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Full Length Research Paper

Evaluation of rapeseed genotypes for yield and oil quality under rainfed conditions of district Mansehra

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Five rapeseed genotypes were evaluated for agronomic parameters, yield, oil quantity and quality. Significant differences were observed for all the parameters except oil and protein percentage. The genotype Siren outperformed the rest of genotypes in yield potential (1104 kg/ha), followed by MRS-1 (866.67 kg/ha). For yield contributing characters like length of inflorescence and pods per plant, genotype Siren again showed good results that are, 51.3 cm and 136.5 pods/plant, respectively. The genotype Siren also showed low glucosinolate (44.82 µmol/g), erucic acid (23.67 µmol/g) and higher amounts of oleic acid (59.01%). Due to its high yield and oil quality, the genotype Siren is recommended for general cultivation in the area and further use in breeding programmes for *Brassica napus.*

Key words: *Brassica napus*, rapeseed, evaluation of genotypes, Mansehra.

INTRODUCTION

Rapeseed and mustard are the major oilseed crops (Mohammad and Khan, 1981; Anonymous, 1984), traditionally grown everywhere in the country due to their high adaptability in conventional farming systems. In 2005 - 2006 rapeseed and mustard were cultivated on 227.3 thousand ha of land producing 180.8 thousand tons of oil. The total consumption of edible oil amounted to 2.381 million tons during 2007 - 2008; local production of edible oil was estimated at 0.833 million tons and the remaining 1.548 million tones were imported (Anonymous, 2007). The per capita oil consumption increasing day by day is impaired by the growth rate of more than 3%. Hence there is no way, but to improve the oilseed production for getting self sufficiency in edible oils demand (Anonymous, 2007).

The genus *Brassica* has over 150 species and represented by 8 species in Pakistan, among them 2 species, *Brassica tourniforti* and *Brassica deflexa* are reported from wild while 6 are agriculturally important species (Ahmad, 2009; Jafri, 1973). *Brassica juncea* Czern. and Coss. *Brassica. carinata* Burn and *Brassica nigra* Koch. are placed in the mustard group (Khan et al., 1987) and are cultivated for mustard oil. *Brassica oleracea* is known for its potential as vegetable. *Brassica rapa* L. and *Brassica napus* L. are grouped into rapeseed (Khan and Munir, 1986; and Islam et al., 2009). Rape and mustard are generally related morphologically and the term “rape “ is derived from Latin word “rapum” meaning turnip and signifies oil seed forms of *Brassica campestris* and *B. napus*, collectively called rapes or rapeseed (Khan et al., 1987). Leaves of *B. napus* are partially clasping and typically glaucous or have a few scattered hairs near the margins. The stem is always ramified, the degree of ramification is however dependent upon variety and the environmental conditions (Musil, 1950). Islam et al. (2004) however showed non-significant variation for branches per plant within the variety. The spring-type oleiferous *B. napus*, a cool season, not drought tolerant and performed well under a range of soils, provided that moisture and fertility levels are adequate. The optimum temperature however, for maximum growth and high yield of spring-type oilseed rape is between 20 and 30°C. *Brassica* species generally grow will on rich sulphur soils. Seedlings prefer relatively cool temperatures up to flowering; high temperatures at flowering render earliness, reducing the time from flowering to maturity. Winter oilseed rape covers the soil for seven to nine months. It has high nutritional demands in autumn and reduces soil erosion in winter. Although rapeseed is

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Table 1. Analysis of variance for the studied traits.

