

Research Article



Sarsabz: A New High Yielding, Well Adapted Pea (*Pisum sativum* L.) Variety

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Abstract | Sarsabz, a high yielding, well adapted and bold-seeded pea variety was evolved by hybridizing two varieties Meteor and Lampo at Vegetable Research Institute, Faisalabad Pakistan. The variety was tested in replicated varietal/ station yield trials and multi-locational trials from 2001 to 2014. Sarsabz gave higher green pod yield (8.52 t/ha) than existing pea varieties i.e. Pea-2009 (7.51 t/ha) and Meteor (6.86 t/ha) and Climax (6.94 t/ha) on average basis. It yielded 13 % more than better check (Pea-2009). The most distinguishing trait of this variety is its greater pod width (2.04 cm) than Pea-2009 (1.87 cm), Meteor (1.59 cm) and Climax (1.61 cm) and more No. of pods per plant. Sarsabz is 27 days earlier in pod bearing than Climax and five days than Pea-2009. It is suitable for early planting (mid of October) as well as for normal planting (Mid of November). Its seed is light green, round and bold and its average 100-fresh seed weight is 67.62 g which is greater than Climax (48.4 g), Pea-2009 (67 g) and Meteor (44.18 g). This variety/line has the ability to tolerate against root rot and powdery mildew diseases of pea crop. The newly approved variety has potential to moderately resist to collar rot disease as compared with all other existing varieties. Studies on organoleptic characteristics showed that Sarsabz is less sweet in taste than Pea-2009, suitable for all types of dishes. This variety was approved by Punjab Seed Council and its seed is available for dissemination.

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Introduction

Peas belonging to the family leguminosae is an important winter vegetable crop in Pakistan due to its dietary qualities. Like pulses, peas are a rich source of protein having essential amino acids particularly lysine which is low in cereals (Roy et al., 2010; Rebello et al., 2014). In addition to protein it also contains many other important minerals. Peas are now grown throughout the world in nearly every climatic zone. Legumes are plants that bear fruits in the form of pods enclosing the fleshy seeds we know as beans.

It is mostly consumed as fresh vegetable in the form of green/fresh grains. Green peas belong to a category of crops called “nitrogen fixing” crops thus stand out as an environmentally friendly food (Graham and Vance, 2000; Anglade et al., 2015).

In Pakistan, Peas is an important crop which plays an important role in farmer's economy. It is the most common crop and enjoys a great commercial demand due to its nutritional value. It is cultivated during winter in plains and during summer in highlands (Habib and Zamin, 2003). In Pakistan, 144422 tonnes of peas

were produced from an area of 22436 hectares during 2015-16 with an average green pod yield of 6.44 t/ha. In Punjab its production is 112267 tones from an area of 17644 during 2015-16. Punjab province has a lion's share in pea area 78.6% and production 77.7 % (Fruits, Vegetables and Condiments Statistics of Pakistan, 2015-16). The major pea growing Districts are Gujranwala, Nankana Sahib, Multan, Sahiwal, Toba Tek Singh, Sialkot, Jhang and Sheikupura in Punjab. Pea crop is mostly grown in the months of October and November in Punjab. Early sowing of peas results in crop failure due to fungal diseases attacked on crop root system. Decrease in per acre average yield (6.44 T/ha) in Pakistan is associated with lack of disease resistant and high yielding varieties along with the use of appropriate production technology. Keeping in view the scenario the high yielding variety Sarsabz was originally developed through hybridization of indigenous material at Vegetable Research Institute, Faisalabad, Pakistan. This variety is suitable for both early and normal planting times with the potential to tolerate against major pea diseases i.e. collar rot and root rot (Falloon et al., 1995; Hamid et al., 2012) in comparison with existing pea varieties. Spot examination of variety was held on 25-02-2014 at the Research Farm of Vegetable Research Institute, Faisalabad. The variety was recommended and approved for general cultivation by the Punjab Seed Council, Lahore on 9th January. 2016.

