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GROWTH, YIELD AND QUALITY RESPONSE OF VARIOUS CANOLA CULTIVARS UNDER AGRO-ECOLOGICAL CONDITION OF FAISALABAD

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Field experiment was conducted to evaluate the quantitative and qualitative response of six Canola hybrids/cultivars viz. Hyola-401, Omega-I, Omega-II, Bulbul-98, Rainbow and Cyclone. Crop growth, agronomic and qualitative traits were recorded by standard procedures. The results showed that hybrid Omega-II produced maximum leaf area index (LAI), crop growth rate (CGR) and total dry matter accumulation (TDM) and also out yielded than other hybrids/cultivars, i.e. 2439 kg ha^{-1}. Whereas, it was observed that Hyola-401 gave the highest oil contents (44.51%) and Omega-I produced the highest protein content (25.25%) amongst all the treatments. It is concluded that Omega-II cultivar performed better and attained maximum yield and quality under the agro-ecological conditions of Faisalabad.
Keywords: Canola, edible oil, cultivars, hybrids, yield

INTRODUCTION

Burgeoning world population has a lot of pressure on food, fuel and fiber. Pakistan is facing acute shortage of edible oil for the last two decades. Edible oil is Pakistan's largest import item after petroleum products; resultantly huge foreign exchange is being spent annually.

Pakistan has become world's third largest edible oil importer. Edible oil consumption in Pakistan during 2008-09 was 2.821 million tons, where the local production stood at 0.68 million tons which accounted for 24% of total availability, while the remaining 76% was made available through imports. The total demand for the year 2009-10 was 3.45 million tons, of which 0.855 million tons was locally produced from all sources and rest of the oil (2.550 million ton) was made available through imports costing 87 billion rupees (GOP, 2009-10)

There are a number of factors which can be explored for boosting the local edible oil production and feed for 180 million people of Pakistan. One the most important factor is the use of hybrids/improved cultivars with high production potential and vigor may enhance the yield of the crop (Blum, 2004),

Canola crop, being high oil contents and productivity has the potential to a bridge the gap between local production and consumption. As the canola crop is low delta crop and can be successfully planted in barani area, this could be very good replacement of rapeseed/mustard crop. Rapeseed/mustard oilseed crops have a same land and water requirement. So it may not be difficult for the farmers in adapting and management practices of canola crop. Moreover, being a high oleic acid, fatty acid constituents, it rank top in high quality oil for cardiac patients which replace the lower density lipids (LDL) with high density lipids (Manaf and Hassan, 2006).

Currently area under cultivation is 223 thousand acres with total production of 136 thousand tons oilseed and 52 thousand tons oil which is much lower than the developed countries of the world. Increasing the production of the crop through horizontal expansion has a limited scope in our country due to competition with other crops. Some efforts could be put forth to increase production through vertical expansion, which can be achieved by planting hybrids/improved varieties and management practices (Sarwar *et al*., 2004).

The selection of suitable variety always plays a vital role in achieving high yield of a crop (Sana *et al*., 2003). There are certain variations in some physiological and agronomic parameters such as leaf area index, crop growth rate and total dry matter accumulations among various canola cultivars. *Brassica juncea* produced significantly higher yield and yield components than *B. napus* genotypes. Seed oil content was higher in *Brassica napus* while the levels of erucic acid and glucosinolates were lower in *B. napus* than in *B. juncea* (Iqbal *et al*., 2008).

Keeping in view the variation in quantitative and qualitative traits of different brassica hybrids/cultivars a project was planned to compare the production potential of different canola cultivars under agro-ecological conditions of Faisalabad.

MATERIALS AND METHODS

A field experiment was conducted to evaluate the quantitative and qualitative response of six Canola hybrids/cultivars at Agronomic Research Area, University of Agriculture Faisalabad, during winter 2008-09. The

experiment was laid out in Randomized Complete Block Design (RCBD) with three replications using net plot size of 5.0 m x 1.8 m. Six hybrids/cultivars were planted, i.e. Hyola-401, Omega-I, Omega-II, Bulbul- 98, Rainbow and Cyclone.

The cultivars were sown on 30th September 30, 2008 with single row hand drill using a seed rate of 5 kg ha^{-1} in 30 cm spaced lines on a well prepared seed bed. The experimental soil was sandy loam. Nitrogen and phosphorus in the form of urea and triple super phosphate were applied @ 90 kg N ha^{-1} and at 60 kg P ha^{-1}, respectively. Whole of the phosphorus and 1/3 of nitrogen was applied as a basal dose while remaining 2/3 nitrogen was applied in two equal splits half at first irrigation and half at development stage. The crop was irrigated three times during the entire period of growth. First irrigation was applied 30 days after sowing, second at flowering and third at the start of seed development.