Trait	Mean Squares			Probability*
	Replication	Genotypes	Error	
1. Plant Height	14.861	64.4	4.146	0.0001
2. Inflorescence length	0.541	24.3	1.548	0.0001
3. Pedicel length	0.021	0.3	0.007	0.0000
4. Pod length	0.060	0.2	0.034	0.0020
5. Number of seed per pod	0.649	24.8	0.557	0.0000
6.Number of pods per plant	191.737	2514.2	67.917	0.0000
7. 1000 seed weight	0.010	0.2	0.016	0.0001
8. Oil percentage	4.726	0.93ns	1.335	
9. Protein percentage	4.096	0.92ns	1.237	
10.Glucosinolate (umol/gm)	41.655	1246.5	33.298	0.0000
11.Erucicacid percentage	16.529	197.6	16.115	0.0003
12.Oleicacid percentage	5.460	67.7	3.717	0.0000
13. Yield per plant	0.040	1.7	0.030	0.0000
14. Yield per hectare	4567.149	208818.3	10839.523	0.0000

*Significant at 1% level of significance.

susceptible to a number of pests, insect control need more care to reduce losses and check costly pesticide damaging to honeybees and other pollinating insects. Crop of *B. napus* is harvested when the first siliquae begin to shatter. In oilseed rape, crop rotation should be practiced for prevention of diseases and pest attacks (Anonymous, 1997). Besides their use for extracting vegetable oil and getting the precious protein cake for live stock feed, the leaves of *B. napus* are also used as salads, pot herb and fermented for later use (Facciola, 1990; Manandhar, 2002). Its oil is used for cooking purposes and salad dressings. Roots, leaves and oil are also used medicinally as diuretic, expectorant, bronchitis, coolants and rheumatism (Manandhar, 2002).

Genetic elaboration of *Brassica* started with the conformation of its chromosomal numbers (Ahmad, 2009). *B. rapa* (2n = 20, genome AA) was conformed by Takamine (1916), *B. nigra* (n = 8, genome = BB), *B. oleracea* (n = 9, genome = CC) and *B. rapa* were thought to constitute the three basic species which give rise to the amphidiploid species, *B. juncea* (n = 18, genome = AABB), *B. napus* (n = 19, genome = AACC) and *B. carinata* with n = 17, genome = BBCC (Morinaga, 1934). Ahmad and Hasnain (2004) observed that the colchiploid recovery was very high but latter stages of development nearly half of the conformed colchiploids reverted in to diploid. Islam et al. (2006) conducted meiotic analysis of the advance line HS- 98 and conformed 2n = 38. No univalent, secondary association or B- chromosomes were recorded hence the genotype were considered as stable.

Rapeseed has attained the status of alternate crop of wheat, in the rainfed areas of District Mansehra. Some traditional landraces of Turnip Rape are widely cultivated as conventional crop mostly for fodder, hair oil and green vegetable. Commercial cultivation of *B. napus* is not in practice due to unavailability of improved genotypes. Keeping in view the importance of edible oil and its shortage in the country, the present study was conducted to evaluate best genotypes on the basis of yield and oil quality.

MATERIALS AND METHODS

Materials used for evaluation were five rapeseed genotypes viz. Altex, Oscar, Siren, MRS-1 and MRS-2. The materials were sown at Hazara University, Garden Campus Mansehra during 2005 - 2006 in accordance with the Randomized Complete Block Design (RCBD), with four replications. The plot size was 5 x 1.2 m where sowing was done in 4 rows, the row to row distance was 30cm. Fertilizers were applied at the rate of 75 kg nitrogen and 60 kg phosphorus/ha at the time of sowing. Thinning was carried out after 30 days of emergence and the crop was harvested at maturity. Data were recorded at the time of harvesting for plant height, inflorescence length, pedicel length, pod length, number of pods per plant, number of seeds per pod, 1000 grain weight, yield per plant and yield per hectare. The analysis of oil quality was carried out at Nuclear Institute for Food and Agriculture, NIFA Peshawar.

RESULTS AND DISCUSSION

Results obtained during the present investigation are summarized in ANOVA (Table 1) and parameter-wise details are presented under the following headings

Plant height

Statistical analysis (Table 1) revealed that plant height was significant among the genotypes at 1% level of significance. Plant height is very important with respect to yield and agronomic parameters. It is a general observa-

Table 2. Performance of five rapeseed genotypes for fourteen quantitative and qualitative characters.