Materials and Methods

Pea variety with Indeterminate flowering habit (Sarsabz) was developed from a cross of two diverse lines Meteor × Lampo made at Vegetable Research Institute (VRI), Faisalabad, Pakistan during 1990-91. Filial generations were studied from 1991-1998 by adopting Pedigree selection procedure (Poehlman and Sleper, 1995). Superior single plants were selected in successive generations and a record was maintained of the parent-progeny relationships. The line Meteor was high yielding, early maturing and medium stature plant where as Lampo was embraced with good yield, medium days to maturity and medium stature with dark green fascinating pod color. The new evolved line is the result of cross of both parents with subsequent selection in filial generations. The developed line was further tested in varietal/ station yield trials and multi-locational trials from 2001 to 2014. Yield trials were conducted in triplicate Randomized Complete Block Design. Data of agronomic

traits (green pod yield, days to 50 % flowering, plant height, pod length, pod width, No. of seeds/pod, No. of pods/plant) were recorded during all the trials to evaluate the consistency and uniformity of these traits in the successive generations. Significant association between these traits has been reported by Kumar and Sharma (2006).

Statistical Analysis

Second-order statistics were employed using estimates of variances and covariances. All quantitative traits were analyzed using analysis of variance (Steel and Torrie, 1980) with MSTATC (Ver. 1.5 Michigan State University, East Lansing, Mich.)

Results and Discussion

Early season yield trials

Data of early season yield trials revealed that the average values of No. of pods/plant, pod width, 100-fresh seed weight and green pod yield of Sarsabz (8.74, 2.03 cm, 64.93 g and 9.04 t/ha respectively) were higher than check varieties i.e. Pea-2009 (7.97, 1.90 cm, 63.65 g and 8.33 t/ha) and Meteor (7.96, 1.59 cm, 44.18 g and 6.65 t/ha (Table 1). Days to 50 % flowering of Sarsabz was five days earlier than Pea-2009 (Table 1). The results depicted that the candidate line competes the highly yielding check variety Pea-2009 in yield relating attributes and depicting its early pod bearing. Shah et al. (2016) also reported that line Sarsabz performed better for green pod yield and 100 grain weight in comparison with approved variety Pea-2009. Average No. of seeds per pod of Sarsabz (7.24) were nearly equal to Pea-2009 (7.40) but greater than Meteor (5.84). On average basis pod length of Sarsabz (9.27 cm) was greater than Meteor (8.27 cm) but less than Pea-2009. So, the five years' average performance of Sarsabz during trials in Punjab province and study conducted during 2014-15 in province Khyber Pakhtunkhwa revealed better performance of Sarsabz over check varieties. So this line proves its yield potential in both major peas growing provinces of Pakistan.

Normal season yield trials

Results of normal season yield trials showed that Sarsabz flowers earlier than Pea-2009 and Climax. On average Sarsabz bear flowers five days earlier than Pea-2009 and 27 days earlier than "Climax" a commercial cultivated variety in Pakistan for normal season planting (Table 2). Average plant height of Sarsabz (72.29 cm)

Table 1: Performance of Sarsabz in early season yield trials at Vegetable Research Institute, Faisalabad against Pea-2009, Meteor and Samrina Zard (Checks).

Year	Variety	Days to 50 % flowering	Plant height (cm)	No. of pods/plant	Seeds/ pod	Pod length(cm)	Pod-Width(cm)	100-Seed weight(g)Fresh	Green pod yield (t/ha)
2001-02	Samrina Zard	45.29	56.0	5.0	6.0	8.20	1.64	54.50	6.89
	Sarsabz	39.33	58.7	6.5	7.5	9.5	1.96	67.67	11.12
	Meteor	35.00	61.1	6.3	5.3	8.27	1.55	45.83	8.66
2010-11	Pea-2009	43.33	57.0	6.1	7.8	11.0	1.84	68.50	11.70
	Sarsabz	40.33	61.7	6.3	7.0	9.7	1.98	69.67	11.30
	Meteor	37.00	64.1	6.7	5.8	8.3	1.58	52.83	9.70
2010-12	Pea-2009	35.00	42.55	5.86	7.0	10.8	1.92	64.67	5.07
	Sarsabz	29.00	52.44	8.0	7.0	9.3	2.00	65.13	6.30
	Meteor	30.67	47.11	6.0	5.8	7.6	1.53	43.83	4.26
2012-13	Pea-2009	39.67	64.1	10.2	8.2	10.8	1.9	61.67	8.04
	Sarsabz	34.33	56.3	10.5	7.1	9.5	2.1	62.87	9.59
	Meteor	35.00	60.7	9.8	6.3	8.9	1.7	46.11	6.54
2013-14	Pea-2009	38.67	50.1	11.7	7.0	11.01	1.97	58.00	6.13
	Sarsabz	32.67	73.3	12.4	7.6	8.36	2.12	59.33	6.87
	Meteor	32.00	60.0	11.0	6.0	8.28	1.59	32.33	4.07
Average	Pea-2009	40.39	53.95	7.97	7.40	10.92	1.90	63.65	8.33
	Sarsabz	35.13	60.48	8.74	7.24	9.27	2.03	64.93	9.04
	Meteor	33.93	58.60	7.96	5.84	8.27	1.59	44.18	6.65

