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Comparative Yield Potential and other Quality Characteristics of Advanced Lines of Rapeseed

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ABSTRACT

An experiment on the genotypic performance of some advanced lines of rapeseed was conducted at Agricultural Research Station Mingora, during 2000-2001. Randomized Complete Block Design, with three replications was used. Twelve genotypes Hyola-308, Bullet, PB-4, 2II-98, Altex, Oscar, Dunkeld, Siren, PC-89, Altex x Shirallee, Altex x Candle, and Altex x PC-89 were under study. Data were recorded on days to 50% flowering, plant height, leaf area, pods plant^{-1}, seeds pod^{-1}, 1000 seed weight, lodging (%), insect attack (%), seed yield kg ha^{-1}, oil contents and glucosinolate contents. Significant differences were recorded for all characters except insect attack, due to various genotypes. Genotypes Hyola-308, (pods plant^{-1} seeds pod^{-1}, 1000-seed weight, and grain yield ha^{-1}) and PC-89, (oil contents) were found to be the best. In case of hybrid Altex x Candle performed well for leaf area. The hybrid Altex x PC-89 was susceptible to lodging and insect attack and also gave the maximum glucosinolate contents (71.70). The genotype Altex was resistant to lodging and gave desirable amount of glucosinolate contents (29.67). The genotypes, Hyola-308, Altex, PC-89 and Altex x Shirallee, are therefore recommended for consideration in the national breeding programs.

Key Words: Rapeseed; Yield; Pakistan

INTRODUCTION

Rapeseed (*Brassica napus* L. & *B. campestris* L.) are the important oil seed crops through out the world which rank third among the oil seed crops after soybean and palm in production of vegetable oils, while fifth in the production of oil seed proteins (Salunkhe *et al*., 1992).

Pakistan has made improvement in the development of agriculture sector but the chronic shortage of edible oil has persisted unabated for the past one and half decades. Edible oil is one of the major items of total national imports amounting for 1.1million tons. The national requirement of edible oil is going to increase even further in the coming years due to high population growth rate and increase in per capita consumption. There is a great potential and scope of raising good crop of rapeseed in NWFP. The soil is suitable and the growers have the knowhow of the crop. Local varieties of rapeseed are traditionally old, poor yielder with low oil content of poor quality oil having high amount of erucic acid and glucosinolates (Khan *et al*., 1984). Glucosinolates were the main antinutritive component of *Brassica napus* (Krzymanski, 1970). Breeding for low glucosinolate (GSL) content in *Brassica* oilseeds has been the subject of intensive research during recent decades because of the toxic and antinutritive effects of these compounds (Downey & Röbbelen, 1989). Success in this field was considerably facilitated by the development of rapid and accurate methods which permit large screenings to be made in a short time and at a low cost (Thies, 1982). The breeding works resulted in decreasing aliphatic glucosinolate content to such extent that the glucosinolate level of modern double low varieties of oilseed rape (Canola type) is low enough to obtain rapeseed meal giving good body weight gain in animal production (Krzymanski, 1993). Therefore breeding for further elimination of aliphatic glucosinolates from rapeseed is desired. Therefore, it is felt that providing farmers with new canola variety is the only promising option for increasing per acre yield. This should increase rapeseed oil production with better quality for human health and improved source of protein meal.

The present study was undertaken to identify high yielding, better oil quality varieties of rapeseed for general cultivation by growers in NWFP.

MATERIALS AND METHODS

The experiment was conducted at Agriculture Research Station Mingora in the year 2000-2002, using Randomized Complete Block Design (RCBD) having three replications. The plot size was 5 1.8m x 5m. Fertilizers DAP and Urea were applied at the rate of 75 kg N: 60 Kg P_2O_5 ha^{-1} at the time of sowing. The experimental material consisted of nine brassica genotypes (Hyola 308, Bullet, BP-4, 2II-98, Altex, Oscar, Dunkeld, Siren, PC-89) and three hybrids (Altex x Shirellee, Altex x Candle, Altex x PC-89). The genotypes were planted in 30 cm apart lines. The sowing was done on 10th October, 2000.

