and then the oil yield (Kg/ acre) was calculated. Fatty acid composition was also determined using methyl etherification and Gas – Liquid Chromatography (Chrisite, 1973). All obtained data of yield and its components were statistically analysis according to Snedecor and Cochran (1980) and the combined analysis according to Steel and Torrie (1980).

Results and discussion

The results presented in Table 2 show that the studied canola genotypes were significantly different in all yield characters, except seeds/ pod and 1000-seed weight. Data showed that some canola genotypes were surpassed in their seed yield (kg / acre) such as AD 201, Pactol and Serw 4. AD 201 yielded the highest seed yield (1116.725 kg / acre), however the other three genotypes, Pactol, Serw 4 and 6 yielded approximately the same seed yield / plant, number of pods and seeds / pod, as well as, 1000- seed weight. The positive relationship between number of pods and 1000 seed weight with seeds per plant and consequently with seed yield (kg / acre) were reported by other studies (Özer et al, 1999 and Mekki, 2003). On the other hand, the other canola genotypes grown under the same conditions yielded the lowest seed yield such as Import 62, 196 and Silvo. Such reduction in seed yield of these genotypes mainly attributed to the reduction in their seeds and number of pods / plant, seeds / pod,as well as, 1000 – seed weight. Topas cv showed an increase in seed yield and yield traits in comparison to Silvo or Import 62 and 196, it ranked the third order for yielding more seeds and also it surpassed in some yield components such as seeds / plant, number pods / plant and 1000 – seed weight. In winter *B. napus*, Mendham and Scott (1975) found that both number of seeds / pod and seed weight were highest in the upper portions and lowest in the down portions. The observed differences between those findings and the obtained results are probably a result of differences in growth habit. Progressive decline in seeds / pod was also observed in winter *B.napus* (Norton and Harris, 1975), they reported that the decline in number of seeds / pod is probably due to competition of assimilates.

Table 2: Seed yield and yield components of some canola genotypes grown under Egyptian conditions.

Genotypes	Seed yield Kg / acre	Seed yield g. /plant	Number of pods / plant	Number of seeds / pod	1000 – seed weight g.	Oil yield Kg / acre	Seed oil %	Protein %
Pactol	1061.625	13.47	208.71	20.33	3.10	443.505	41.78	23.00
Silvo	763.200	17.26	248.65	20.92	3.34	311.746	40.83	21.65
Topas	947.625	17.68	251.44	20.75	3.51	396.190	41.86	22.10
AD 201	1116.725	17.36	228.44	22.12	3.51	487.806	43.81	24.35
Import 62	874.650	13.75	237.70	19.69	2.92	354.678	40.41	22.55
Import 196	693.525	15.23	218.22	20.57	3.39	279.379	40.63	27.06
Serw 4	1077.150	16.92	257.77	20.37	3.32	444.527	41.28	23.90
Serw6	1053.675	17.53	248.59	21.04	3.46	450.535	42.76	26.60
LSD 5%	138.400	3.47	29.91	NS	NS	59.620	2.13	---

Data in Table 2 also show that oil percentage in all canola genotypes used were significantly different. AD201 showed the highest seed oil % (43.81) followed by Serw 6 (42.76). At the same time, Pactol and Serw 4 ranked the second order, whereas the lowest seed oil percentage (40.41 and 40.63) were recorded by Import 62 and 196, respectively. The increase of oil content in AD 201 and Serw 6 mainly attributed to increasing in 1000 seeds weigh than other canola genotypes. These findings are in line with those obtained by Tkachuk and Kuzina (1976), stated that within each cultivar, Oro and Span, heavier seeds contained more oil. Özer et al. (1999) reported that the highest correlation coefficients were found between 1000 - seed weight and oil percentage. The increase in seed yield production and oil percentage of both genotypes AD201 and Serw 6 lead to an increase of oil yield (kg / acre) in the same two genotypes. On the other hand, the lowest oil yield was noticed at Import 196 due to the reduction in seed production and also in oil percentage. Protein percentage was also different between all genotypes ranged from the lowest (21.65%) with Silvo to the highest (27.06%) with Import 196.Other genotypes tended to increase of protein % such as Serw 4. MecVetty et al. (1997) stated that Castor cv had an average of protein content of 450 g Kg^{-1}, 4g Kg^{-1} lower than Mercury cv. Also in other study of McVetty et al. (2001) indicated that the mean meal protein content of Zodic BX was 460 gKg^{-1} lower than of that check cultivars.

