Research Article

Surhan-2012: A Novel High Yielding, Insect Resistant, and High Oil Content Canola Variety Released for General Cultivation in the Sindh Province

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Abstract | Genetic variability is a prerequisite for any effective breeding program. Surhan-2012 (R00-125/14) is the mutant line that developed through mutation breeding (Gamma radiation) from Rainbow parent. Initially, the promising mutant line was selected from mutant population and advanced homozygous mutant progenies during 2004-05 for yield evaluation in zonal varietal trials and the national uniform rapeseed yield trials (NURYT). The resultant variety exhibited the highest seed yield (2826 kg ha^{-1}) in NURYT compared to other contesting advanced genotypes during 2008-09. Surhan-2012 was performed better for seed yield (1460.8 kg ha^{-1}) as compared to parent genotype (800kg/ha seed yield) in advanced station yield trials. Surhan-2012 produced higher seed yield (1818kg/ha) than local check varieties (1457 kgha^{-1}) in NURYT during 2007-08 and similar trend was observed during 2008-09. The oil quality of Surhan-2012 was also determined. The mutated variety showed 9.7% increase in its oil content and novel fatty acid profile which was comparatively higher than the commercial check variety. It was also tolerant against insect pest and diseases including *Alternaria blight, powdery mildew, downy mildew* and *white rust*. The agronomic study suggested that this mutant stain (R00-125/14) best fits in the existing cropping system and agronomic package of technology. Surhan-2012 is a first canola mutant variety developed through the induced mutagenesis (gamma irradiations), released for general cultivation practices in the province of Sindh.

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Introduction

Arid and semi-arid sections of the third world nations have been facing shortage in their edible oil reserves and imports a large quantity of edible oil every year to fulfill country's demand (Mustafa *et al*., 2017). There is a great potential of enhancing the canola yield for under developed countries to reduce the gap between consumption and indigenous edible oil production (Onemli, 2014) The edible oil extracted from the seeds of various oil seed crops also display great nutritious and economic value (Mahmood *et al*., 2019). The vegetable oil composition, fatty acid profiling and nutritional varies variety to variety and plant species (Onemli, 2014; von Hanstein *et al*., 2020). In the current scenario researchers try to explore the species with good oil content and better fatty acid compositions from the exiting wild germplasm with

broad adaptability. The wide genetic variation and genetic pool is necessary for scientists to develop new cultivars with genetically improving oil contents, and novel fatty acid (Mustafa *et al.*, 2017; Mahmood *et al.*, 2019). Various Breeding approaches used to modify the plant architecture for the improvement of plant seed yield, oil contents and fatty acid compositions especially low erucic acid and glucosinolates. These are the important factor to improve the nutritional value of new commercial cultivars (Abbadi and Leckband, 2011).

The high yield potential is the major ultimate goal in the present era because world population is increasing geometrically (Abbadi and Leckband, 2011). Induced mutations have been accepted as useful tool in a plant-breeding programme. One of the most important role of mutation breeding is the creation of genetic variability for quantitative traits in various crop plants. The variability, thus created, enhances the chance for selection of new genotypes with desired characteristics.

In Pakistan, the cultivated varieties evolved through direct introduction or selection from exotic germplasm. The exotic germplasm has always been a danger as it may easily become susceptible to local pests. Similarly, the existing varieties losing canola quality characteristics and yield potential due to contamination and out-crossing. Therefore, it is essentially required to develop high yielding canola varieties to overcome the food security problem and replace the existing low yielding varieties. Moreover, the development of new verities can overcome the gap between consumption and production of edible oil which is still widening due boosting population pressure and challenges unsuitable verities cultivation (Hatzig *et al.*, 2018). The commercial release variety (Surhan-2012) has been significantly contributed best performance to overall production in the country and is now considered as a bench mark for oil and seed yield in Pakistan (Mustafa *et al.*, 2017; Mahmood *et al.*, 2019; Viana *et al.*, 2019). In this context, selection and consequently development canola mutant variety (Surhan-2012) that has been registered in 2013 for commercial cultivation in Sindh province of Pakistan. This variety possesses good agronomic characters when compared with locally adapted cultivars.