Thinning was done twice up to the age of one month to maintain a distance of 10 cm between the plants. Two hoeing were given to keep the field free from weeds. Insecticides were sprayed for the control of aphids. All the other agronomic practices were kept normal and uniform for all the experimental units. Hybrids/cultivars were harvested on April 01, 2009 and left in the field for sun-drying. All the hybrids/cultivars were threshed manually. For growth parameters periodical data was collected after every 15 days. Five randomly plants per plot were harvested at two weeks interval and analyzed for leaf area and dry matter accumulation. The leaf area was measured with the help of leaf area meter (LICOR, Model 3100, USA). The crop growth rate was calculated according to the formulae described by Hunt (1978). Observations on various yield and yield parameters were recorded by using standard procedures.

The oil contents of canola seeds were obtained by using rooskvisky's method. Usually diethyl ether or refined petroleum (of low boiling point, i.e. 40-60°C) is used for extraction of fat from dry powdered material. "Soxhlet" apparatus was used for this routine analysis (AOAC, 1970). For determination of protein contents seed samples were taken randomly from each plot, ground sample were analyzed by using gunning and Hibbard's method of H_2SO_4 digestion and using Micro Kjeldahl's method for distillation (İzci, 2010). From this whole process N % was obtained which then multiplied with a constant factor of 6.25 for protein content in the seed. The data collected were analyzed statistically by using Fisher's analysis of Variance technique and LSD test was employed at 5% probability level to test the significance of difference among treatments' means (Steal *et al*., 1997).

RESULTS AND DISSUSION

***Leaf area index, total dry matter accumulation and crop growth rate*:** Canola hybrids/cultivars had significant effect on leaf area index (LAI) (Fig. 1). Maximum LAI was recorded in Omega-II which was 4.5 against the lowest LAI of 3.00 which was noted in cyclone cultivar. LAI increased steadily up to 75 days and reached up to maximum 75 days after sowing (DAS), therefore it declined sharply 105 DAS. Maximum value of LAI in Omega-II was probably due to genetic makeup of the hybrids when it achieved the maximum biomass accumulation. Decline in LAI was recorded 75 DAS and might be senescence of leaves, which lead to sharp decline in LAI. Cheema *et al*. (2001a), Basra *et al*. (2003), Kumar *et al*. (1997) and Tahir *et al*. (2007) while working on canola crop reported similar results.

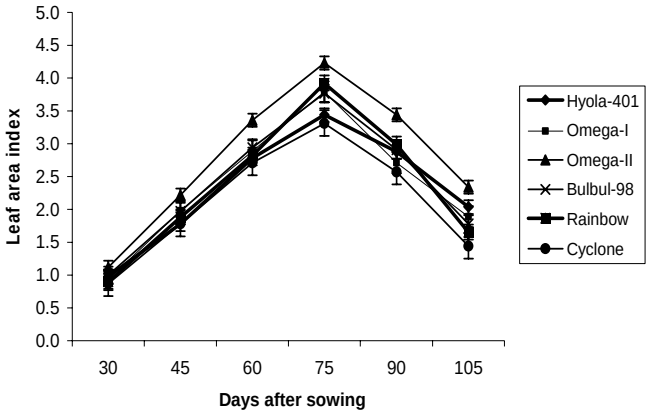

Figure 1. Response of leaf area index (LAI) of various canola cultivars ± SE

Different canola hybrids/cultivars had significant effect on total dry matter (TDM) accumulation. Maximum TDM accumulation was recorded in Omega-II hybrid whereas, the lowest dry matter accumulation was noted in Cyclone cultivar (Fig. 2). Total dry matter accumulation was maximum up to 75 DAS and decline in TDM was noted. Decline in TDM might be due to physiological maturity and photosynthetic activity of the crop which eventually reduced total biomass. It is also reported that TDM accumulation is a physiological index being closely related to the photosynthetic activity of leaves (Cheema *et al.*, 2010; Ali *et al*., 2011). Similar pattern of total dry matter accumulation in canola was reported by Cheema *et al*. (2001a) and Zaman (2003).

Crop growth rate (CGR) was significantly affected by the cultivars/ hybrids. Data revealed that maximum CGR was produced by Omega-II hybrid whereas minimum CGR was recorded in cultivar Cyclone that was statistically at par with cultivar Bulbul-98. Maximum CGR in Omega-II may be due to maximum dry matter accumulation (Fig. 2) which enhanced the crop growth rate in this hybrid. These results corroborated the findings of Cheema *et al*. (2001b).

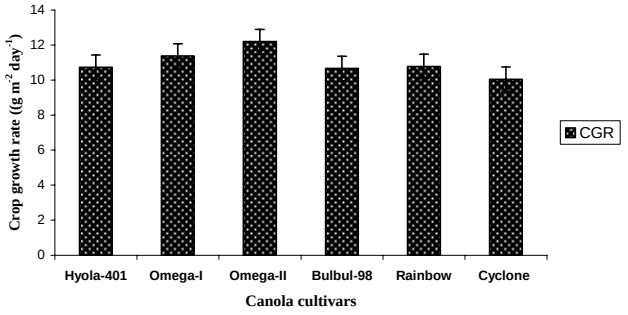

Figure 2. Response of crop growth rate (g m^{-2} day^{-1}) of various canola cultivars ± SE