Data presented in Table 3 illustrated that all canola genotypes were different in their fatty acids contents. In general the saturated fatty acids specially Palmitic acid ranged from the lowest (3.78%) in Serw 6 to the highest (6.98%) in Serw 4. Stearic acid was only increased in Serw 4 (3.58%) followed by Import 62, Serw 6 and Import 196. Although the low level of Palmitic acid and other saturated fatty acids (less than 5%) in canola oil is considered to be nutritionally desirable (Kay,1988) and an increase of short chain fatty acids such as Palmitic could improve the suitability of canola oil for manufactories of margarines and shortening. In this concern that, Getient et al. (1997) and McCartney et al. (2004) reported that the majority of the variation in Palmitic (C16:0) due to the genotype main effect and variation in Stearic acid (C18:0) due to the genotype and environment main effect, also who stated that Palmitic acid concentration was controlled by linked genes in the cultivars tested.. At the same time, Bechenic acid (C22:0) in all canola genotypes approximately tended the same values, however the other long saturated fatty acids (22: 0) mainly Arachidic acid the values ranged from the lowest (0.93 %) in Topas to the highest (3.10%) in Serw 6.

Table 3. Fatty acids composition of some canola genotypes grown under Egyptian conditions.

Genotypes	Saturated fatty acids %				Unsaturated fatty acids %			
	Palmitic 16 : 0	Stearic 18 : 0	Arachidic 20 : 0	Behenic 22 : 0	Oleic 18 : 1	Linoleic 18 : 2	Linolenic 18 : 3	Erucic 22 : 1
Pactol	4.61	0.72	1.18	1.16	62.36	23.04	6.52	0.31
Silvo	6.44	0.83	2.99	1.16	51.22	25.03	10.80	1.53
Topas	5.90	0.55	0.93	1.02	57.23	23.72	9.60	1.05
AD 201	5.53	0.22	1.10	1.19	58.15	23.20	9.30	1.35
Import 62	4.38	2.60	2.69	1.18	60.28	17.84	9.06	1.95
Import 196	3.92	2.43	2.75	1.10	61.04	17.17	9.38	2.21
Serw 4	6.98	3.58	2.03	1.64	56.64	17.85	9.25	2.03
Serw6	3.78	2.54	3.10	1.06	58.24	17.96	9.66	2.66

Data in Table 3 show that Oleic acid was the most prevalent unsaturated fatty acid and the values were different in all genotypes used. It ranged from the lowest (51.22%) in Silvo to the highest (62.36%) in Pactol. Linoleic acid is the second major unsaturated acid, its content ranged from 17.17 % in Import 196 to 25.03 % in Silvo. Linolenic acid is the third major unsaturated acid, data in Table 3 indicated that Pactol had the lowest (6.52%), while the highest value was obtained with Silvo (10.80%), the other canola genotypes tended to the same values. The second oil quality breeding objective is to reduce the percentage of Linolenic acid from the percent 8 – 10 % to less than 3 %, while maintaining or increasing the level of Linolenic acid (Downey and Röbbelen, 1989). Lower Linolenic acid is desired to improve the storage characteristics of the oil, while a higher Linoleic acid content may be nutritionally desirable. Similar observations were reported by Farag et al. (1986) and Getinet et al. (1997). Other studies, Getinet et el (1994) and Raney et al. (1995) reported that in zero erucic acid *B. carinata*, the concentration of the polyunsaturated fatty acid Linoleic and Linolenic were very high and Oleic acid was low compared to levels of these fatty acids in concentration of *B. napus* canola.

Concerning, the Erucic concentration, generally the amount of Erucic acid present in *Brassica* seeds oils is controlled by the genetic make up of the developing embryo, rather than the maternal parent, through a series of alleles exhibiting additive gene action. Data in Table 3 show that the amount of Erucic percentage in all canola genotypes used ranged from the lowest (0.31%) in Pactol to the highest (2.66, 2.21 and 2.03%) in Serw 6, Import 196 and Serw 4, respectively. The other canola genotypes Silvo, Topas, AD201 and Import 62 produced Less than 2% of Erucic acid. These results were supported by findings of Tkachuk and Kuzina (1976). Such reduction in Erucic acid content in canola genotypes mainly attributed to the increase of Oleic and Lineoleic acids, while in Serw 6, Import 196 and Serw 4 the increase of Erucic acid attributed to the reduction of Oleic and Linoleic acids. Davik and Heneen (1993) reported the same findings, who found that the concentration of two fatty acids Oleic (18: 1) and Erucic (22: 1) were negatively correlated and a high Oleic acid concentration (>50 %) was always associated with low Erucic acid concentration (< 4 %).

Finally, the all canola genotypes used are grown successfully in winter season in Egypt, but some genotypes surpassed in yield production such as AD201, Pactol, Serw 4 and 6 and others contained high Oleic, Linoleic and low Linolenic, Erucic acids such as Pactol, Silvo, Topas and AD 201 genotypes.

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