Materials and Methods

The variety (Surhan-2012) was developed through induced mutation at the dose of 1250Gy from cv. Rainbow and selected through mutant selection at Nuclear Institute of Agriculture, Tandojam, Sindh, Pakistan. Homozygous progenies of mutant selection as serial number R00125/14 were bulked during 2004-05 for seed yield evaluation. Its performance was evaluated in different trials such as station yield trial, zonal trial and National Uniform Rapeseed Yield Trials. Similarly, different botanical characteristics were also recorded according to *FSC*&RD, Islamabad (Table 1).

Evaluation and yield testing

In station yield trials during 2008-09, yield of R00-125/14 was compared with parent (Rainbow). The high yield promising line (R00-125/14) was then further evaluated at zonal yield trial of rapeseed at seven locations viz. Tando Jam, Sheikh Burkhio, Tando Adam, Sanghar, Khipro Shaikh Burkhio and Badin during 2007-08 and NURYT at eight locations during 2007-09 (Table 4). The yield was evaluated by applying the standard agronomic practices from the date of sowing to harvest.

Seed rate trial

This trial was conducted to optimize the seed rate of suhran-2012 for maximum yield. Three different seed rates 1, 2 and 3 kg were used. This experiment was conducted under RCBD with three replications.

Row spacing trial

The purpose of this trial to maintain maximum plant population and production. There were three different row spacing used under RCB design with three replications. Three different row spacing (15, 30, 45 cm) were used in this experiment to optimize the maximum production.

Date of sowing trial

This trial was conducted to assess the maximum yield under three various sowing dates (15th September, 1st October and 15th October). Data of three different sowing dates was analyzed to optimize the maximum production of surhan-2012.

Fertilizer yield trial

This trial was conducted to optimize rate and application method of fertilizer for maximum production of surhan-2012. The combination of three levels of nitrogen, phosphorus and potassium were evaluated along with control under RCB design (Table 10).

Table 1: *General plant descriptor of mutant R00-125/14.*

Traits	Description
Plant characteristics	
Plant Height	177.3 cm
Plant Type	Determinate
Growth habit	Spreading
Branching	Branchy
Plant Colour	Dark Green
Seedling characteristics	
Growth Habit	Errect
Seedling Length	65mm
Cotyledon Length	1.7mm
Cotyledon Width	9.5mm
Seedling Anthocyan	Absent
Leaf characteristics	
Leaf Colour	Dark green
Leaf Attitude	Errect
Leaf Size	63mm
Leaf Length	15mm
Leaf Width	9.2
Petiole Length	12-14 cm
Petiole Base	Medium
Leaf Lobbing	Medium
Margin Indent	Medium
Terminal Segment	Large
Leaf Hair	Absent
Leaf	Anthocyan
Stem characteristics	
Stem Shape	Round
Stem Thickness	16-20 mm
Stem Stiffness	Medium
Stem Pith	Thick
Ramification	At low level
Flower characteristics	
Days to Flowering (50 % flowering)	77-80 days
Earlier/Later than	Earlier than Rainbow and Wester
Duration	30-35
Petal Colour	Yellow
Anther Dotting	Absent
Pollination	Self
Silique characteristics	
Pod Shape	Cylindrical
Pod Anthocyan	Absent
Pod Attitude	Erect
Pod Density	Heavy
Pod Length	82mm,
Pod Width	6.1mm
Pedical Length	18mm,
Beak Length	15mm,
Shattering	Low
Seeds/Pod	30-35
Seed characteristics	
Seed Colour	Dark brown
Seed Size	Bold
Seed weight	2.9-4.0 mg/seed
Seed Yield Potential	2000 kg/ha
Oil Content	45%
Lenolenic acid	18.5%
Lenoleic acid	15.30%
Oleic acid	66.3%
Resistant	
Lodging	Tolerant
Mildew (*Personospora parasitica)*	Resistant
Aphids	Tolerant

Pest and disease incidence

The infestation data of various biotic diseases were recorded after the 15 days intervals in NURYT at the nuclear institute of Agriculture during 2006-08. The yield performance of candidate strain (R00-125/14) was evaluated and compared with the parent variety and local check Shiralee.