The data were collected on days to 50% flowering, plant height (cm), number of pods plant^{-1}, number of seeds pod^{-1}, 1000 seed weight (g), and yield ha^{-1} (kg) as per standard procedure. In addition, other traits were also evaluated as per given details. Oil (%) and glucosinolate contents (μ mol g^{-1}) from 36 samples (one replication^{-1}) were determined at the oil quality laboratory NIFA, Peshawar, using the procedure of Reinhart and Tillmann (1993). First cleaned seed was taken from every sample. The seed samples were put in cabinets (a small pot) and exposed to the near infrared system (fully computerized). This system is quick and accurate for un-destructive analysis (does not destroy the material and hence can be used again for other purpose. The data were recorded visually on the lodging and insect attack percentage (Webster *et al*., 1991) on 0-9 scale (0 - no lodging no insect attack and 9-fully lodged and 100% plants affected/attacked by aphids).

RESULTS AND DISCUSSION

Days to 50% flowering. Analysis of the data revealed significant difference among the genotypes at 1% probability level. Mean data on flower initiation shows that (Table I) genotype Siren took maximum of 135.3 days to 50% flowering, closely followed by genotypes Altex x Candle, Oscar, PC-89, Dunkeld and Altex with 133.7, 132.7, 132.3, 132.0 and 131.0 days respectively. The cultivars Bullet and BP-4 took the minimum days of 61.67 and 62.00, respectively to 50% flowering.

Days to flowering is directly related with maturity of the crop. Early maturing varieties flowered earlier, while late maturing genotype flowered later. Significant differences among varieties were found for days to 50% flowering in rapeseed canola. The genotypes Bullet and BP-4 flowered earlier while genotype Siren was late in flowering. However, Oscar, Dunkled, PC-89 and Altex x candle were also late in maturity. Similar results have been reported by Govil *et al.* (1984).

Plant height (cm). Statistical analysis of the data revealed highly significant difference among genotypes. Mean data on plant height shows that the tallest plants of 165.5 cm were observed in genotype PC-89, followed by genotypes Dunkeld (163.7), ZII-98(160.0), Altex x Shirallee (159.3), Bullet(158.4), Altex x PC-89(158.0) and Oscar(156.7). The cultivar Siren was found to have the shortest plants with height of 127.3 cm.

The difference in plant height is due to genetic variability present in various genotypes. These results are in disagreement with that of Labana *et al.* (1987) who stated that in total of 39 accession of Ethiopian origin evaluated for various agronomic traits, low variation was recorded for plant height. This may be due to climatic variations including drought.

Number of pods plant^{-1}. Various genotypes showed highly significant differences for number of pods plant^{-1}. Hyola-308 produced the maximum number of pods plant^{-1} (238.7), closely followed by cultivar Altex x Shirallee which produced 224.3 pods plant^{-1}. The minimum number of pods plant^{-1} (101.3) was produced by the genotype PC-89.

Number of seeds pod^{-1}. Another important character, which directly influence the seed yield. Significant differences among various genotypes for number of seed pod^{-1} were found. The cultivar Hyola-308 had the maximum number of seed pod^{-1}, while genotype BP-4 had the minimum number of seeds pod^{-1}. These results are in conformity with those of Paul (1978) who reported significant effect for number of seed pod^{-1}. The most possible reason, for highest number of seed pod-1 in Hyola-308, could be the better quality of fertility, compatibility and fertilization in the said variety.

1000-seed weight (g). 1000-seed weight is one of the important yield components in canola, which was significantly different in various genotypes under study. The