***Yield and yield components*:** Seed yield of the crop is the combined expression of all the yield components. Maximum seed yield (2439 kg ha^{-1}) was recorded in Omega-II against the lowest seed yield (1637 kg ha^{-1}) of Rainbow cultivar. Hyola-401 produced 2366 kg ha^{-1} and ranked second after Omega-II whereas, Omega-I, Cyclone and Bulbul-98 gave the yield of 2250, 1909 and 1814 kg ha^{-1}, respectively. Maximum seed yield produced by Omega-II can be attributed due to higher biological yield, 1000-grain weight, seed/siliqua and siliquae per plant. All these yield components boosted the overall seed yield of Omega-II whereas rest of the hybrids/cultivars were not able to attain the higher value of the yield components. Moreover, maximum LAI, TDM and CGR was also noted in Omega-II which might enhanced it's photosynthetic efficiency and its translocation toward the sink, probably gave a quantum jump in attaining high yield. The findings of this experiment were in agreement with those of Cheema *et al*. (2001b) and Chaudhry *et al*. (1987) who also reported significant differences in branches per plant, number of siliquae per plant, number of seeds per siliqua among different cultivars of Brassica species.

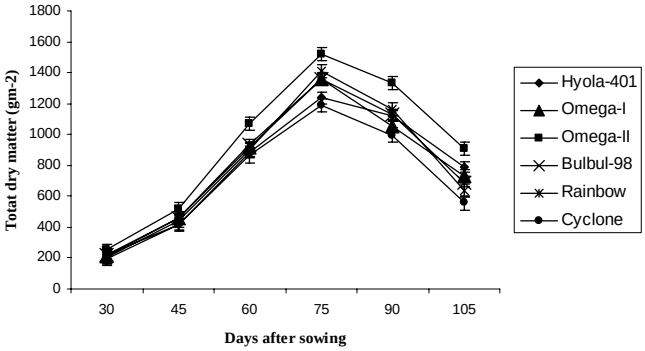

Figure 3. Effect of various canola cultivars on the total dry matter (g m^{-2}) ± SE This figure is not referred in text

Plant height of a crop is the function of both genetic and environment factor. Plant height (cm) was significantly affected by the canola cultivars. Significant taller plants were recorded in cultivar Omega-II that was statistically at par with Omega-I whereas dwarf plants was observed in Cyclone. Maximum plant height (cm) in Omega-II might be due to its genetic character. Similar results were reported by Cheema *et al*. (2001b) and Chaudhry *et al*. (1987) who also found the significant difference in plant height among the canola cultivars. Harvest index was found maximum in cultivar Hyola-401 whereas minimum was recorded in Cyclone.

***Quality characteristics*:** Seed oil contents were significantly affected by the various canola cultivars (Table 1). Maximum seed oil content was found in cultivar Hyola-41 that was followed by the Omega-I which was statistically at par with Omega-II. While minimum seed oil contents was recorded in Cyclone. Seed oil concentration is purely genetically controlled character and plays vital role in determining total oil yield per unit area. These results are in accordance with the findings of Bengtsson (1988) and Karaaslan (2008) who reported 9% difference between different Brassica species.

Among the cultivars maximum protein contents was found the in cultivar Omega-I and followed by the cultivar Omega-II whereas minimum protein content was recorded in Bulbul-98. The protein contents differ significantly among the cultivars as have also been reported by Parveen *et al*. (1996) and Padmani *et al*. (1992).

CONCLUSIONS

It can be concluded form the findings of this study that Omega-II proved to be the best in seed yield, seed oil content among the different canola cultivars. In growth parameters, Omega-II produced maximum leaf area index (LAI), crop growth rate (CGR) and total dry matter accumulation (TDM) other hybrids/cultivars. It is suggested that Omega-II cultivar should be sown for attaining maximum yield and quality under the agro-ecological conditions of Faisalabad.

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Table 1. Response of yield and yield components, oil and protein contents of various canola cultivars

Cultivars	Plant Height (cm)	Branches /plant	Siliquae /plant	Seeds /siliqua	1000-seed weight (g)	Biological yield (kg ha^{-1})	Seed yield (kg ha^{-1})	Harvest index (%)	Oil content (%)	Protein content (%)
Hyola-401	223.83 b	24.82 b	583.15 c	26.77 b	3.50 b	15994 c	2366.7 b	14.80 a	44.51 a	23.95 c
Omega-I	227.43 a	23.45 c	593.77 b	25.74 bc	3.57 b	16328 b	2250.0 c	13.78 b	43.53 b	25.25 a
Omega-II	227.63 a	25.89 a	617.43 a	28.50 a	3.81 a	17841 a	2439.8 a	13.67 b	43.26 b	24.43 b
Bulbul-98	206.33 d	21.34 d	554.70 d	24.86 cd	3.17 d	16114 bc	1814.4 e	11.26 c	40.53 d	22.21 e
Rainbow	210.53 c	24.56 b	495.07 f	17.75 e	3.07 e	16019 c	1637.7 f	10.22 d	41.19 c	22.73 d
Cyclone	196.57 e	20.90 d	544.66 e	23.63 d	3.26 c	16445 b	1909.2 d	11.61 c	38.59 e	23.94 c

Means followed by the same letters within a column do not differ significantly (P< 0.05)

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