Statistical analysis

The statistics analysis of variance of each measuring traits was performed by using appropriate procedure of statistical package MSTAT-C. Differences among means were tested by the least significant difference test at 5 percent probability level.

Results and Discussion

Determination of Agronomic and quality related parameters

R00-125/14 plants have mostly round and thick stem, the average plant height is 177.3 cm with determinate, spreading and branchy growth habit and earlier flowering than rainbow and wester varieties. Silique is cylindrical and filled with 18-20 seeds and seeds are dark brown, bold with average 45 % oil content and may also be used for edible purpose. R00-125/14 seeds have oleic acid (66.3 %), lenoleic acid (15.30 %) and lenolenic acid (18.5 %). Siliqua length

of R00-125/14 ranging from 80 to 85 mm in length and 5.3 to 6.5 mm in width along with average of 19 seeds siliqua^{-1}. The overall usual seed yield potential of R00-125/14 is 2000 kg ha^{-1} (Table 1).

R00-125/14 is high yield and bold seeded new variety having good yield performance. This mutant stain contains low erucic acid (~0.76%) and glucosinolates (~ 27.81 µ mole/g) contents. This mutant show high oil contents (42.90%), compared to local check and parents. The morphological and botanical characteristics also recorded for this variety (Table 1). R00-125/14 variety is most popular in the Sindh province due to good oil content and yield. R00-125/14 is required short duration to complete vegetative and reproductive cycle and give high yield as compared to local check and parents. The short duration variety encourages the farmers to expand on a large area.

Initial varietal evaluation trials

Seed of Rainbow were treated with doses (750, 1000 and 1250Gy) of gamma rays and irradiated material were grown at the experimental farm of Nuclear Institute of Agriculture (NIA) Tando Jam. In this trial eighteen mutants were selected for further evaluation. The mutant with high seed yield with remarkable high oil contents. Mutant R00-125/14 produced the highest seed yield (1575 kg/ha) and oil content (45.66%) as compared to all other entries. The mutant stain (R00-125/14) produced high 1000 seed weight (g) and oil content as compared to the parents. Besides the promising potential for seed and oil yield, this mutant also exhibited good growth habit. Erectness and non-shattering plants are some of attractive features in brassica because shattering, adversely reduces (30-40 %) seed yield.

Preliminary yield trial

Nine mutants were selected along with parents and check variety for evaluation in preliminary yield trial at experimental farm, NIA, Tandojam during 2003-04. The mutant R00-125/14 produced the highest seed yield (1859 kg/ha) and oil (43.20 %) followed by R00-125/16 (1348 kg/ha); whereas parent (Rainbow) produces low (493 kg/ha) seed yield and oil content (39.50 %) which is significantly less as compare to mutant R00-125/14. This mutant not only produced the highest seed yield but also high oil contents per unit area. It exhibited increased 1000 seed weight, seed yield and oil contents as compared to Rainbow and Wester, respectively (Table 2).

Table 2: *Performance of mutant (SUHRAN-2012) in preliminary yield trial of rainbow & westar.*

Varieties	Maturity (days)	Plant Height (cm)	1000 Seed Wt. (g)	Seed Yield Kg/ha	Oil Content %
Rainbow(P)	135.0b	170.53b	3.94e	800.0h	42.0d
ROO-75/2	131.0c	138.53e	4.34ab	708.0h	44.0b
ROO-100/5	130.5cd	141.70d	4.19c	650.0j	41.66d
ROO-100/8	122.0h	136.20f	3.99e	761.2i	41.66d
ROO-100/9	120.0i	135.33g	4.17cd	880.0g	42.33c
ROO-100/10	122.5gh	146.60c	4.10d	982.2f	42.33c
ROO100/11	126.3f	137.60d	4.22bc	1050.6e	44.0b
ROO-125/12	127.5e	134.90h	4.23bc	1205.3cd	41.0ef
ROO-125/13	129.6d	145.50cd	4.26b	1318.6b	42.33c
ROO-125/14	124.5g	133.40i	4.75a	1460.8a	45.0a
Pakola(C)	181.5a	178.00a	3.74f	1254.1c	40.33f