Table I. Comparative performance of 12 genotypes of rapeseed

Genotypes	Days to 50% flowering	Plant height (cm)	Pods plant $^{-1}$	Seeds pod $^{-1}$	1000 seed weight (g)	Glucosinolate contents µmg^{-1}	Oil contents %	Lodging	Insect attack	Yield ha^{-1} (kg)
Hyola-308	83.00 E*	139.3 CDE	238.7 A	21.10 A	4.02 A	39.23 C	46.03 A	0.6667 B	1.333	3000.00 A
Bullet	61.67 F	158.3 ABC	164.7 CD	19.73 AB	3.55 BCD	53.53 B	44.83 ABC	1.333 B	2.000	2277.78 CD
BP-4	62.00 F	141.3 BCDE	134.3 E	10.99 D	1.800 F	32.43 CD	39.40 E	1.000 B	1.000	1777.78DEF
ZII-98	95.33 D	160.0 AB	147.3 DE	18.83 ABC	3.533 BCD	35.97 CD	45.47 AB	2.333 AB	2.333	2500.00 ABC
Altex	131.00 AB	137.0 DE	155.7 CDE	17.53 ABC	3.003 E	29.67 D	43.57 CD	0.666 B	2.000	2388.89 BC
Oscar	132.70 A	156.7 ABCD	160.0 CD	17.67 ABC	3.383 CDE	31.33 CD	45.30 AB	1.000 B	2.000	2500.00 ABC
Dunkeld	132.00 A	163.7 A	189.0 B	19.87 AB	3.833 AB	31.97 CD	44.00 BCD	0.6667B	2.333	2555.56 ABC
Siren	135.30 A	127.3 E	168.7 BCD	17.63 ABC	3.350 CDE	48.37 B	42.97 D	1.667 B	2.000	1722.22 EF
PC-89	132.30 A	165.3 A	101.3 F	18.40 ABC	3.550 BCD	39.00 C	46.23 A	2.333 AB	2.333	2222.22 CDE
Altex x Shirallee	126.70 B	159.3 ABC	224.3 A	20.20 AB	3.917 AB	67.70 A	46.03 A	2.333 AB	2.333	2833.33 AB
Altex x Candle	133.70 A	148.3 ABCD	176.3 BC	15.20 C	3.200 DE	51.33 B	42.38 D	1.667 B	2.667	1666.67 F
Altex x PC-89	103.70 C	158.0 ABC	163.7 CD	16.43 BC	3.737 ABC	71.70 A	45.11 ABC	4.000 A	3.667	2555.56 ABC

* Means followed by the same letters are not significantly different at 1% level.

maximum 1000-grain weight was produced by genotype Hyola-308, while BP-4 produced the minimum 1000-grain weight of 1.8 g. These differences in weight might be due to the genetic variation in various genotypes. The varietal differences were also confirmed by Minkowski and Krygier (1998) in rapeseed. According to their results mass of 1000 seeds differed among three varieties - Polo (5.56 g), Mar (4.79 g) and Leo (4.32 g).

Yield kg ha^{-1}. Mean data on yield (kg ha^{-1}) shows that genotype, Hyola-308 produced highest yield of 3000 kg ha^{-1}, closely followed by Altex x Shirallee with 2833.33 kg ha^{-1}. The lowest yield of 1666.67 kg ha^{-1} was obtained from the cultivar Altex x Candle.

A difference in seed yield could be due to all genetic variations attributed towards it because of the quantitative nature of the character. Marzi (1996) found similar results. High number of pods plant, seed pod-1 and 1000 seed weight was the attributes contributing towards the maximum seed yield of Hyola-308 genotype, which reflects the contribution of yield components towards yield.

Oil contents (%). Statistically matching response was recorded for Hyola-308 (46.03), Altex x Shirallee (46.03%) and PC-89 (46.23%) and means of hybrids Altex x Shirallee and Hyola-308 were exactly the same. However, the mean oil contents were maximum for PC-89 (46.23%). The oil contents of cultivar ZII-98 (45.47%) and Oscar (45.30%) are also considerable. The cultivar BP-4 produced the lowest oil percentage (39.40%).

The results are in accordance with that of Bhardwaj and Hamama (2000), who evaluated some 938 accessions of rapeseed and reported significant variation for oil contents.

Glucosinolate contents (µ mole g^{-1}). The data shows a significant difference among the genotypes for the parameter understudy. Mean data shows that hybrids Altex x PC89 and Altex x Shirallee gave the maximum amount of glucosinolate i.e. 71.70 and 67.70 µmg^{-1}, respectively, followed by Bullet (53.53), Altex x Candle (51.33 µmg^{-1}) and Siren (49.37 µmg^{-1}). The cultivar Altex yielded the lowest amount of glucosinolate (29.67 µmg^{-1}), followed by genotypes Oscar and Dunkeld with 31.33 and 31.97 µmg^{-1} glucosinolate, respectively.

Lodging (%). Significant difference among the genotypes shows that these genotypes have heritable variation for lodging. The maximum lodging percentage was observed in hybrid Altex x PC-89, while minimum lodging percentage was observed in genotype Hyola-308. The good reason for this difference in lodging is the difference in plant height of Hyola-308 (139.3 cm) and Altex x PC-89 (158.0 cm).

Insect attack (%). Non-significant difference among various genotypes was observed for insect attack. However, the genotype Altex x PC-89 was more sensitive to insect attack, while genotype BP-4 was comparatively tolerant.

Based upon the observations under the prevailing agro-climatic conditions of Swat valley, the response of cultivars Hyola-308 (maximum yield ha^{-1}), PC-89, Altex x Shirallee (oil contents), and Altex (contents of glucosinolate) were ideal

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