Table 2: Performance of Sarsabz in Normal season yield trial at Vegetable Research Institute, Faisalabad during 2011 to 2014 against checks (Pea-2009 and Climax).

Year	Variety	Days to 50 % flower	Plant height (cm)	No. of pods/plant	Seeds/ pod	Pod length (cm)	Pod Width (cm)	100-Seed Weight (g)Fresh	Green pod yield (t/ha)
2011-12	Climax	80.67	79.9	12.0	8.1	9.5	1.67	42.67	8.52
	Sarsabz	53.00	80.8	17.4	8.1	9.7	2.11	70.83	8.40
	Pea-2009	59.67	79.3	14.0	8.5	11.3	1.85	71.33	8.18
2012-13	Climax	62.00	97.41	10.3	5.6	8.7	1.59	47.83	4.69
	Sarsabz	35.33	70.46	12.0	6.8	8.8	1.99	64.33	7.88
	Pea-2009	35.67	74.93	10.6	6.8	10.4	1.83	60.53	5.33
2013-14	Climax	59.33	77.3	10.1	6.1	8.2	1.58	54.7	7.60
	Sarsabz	31.00	65.6	11.6	7.0	9.2	2.02	67.7	10.15
	Pea-2009	37.67	64.7	10.0	7.7	10.8	1.92	69.3	9.89
Average	Climax	67.33	84.87	10.8	6.6	8.8	1.61	48.4	6.94
	Sarsabz	39.66	72.29	14.3	7.3	9.2	2.04	67.62	8.93
	Pea-2009	44.33	59.89	11.4	7.7	10.8	1.87	67.05	7.80

was less than the Climax (84.87 cm) but greater than Pea-2009 (59.89 cm) showing better resistance of Sarsabz to lodging than that of Climax. Sarsabz exhibited superior performance in terms of average No. of pods/plant, pod width, 100-fresh seed weight and green pod yield with respective values of 14.34, 2.04 cm, 67.62 g and 8.93 t/ha over Climax (10.8, 1.61 cm, 48.4 g and 6.94 t/ha respectively) and Pea-2009 (11.43, 1.87 cm, 67.05 g and 7.8 t/ha respectively) (Table 2). Shah et al.

(2016) conducted evaluation of different Peas genotypes for yield and yield related traits and reported highest 100-fresh seed weight of Sarsabz than other genotypes of peas and earlier days to 50% flowering than Climax.

Multilocal yield trials

The new variety (Sarsabz) along with Pea-2009 and Meteor was tested from 2011 to 2014 at various locations all over the Punjab province i.e. Multan,

Sheikhupura, Faisalabad, Sahiwal and Bahawalpur. The grand mean showed that the variety Sarsabz (7.60 t/ha) gave higher average green pod yield than check varieties during all the years at all locations (Table 3). During 2011-12, average yield of Sarsabz at all the locations was 6.48 t/ha that is significantly higher as compared to Pea-2009 and Meteor (4.76 t/ha and 3.12 t/ha respectively). Likewise, during 2012-13 it showed higher average yield (7.6 t/ha) at all the locations than checks (6.9 t/ha and 5.8 t/ha). In 2013-14 average yield of Sarsabz at all the locations was 8.7 t/ha that is considerably higher as compared to checks (7.54 t/ha and 6.33 t/ha). Sarsabz depicted increase of 18% in yield over better check (Pea-2009). Study on peas varieties conducted in different districts of central to southern Punjab to check its adaptability in different ecological zones confirmed that the new variety has the potential to produce better yield all over the Punjab.