Station yield trial

The yield performance of four mutants with parents and two checks (Bulbul and Pakola) were evaluated at Experimental Farm, NIA, Tando Jam in Station Yield Trial. The performance of mutant R00-125/14 (1608.4 kg/ha) was better than rainbow parent (1259.0 kg/ha) and both check bulbul (982.2 kg/ha) and pakola (1545.0 kg/ha) which are depicted in **T**able 3.

Table 3: *Performance of mutant (R00-125/14) in station yield trial of rainbow & westar.*

Varieties	Maturity (days)	Plant Height (cm)	1000 Seed Wt. (g)	Seed Yield Kg/ha	Oil Content %
R00-75/1	116.0g	126.2f	4.63bc	1005.7f	44.16bc
R00-125/12	131.0d	149.0d	4.83a	1058.1e	44.3b
R00-125/14	124.0f	160.0c	4.82a	1608.4a	45.0a
R00-125/17	126.3e	146.0e	4.77b	1161.1d	44.8ab
Rainbow(P)	138.0c	146.0e	3.86cd	1259.0c	44.0c
Bulbul (C)	181.0b	178.5a	3.95c	982.2g	40.16de
Pakola(C)	185.0a	165.5b	3.50d	1545.0b	40.50d

Advanced yield trial

The four mutants along with Rainbow parent and two checks (Bulbul and Pakola) were evaluated in Advanced Yield Trial at Experimental Farm, NIA, Tando Jam during 2005-06 (Table 4). The mutant R00-125/14 produced the highest seed yield (1998 kg/ha) and oil content (44.8 %). It also showed higher 1000 seed weight (4.90 g) as compared to Rainbow parent (1403.0 kg/ha) and local check Wester (1357.0 kg/ha).

Table 4: *Performance of mutant (R00-125/14) in advanced yield trial of Rainbow & Westar during 2005-06.*

Varieties	Maturity (days)	Plant Height (cm)	1000 Seed Wt. (g)	Seed Yield Kg/ha	Oil Content %
R00-75/1	111.6g	137.6g	4.20c	1038.0g	40.0d
R00-125/12	122.3f	169.3c	4.53b	1884.0b	43.0b
R00-125/14	124.6e	158.6f	4.90a	1998.0a	44.80a
R00-125/17	126.3d	168.6d	4.93a	1806.0c	40.20c
Rainbow(P)	133.3c	175.6b	3.80f	1403.0e	39.70e
Bulbul (C)	138.6b	167.3e	4.00d	1357.0f	39.01f
Pakola(C)	184.5a	177.5a	3.98e	1625.5d	39.50ef

Zonal yield trial

The performance of canola mutant (R00-125/14) along with parent (Rainbow) and local check (Wester and Pakola) were evaluated in zonal yield trial at seven different locations viz. Tando Jam, Sheikh Burkhio, Tando Adam, Sanghar, Khipro and Badin during 2007-08. The mutant R00-125/14 produced the highest seed yield at all the locations and showed 30.39, 12.68, 42.31 and 9.80 % increase in Rainbow at all locations respectively (Table 5).

National uniform rapeseed yield trial (NURYT)

National uniform yield trails of promising mutant R00-125/14 and other entries including Shiralee as a check were conducted on eight different ecological zones throughout the country under auspicious of NARC, Islamabad during 2007-08 and 2008-09. The mutant stain (R00-125/14) showed promising performance and attained 3rd position at national level and produced average seed yield 1813 kg/ha and exhibited 4.25% increase over Shiralee. Whereas in Sindh province at Tando Jam and Khairpur, R00-125/14 showed 10.96% and 30.48% increase from both check shiralee and Hyola -42 (Table 6a and 6b).