S/N	Parameter	Genotype					LSD Value
		Altex	Oscar	Siren	MRS-2	MRS-1	
1	Plant height	104.7 a	98.72 bc	96.5 cd	100.72 b	94.7 d	3.137
2	Inf. length	49.02 bc	45.22 d	51.35 a	50.13 ab	49.02 ab	1.917
3	Pedicel length	3.15 a	3.07 a	2.79 b	2.71 b	2.37 c	0.129
4	Pod length	5.47 bc	5.26 c	5.53 ab	5.34 bc	5.94 a	0.284
5	Seed per pod	22.85 b	21.37 c	23.95 b	19.42 d	25.97 a	1.15
6	Pod per plant	107.5 bc	96.82 c	136.5 a	70.10 d	120.4 b	12.7
7	1000 seed wt	2.55 b	3.17 a	3.14 a	3.04 a	3.17 a	0.194
8	Oil percentage	46.21	47.51	47.09	47.20	46.99	1.78
9	Protein percentage	23.14	23.30	22.84	22.20	23.39	1.71
10	Glucosinolate	74.75 b	57.32 c	44.83 d	61.22 c	90.97 a	8.89
11	Erucic acid	25.06 b	34.64 a	23.67 b	26.62 b	39.95 a	6.18
12	Oleic acid	55.16 b	51.92 c	59.01 a	55.44 b	48.09 d	2.97
13	Yield per plant	3.68 c	4.05 b	4.78 a	3.01 d	4.20 b	0.267
14	Yield per hac	720.8 cd	825.3 bc	1104.0 a	658.3 d	841.7 b	108.2

tion that dwarf varieties over yield the tall ones, they resist lodging and more efficient in nutrient uptake. Among the genotypes tested Altex was the tallest having mean value of 104.7 cm as compared genotype MRS-1, which was dwarfish having mean value of 94.7 cm. Our results are in agreement with those of Islam et al. (2004). Qayyum et al. (1999) reported highly significant data for plant height in different varieties in response to different levels of nitrogen application.

Inflorescence length

Analysis of variance (Table 1) for length of inflorescence showed that all the genotypes were significantly different at 1% level of significance. Length of inflorescence has direct effect on flower and pod production. Genotypes with long inflorescence will produce more flowers, fruits and seeds thus will increase the production. Table of means (Table 2) showed that genotypes Siren and MRS-2 have long inflorescence having mean inflorescence length of 51.35 and 50.57, respectively. Genotype Oscar with the values of 45.22 has shortest inflorescence. Similar results have also been reported by Islam et al. (2004).

Pedicle length

Statistical analysis (Table 1) for pedicle length revealed that genotypes were significant at 1% level of significance. Pedicel keeps the pod in upright position with stem. Longer pedicel will be weaker than shorter pedicel. Shorter pedicel will give firm support to pod and pod will grow more. Mean data (Table 2) for pedicel length shows that genotypes Altex (3.15 cm) and Oscar (3.07 cm) are similar with respect to pedicel length. Similarly genotypes Siren (2.79 cm) and MRS-2 (2.71 cm) are also similar for pedicel length. Genotype MRS-1 has shortest pedicel length of 2.37. Islam et al. (2004) have reported non significant results for pedicle length. Ahmad et al. (2008) have reported significant results for pedicel length.

Pod length

Genotypes were significantly different with respect to pod length at 1% level of significance (Table 1). Longer pod will enclose more seeds thus with more yield. Table of means (Table 2) for pod length shows that genotypes MRS-1 and Siren have longer pod with values of 5.94 and 5.53 while genotype Oscar with the value of 5.26 have shortest pod. Similar findings were reported by Islam et al. (2004). Similarly, genotypes HS. 98, Altex, Oscar, Dunkled and Rainbow were studied in which siliqua length and siliqua width were significant and non significant respectively at 1% level of probability (Ahmad et al., 2008).