Table 3: Performance of Sarsabz from 2011 to 2014 in Multi-Locational Trial.

Year	Location	Varieties/Green pod yield (t/ha)		
		Sarsabz	Meteor	Pea-2009
2011-12	Faisalabad	7.12	4.0	6.09
	Sheikhupura	4.85	2.03	3.77
	Multan	7.49	3.33	4.42
	Average	6.48	3.12	4.76
2012-13		Sarsabz	Meteor	Pea-2009
	Faisalabad	8.62	7.51	8.38
	Sheikhupura	7.51	5.37	6.26
	Multan	9.02	7.43	8.88
	Sahiwal	8.53	5.86	8.26
	Bahawalpur	4.53	3.20	2.93
Average		7.6	5.8	6.9
		Sarsabz	Meteor	Pea-2009
2013-2014	Faisalabad	8.40	5.01	8
	Sheikhupura	8.88	6.66	7.91
	Multan	8.62	5.86	7.51
	Sahiwal	9.20	7.82	6.77
	Average	8.7	6.33	7.54
Mean Average		7.60	5.08	6.40
Percent increase of Sarsabz in yield over checks		-	49 %	18 %

Cumulative result of station and multilocational yield trials

Results of all green pod yield trials i.e. station (early season trials and normal season trials) and multiloca-

tional yield trials showed that average green pod yield of Sarsabz was 8.52 t/ha that is significantly higher than Meteor (6.86 t/ha), Pea-2009 (7.51 t/ha) and Climax (6.94 t/ha). It performed better in Oct. sowing than in Nov. sowing. It yielded 24, 13 and 22 % more than Meteor, Pea-2009 and Climax respectively (Table 4). Akhtar et al. (2015) in case of rice variety, PK-386 reported 10 % increase in its yield over better check (PK-385). Hassan et al. (2012) reported 9% increase in yield of improved maize variety "Pearl" over standard.

Table 4: Average of station and multilocational yield trials.

No. of trials	Name of the Trial	Varieties/Green pod yield (t/ha)			
		Sarsabz	Meteor	Pea-2009	Climax
Five	Early season yield trial	9.04	6.65	8.33	-
Three	Normal season yield trial	8.93	-	7.8	6.94
Three	Multilocational yield trial	7.60	5.08	6.40	-
Average yield (t/ha)		8.52	6.86	7.51	6.94
Percent increase of Sarsabz in yield over checks		-	24 %	13 %	22 %

Pathological studies

Pea plant is vulnerable to several diseases; collar rot, powdery mildew, wilt and leaf spots disease annually reduce the biologically yield considerably (Kraft and Pfeiffer, 2001). Root damaging fungal diseases of pea crop attack as an epidemics and leads to crop failure. To check the pathological studies of candidate variety trials were carried out at Vegetable Research Institute, Faisalabad and Plant Pathological Research Institute, Faisalabad depicted that no serious disease has been reported on Sarsabz (Table 5). Pea-2009 and Sarsabz are moderately susceptible to root rot while Meteor is susceptible (Table 5). Phytophthora megasperma causing collar rot disease is a devastating pathogen of the pea plant and a major threat to crop failure. Symptoms with the varying intensity are more visible in all pea fields at the end of flowering stage (Podger, 1978). The candidate variety Sarsabz is found moderately resistant to collar rot while Pea-2009 is moderately susceptible and meteor is susceptible to this disease respectively.

Entomological studies

No serious insect/pest on Sarsabz has been recorded by Entomological Research Institute, Faisalabad. Negligible attack of aphid and pod borer was observed

(Table 6). On one plant of Pea-2009, 13.33(mean) No. of aphids were found and on one plant of Sarsabz 12.55 No. of aphids were found. Pod borer infestation was 1.33% on Pea-2009 and 0.67% on Sarsabz.