Seed rate trial

The yield performance of mutant R00125/14 was assessed in seed rate trials during 2007-08 and 2008-09. The highest seed yield (1910 kg per acre) was recorded in treatment T_2 followed by treatments T_3 (1855 kg per acre) which depicted in Table 7. Lowest seed yield was recorded in T_1. Essence of

Table 5: *Mean yield performance of R00-125/14 in zonal varietal trial during 2007-09.*

Genotypes	Tando Jam	Shaikh Burkhio	Tando Adam	Sanghar	Khipro	Shaikh Burkhio	Badin (Golarchi)
R00-75/1	1011.0d	992.3c	1231.0b	940.5c	1356b	1466b	1245c
R00-125/14	1371.0a	1132.5a	1278.0a	1053.5a	2353a	2233a	2026a
Rainbow(p)	1051.4c	1005.0b	898.0e	959.4b	1243cd	1433cd	1136e
Westar(C)	987.5e	784.4d	1022.5c	849.3d	1246c	1454c	1326b
Pakola(C)	1182.2b	695.6e	924.8d	675.3e	1084de	1065d	1148d

Table 6a: *Performance of R00-125/14 in NURYT at Eight Locations during 2007-08.*

Entries	NARC	CHK	FSD	KPUR	BWP	NIFA	Kohat	T.Jam	Mean
R00-75/1	2826	792	1118	1511	1243	1729	1517	1417	1519
R00-125/14	2628	1444	1428	1511	2050	1729	1417	2333	1818
Hyola-42	2638	847	1250	1470	903	1917	500	1317	1355
Shiralee(C)	2788	729	1123	1158	1414	1896	1271	1277	1457
97-5/2-4	2551	903	1313	1563	1462	2354	1742	1234	1640
LSD(0.05)	278.2	181.3	204	302.5	51.9	307.6	313.0	104.3	-

Table 6b: *Performance of R00-125/14 in NURYT at Eight Locations during 2008-09.*

Entry Name	NARC	CHK	FSD	B-PUR	K-PUR	Pioneer	NIFA	DIK	Mean
R00-75/1	2135	1264	1285	1370	1246	1600	1375	1917	1524
R00-125/14	2227	1444	1428	2050	1229	1759	1562	2333	1754
Hyola-42	2809	2006	1377	1834	333	1944	2292	2208	1850
Shiralee(C)	2052	1588	1948	2111	979	2001	1604	2083	1796
97-5/2-4	2582	1799	1764	1363	696	1329	2688	2167	1798
LCD (0.05)	386	139	146	319	272	576	599	530	172

application of proper seed rate was evident from the lowest seed yield in T_1 where low seed rate was practiced. The seed yield difference among the treatments T_2 and T_3 was less than 5 %. Yield differences was negligible reflect its impact on the economic benefit. As per cost benefit ratio, it was observed that 2 kg per acre was suitable seed rate for seed yield.

Table 7: *Seed rate trial at NIA, Tando Jam during 2007-09.*

Genotypes	Seed Rate	Maturity (days)	Plant Height (cm)	1000 Seed Wt. (g)	Seed Yield Kg/ha	Oil Content %
R00-125/14	1 kg	131	143	4.45	1247	41.2
	2 kg	129	154	4.76	1910	41.9
	3 kg	134	165	4.54	1855	41.7

Row spacing trial

The yield performance of mutant R00125/14 was evaluated in row spacing trials during 2007-08 and 2008-09. The highest seed yield (1898 kg/ha) was recorded at 30 cm row spacing followed by 45 cm (1867 kg/ha while lowest seed yield was observed at 15 cm row spacing. The proper row spacing is required by the plant for its nourishment and growth. As per cost benefit ratio, it was observed that 30 cm row spacing was most suitable strategy for seed yield (Table 8).