Number of seed per pod

Analysis of variance (Table 1) for seed per pod showed that genotypes were significantly different at 1% level of significance. Table of means (Table 2) for number of seed per pod revealed that genotype MRS-1 has highest number (25.97) of seeds per pod followed by Siren with 23.95 seeds per pod, while lowest mean value of seed per pod is 19.42 for MRS-2. Islam et al. (2004) also reported that genotype Oscar has less number of seeds per pod. Ahmad and Mohammad, (1999) reported that seed/pod is also affected by spacing and plant density.

Qayyum et al. (1999) reported that various nitrogen levels had pronounced effect on seeds/pod and the number of seeds/pod increases at 120 kg N/ha and above this dose has adverse effect on production of seeds/pod. Average seeds/pod increased with increasing levels of Sulphur application (Govahi and Saffari, 2006).

Number of pods per plant

Analysis of variance (Table 1) for pod per plant showed that genotypes were significantly different at 1% level of significance. Number of pods per plant directly affects the yield of rapeseed. Genotypes having more pods per plant will give more seed and more oil. Mean values (Table 2) for Number of pods per plant for five genotypes viz Siren, MRS-I, Altex, Oscar and MRS-2 were 136.52, 120.37, 107.85, 96.82 and 70.10 respectively. Islam et al. (2004) have reported similar results for number of pod per plants. Sieling et al. (1997) reported that oil-seed rape grown after wheat had more pods per plant, due to an increase in the number of pods on the higher category branches.

1000 seed weight

Genotypes were significant at 1% level of significance for 1000 seed weight (Table 1). 1000 seed weight directly affect the yield. Table of means (Table 2) for 1000 seed weight showed maximum value (3.17) for both genotypes Oscar and MRS-1. While minimum value was 2.55 for Altex. 1000 seed weight is significantly affected by spacing and sowing time (Rehman and Ali, 2000). Qayyum et al. (1999) reported that 1000 seed weight is significantly affected by N-fertilizer. Ahmad (2009) reported significant result for 1000 seed weight for five genotypes; HS-98, Altex, Oscar, Dunkled and Rainbow at 1% level of probability.

Oil percentage

Quality analysis of the *Brassica* oil is an important parameter. *B. napus* oil contains about 70% or more unsaturated fatty acids. However, the presence of certain toxic compound, erucic acid and glucosinolates in rapeseed oil lower its value (Khalil et al., 1989). It is suggested that the canola cultivars are fit for human consumption; rather the oil is beneficial for health due to the higher amount of polyunsaturated fatty acid. Analysis of variance (Table 1) for oil content revealed that genotypes were non significant for oil content. However the highest amount for oil percentage was observed for genotype Oscar. The results of Islam et al. (2004) are not in agreement with ours. Hayat et al. (1997), reported difference in oil contents for different sowing dates.

Protein percentage

Analysis of variance showed that genotypes are non-significant at 5% level of significance for protein percentage. Processing of rapeseed for oil production provides rapeseed animal meal as by-product. The feed is mostly used for cattle feeding, but also for pigs and chickens. Highest amount of protein were found in MRS-1 (23.39) while lowest amount was present in MRS-2 (22.20). Ping et al. (2003) have reported significant values for protein meal ranging from 30 to 46%. Similarly Ahmad et al. (2008) reported highest amount of protein, 25.1% for HS.98 while the lowest amount 21.1 for genotype Oscar.