Table 5: Level of resistance of Sarsabz against powdery mildew, root rot and collar rot.

Variety	Powdery mildew	Root rot	Collar rot
Pea-2009	-	Moderately susceptible	Moderately susceptible
Meteor	Tolerant	Susceptible	Susceptible
Sarsabz	Tolerant	Moderately susceptible	Moderately Resistant

Table 6: Entomological studies of Sarsabz at Entomological Research Institute, Faisalabad during 2010-11.

S. No.	Variety	Aphid pop. / plant (Mean)	% age infestation of pod borer (Mean)
1	Pea-2009	13.33	1.33
2	Meteor	9.06	0.33
3	Sarsabz	12.53	0.67

Agronomic studies

Agronomic studies during 2012-13 and 2013-14 depicted that highest yield (8.82 t/ha) of Sarsabz was obtained at the plant spacing of 5 cm and lowest yield was obtained at plant spacing of 10 cm (Table 7). This variety should be planted at plant spacing of 5cm on raised beds for getting maximum yield potential.

Table 7: Performance of Sarsabz at different plant spacing's at Agronomic Research Institute, Faisalabad.

Year	Variety	Plant spacing/ green pod yield (t/ha)		
	Sarsabz	5.0 (cm)	7.5 (cm)	10.0 (cm)
2012-2013		8.75	6.16	5.32
2013-2014		8.90	7.20	4.32
Average		8.82	6.68	4.82

Table 8: Organoleptic Performance of Sarsabz after cooking at Vegetable Research Institute, Faisalabad during 2013-14.

S.No.	Variety/line	Taste
1	Pea-2009 (Check)	Sweetest
2	Meteor Check)	Sweet
3	Sarsabz	Sweet
4	2001-60	Less sweet
5	It-96	Tasteless

Organoleptic study

Studies on Organoleptic characteristics revealed that Pea-2009 was found sweetest in taste and Sarsabz and Meteor were found sweet in taste after cooking (Table 8). An advance line (2001-60) was less sweet than Sarsabz and a commercial variety (It-96) was tasteless after cooking. So due to medium sweet taste Sarsabz is suitable for all types of dishes.

Botanical description of sarsabz

Mode of pollination	Self pollinated
Adult Plant	
Plant height (cm)	42 for Oct. sowing, 75 for Nov. sowing
Foliage color	Medium Green
Waxiness of upper surface of leaflet	Absent
Flower	
Ave. flowering days	35 days for early season, 50 days for normal season
Flower color	White
Anther color	Orange
POD	
Pod color	Medium green
Pod length /width (cm)	9.0/2.0
Pod shape	Slightly curved
Pods /plant	9-14
No. of seeds/pod 7-10 Ave. Pod yield (t/ha)	8.52
Potential Pod yield (t/ha)	10.3
Seed	
Seed colour	Light green
Seed shape	Roundish
Seed size	Bold
100-seed weight (g)	68

Conclusions and Recommendations

It could be concluded that pea variety Sarsabz is superior over existing approved varieties Pea-2009, Meteor and Climax in terms of green pod yield, earliness and pod size. This variety/line is tolerant to collar root, root rot disease and suitable for October cultivation as well as for November cultivation. This variety is fit for early and normal palnting and has the potential to produce good yield in all districts of Pakistan. Sarsabz is less sweet in taste than Pea-2009, so suitable for all types of dishes. Cultivation of this variety on large scale will surely increase the production of peas in Pakistan and will also prove beneficial for farmers increasing their income.

Saeed Ahmad Shah Chishti: Supervised the research and facilitated experimental work.

Mudassar Iqbal: Designed experiments, collected data and wrote the manuscript.

Nusrat Parveen: Wrote and edited the manuscript.

Kashif Nadeem and Muhammad Iqbal: Evaluated the research station and multilocal trials.

Umbreen Shahzad: Assisted in conductance of multilocal yield trials.

Rana Husnain Shabbir: Analyzed the data.

Muhammad Najeebullah: Supervised the research and facilitated experimental work.

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