Table 8: *Row spacing trial at NIA, Tando Jam during 2007-09.*

Genotypes	Spacing	Maturity (days)	Plant Height (cm)	1000 Seed Wt. (g)	Seed Yield Kg/ha	Oil Content %
R00-125/14	15 cm	127	147	4.65	1734	41.3
	30 cm	123	158	4.70	1898	41.8
	45 cm	125	162	4.82	1867	41.5

Date of sowing trial

Data showed that the yield performance of mutant R00-125/14 was assessed under various sowing dates. The highest seed yield (2455kg/ha) was recorded at sowing date 1st October followed by 15th September (2339 kg/ha) sowing date. The recommended sowing date according to the current series of trials of mutant R00-125/14 is 1st week of October (Table 9).

Fertilizer trial

The yield performance of R00-125/14 was assessed under various levels of fertilizer doses. The highest seed yield (2321 kg ha^{-1}) was recorded in treatment (6) followed by treatments (5) (2245 kg ha^{-1}) which depicted in Table 10 and lowest seed yield was recorded in control. The essence application of NPK fertilizers in our soil was evident compared to the lowest seed yield under control where no fertilization was practiced. The yield difference among the treatments T_5 and T_6 was less than 5%. As per cost benefit ratio, it was observed that treatment T_5 was suitable fertilizer treatment for seed yield.

Table 9: *Yield performance in date of sowing trial.*

Sowing Date	Yield (kg/ha)		Av. (kg/ha)
	2007-08	2008-09	
15th September	2539	2138	2339
Ist October	2301	2608	2455
15th October	2013	1714	1864
Ist November	1468	1534	1501
1 5th November	1210	1217	1214
LSD 5%	76	105	

Table 10: *Yield response to different fertilizer levels.*

Treatment	Nitrogen (kg/ha)	Phosphorus $_{P2O5}$ (kg/ha)	Potash K2O (kg/ha)	Seed Yield (kg/ha)
1	00	00	00	1459
2	75	75	00	2074
3	75	75	30	2209
4	75	75	60	2029
5	75	75	90	2245
6	100	90	00	2321
7	100	90	30	2146
8	100	90	60	2074
9	100	90	90	2123
LSD 5%				230

Biotic stress studies

R00-125/14 and thirty other canola genotypes were evaluated against insect pests and other pathological diseases (*Alternaria Blight, Powdery Mildew, Downy Mildew and White Rust*) at Experimental Farm, NIA, Tando Jam under open field and laboratory conditions. The data showed that the candidate variety was highly resistant as compared to other canola genotypes which are depicted in Table 11 and 12.

R00-125/14 is referred to as short height mutant which is lodging resistant in response to unfavorable weather conditions, and high responsive to fertilizers to attain primary goal of high seed yield. Furthermore, the short height (dwarfness) positively correlated to early maturity. The early maturity is desirable character of crops especially canola (Hu *et al.*, 2017).

Table 11: *Aphid (%) infested plant in mutant along with parent and check at 5 ecological zone of Sindh Province.*

Genotypes	Tando Jam	Shaikh Burkhio	Tando Adam	Sanghar	Khipro	Shaikh Burkhio	Badin (Golarchi)
Wester	14.5	15.6	13.5	10.8	12.6	13.6	13.6
R00-125/14	8.2	9.4	6.4	4.3	7.5	4.3	6.8
Rainbow(p)	9.6	10.3	7.9	12.5	14.6	12.4	9.7
Oscar	11.3	9.8	8.3	13.4	12.4	11.3	12.6
Pakola(C)	10.4	12.4	11.4	10.9	15.6	13.6	10.7
Shirale	12.17	10.13	9.5	8.5	14.7	12.3	11.3

Table 12: *Disease response of SUHRAN-2012.*

Genotypes	Alternaria Blight (0-9)*	Powdery Mildew(%)	Downy Mildew(%)	White Rust (%)
Wester	3	2	1	1
R00-125/14	2	0	0	0
Rainbow(p)	3	4	2	3
Oscar	5	0	1	3
Pakola(C)	3	4	2	1
Shirale	3	0	0	0

The short statured mutants were selected from the rapeseed and mustard population which is treated with physical mutagen (Javed *et al*., 2003). R00-125/14 mutant results are in accordance with this study and also confirmed positive impact of induced mutation (Gamma radiation).