Glucosinolate

Analysis of variance (Table 1) showed that genotypes were highly significant with respect to glucosinolates at 1% level of significance. Glucosinolate interfere with the catalyst, nickel. High glucosinolates have deleterious effect, especially in monogastric animals and largely restricted to use as cattle feed. The specific odor of Brassica species is also due to glucosinolate (GSL). Table of mean (Table 2) shows that genotype MRS-1 had high amount (90.97 µmol/gm) of glucosinolate while genotype Siren had the lowest amount (44.83 µmol/g) of Glucosinolate. Our results are in agreement with Islam et al. (2004), who reported that highest amount of glucosinolates was found in HS-98 (89.0 µmol/gm of seed) while the lowest amount of glucosinolates present in Oscar genotype (29.9 µmol/g of seed). Bhardwaj and Hamama (2000) reported that glucosinolate content were higher in *B. napus* than the *B. rapa* meal (49.2 vs. 43.8 µmol/g).

Erucic acid percentage

Analysis of variance (Table 1) revealed that genotypes were significant with respect to erucic acid percentage at 1% level of probability. Table of mean (Table 2) shows that genotype MRS-1 and Oscar have high amount of erucic acid (39.95 and 34.64% respectively), while genotypes Altex, Siren and MRS-2 are similar for erucic acid amount. Lowest amount is 23.67 for genotype Siren. Rahman (2002) reported that the erucic acid content in resynthesized *B. napus* (AACC) lines derived from these crosses was only about half that of the high erucic acid CC genome parents, indicating equal contributions of the two genomes to oil (fatty acid) synthesis and accumulation. Sowing date also affect the amount of erucic acid. The lowest erucic acid 3.83% was also obtained for *B. napus* genotype CON-1 (Hayat et al., 1997).

Oleic acid percentage

Analysis of variance (Table 1) shows that genotypes were highly significant with respect to oleic acid content at 1% level of significance. Table of mean (Table 2) shows that genotype MRS-1 have low value (48.09) of oleic acid, while Siren have high value (59.01) for oleic acid. Our results are in agreement with Islam et al. (2004), who reported that the highest amount of oleic acid (61.6%) for genotype Oscar and the lowest amount of oleic acid for Altex (22.7 %). Canola and peanut oil are rich in monosaturated (oleic acid) where as corn, soy-bean and sunflower oil are rich in polyunsaturated (linoleic and linolenic) acid. Dimic et al. (1992). The oleic acid percentage observed for five genotypes viz. HS-98, Altex, Oscar, Dunkled and Rainbow showed significant result at 1% level of probability (Ahmad, 2009).

Yield per plant

Analysis of variance (Table 1) for yield per plant revealed highly significant result at 1% level of probability. Yield per plant directly affect the yield of a crop. Table of mean (Table 2) for yield per plant showed highest value of yield per plant 4.78 and 4.20g for genotype Siren and MRS-1 respectively. Genotype MRS-2 had lower value of 3.01 for yield per plant. Ghobadi et al. (2006) reported that seed yield greatly reduced when water stress occurred at flowering (30.3%) and then at silique development (20.7%).

Yield per hectare

Analysis of variance (Table 1) for yield per hectare showed significant differences at 1% probability level. Data for yield per hectare (Table 2) showed that highest value of yield per hectare was 1104 kg for Siren followed by 841.7 kg for MRS-1. Lowest value 658.3 recorded for MRS-2. Our results corroborated with Yasari (2006) who reported the effects of chemical fertilizers on the yield, yield components and seed oil content of canola (*B. napus* L). He obtained 3141.250 kg/h which shows 326.61% increase over the control.

Conclusion

The present research work was conducted to asses' geno-types for quantitative and qualitative parameters. Old varieties are eliminated with the passage of time and new varieties take over their place because of their high yield. The plant breeder has to stress on the enhancement of yield, oil quantity and quality and maturity.

The data revealed that genotype Siren is the best variety on the basis of yield; it produced 1104 kg/hectare in the study area followed by MRS-1 which produced 841.7 kg/hectare. It means that genotype Siren is fit for commercial cultivation in the area. The data showed that climatic conditions were best for genotype Altex because it showed maximum values for plant height (104.7).

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