Breeding for enhancement of seed yield significantly correlated to genetically improve new genotypes with accumulation of desirable and high yielding genes. The siliqua per plant, number of seed per siliqua and 1000 seed weight are the significant factors responsible to enhance the productivity of oil seed crops (Barve *et al*., 2009). R00-125/14 was selected from mutagen treated population which produced higher number of siliqua per plant, seed per siliqua and 1000 seed weight as compared to mother variety (Landge *et al*., 2009). The pervious researchers also reported that mutant selected from mutagen treated population which has high seed yield and oil contents in rapeseed and mustard than the mother variety (Channaoui *et al*., 2019). R00-125/14 mutant exhibited large size and high seed per siliqua related to high yield. Early maturity is very important character in many crops including rapeseed and mustard which is the outcome of mutation breeding (Malek *et al*., 2014). Many early matured mutants varieties have been reported in oilseed crops Brassica (Kumawat *et al*., 2019), which is reliable in accordance to the season and demand of the farmers. The R00-125/14 mutant showed significantly high yield and oil contents with respect to check and mother variety during early station trial. The high 1000 seed weight was the actual cause of high yield in this variety (Ray *et al*., 2019; Viana *et al*., 2019).

Powdery mildew is a serious disease of canola which predominantly affects the mid-season and late mid-season canola crop especially at the seed development stage. The disease screening against the powdery mildew (*Erysiphe polygoni*) was made in the open field and was found moderately resistant. The same screening method of powdery mildew was already reported in previous research (Nanjundan *et al*., 2020). Their level of tolerance against this disease was also reported by (Azmat *et al*., 2020).The level of tolerance/resistance is defined through the genetics. The level of resistance against these two diseases was justified by the low rate of plant mortality (11-25 %) effecting the mutant (R00-125/14).

No, serious insect/pest on the mutant R00-125/14 was recorded. Only minute attacks of aphid per plant per leaf were noticed on R00-125/14 which can be easily controlled or overcome through suitable insecticide dosage. The characteristics of a cultivar along with a combination of traits differ according to the varying climatic conditions at different localities (Raza *et al*., 2019). Not only the environment played a vital role in the performance of the mutant (R00-125/14) in diverse ecological zones of the country but at the same time the role of genetics cannot be over looked.

Sowing date trials were conducted to optimize sowing season and harvest maximum yield potential (Andarzian *et al*., 2015). Previous research findings are in consistent with the R00-125/14 which perform well when sown first week of October. The highest yield was recorded at 30 cm row spacing and similar finding also has been reported (Birhanu *et al*., 2018).

Conclusions and Recommendations

It is concluded that R00-125/14 performed better in all the yield trials as compared to other existing varieties (check and parent). The mutant stain showed maximum yield potential 1813 kg/ha as compared to other existing mutant lines (R00-75/1, R00-125/12 and R00-125/17) during 2007-08 and 2008-09. The newly developed mutant strain showed higher seed yield (1998.0 kg/ha) advanced yield trial as compare to check (Bulbul and Pakola) and rainbow parent (1403 kg/ha). It was also insect pest and disease including *Alternaria blight, powdery mildew, downy mildew* and *white rust* tolerance. The agronomic study suggested that this mutant strain (R00-125/14) is most suitable in the existed cropping system and agronomic package of technology.

Novelty Statement

The current study conducted to selection and consequently development one of the first canola variety named as surhan-2012 for commercial cultivation in Sindh province of Pakistan. This variety possesses good agronomic characters as compared with locally adapted cultivars.

Author's Contribution

Mohammad Aquil Siddiqui: Conceived the idea, statistical analysis of the data and supervised the experiment.
Muhammad Mahran Aslam: Conducted the study, collected data and wrote first draft of manuscript.
Mahboob Ali Sial and Nighat Seema Soomro: Improved the manuscript through revisions and provide technical inputs.
Muhammad Tahir Khan, Shafquat Yasmeen and Shumaila Sial: Helped in collecting the agronomic data of the crop.
Imtiaz Ahmad Khan: Provided technical inputs, proofread the work.

Conflict of interest

The authors have declared no conflict of interest.

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