Evaluation of Lettuce Genotypes for Growth and Yield Attributes in Kashmir Valley

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The experiment was conducted during 2006 and 2007 at Sher-e-Kashmir University of Agricultural Sciences & Technology (K), Shalimar, with 25 genotypes of lettuce. Among all the genotypes, LS-2 proved significantly superior to rest of the genotypes in terms of yield (362.60 g/plant) and most of the yield attributing characters. It was statistically comparable with LS-17 (342.31 g/plant). The genotypes LS-11 exhibited highest plant height of 29.09 cm where as maximum plant spread was recorded in LC-4 (37.37cm) followed by LS-15 (37.01cm) and LS-2 (35.98 cm). The genotypes LS-2 (49.26), LS-15 (47.16) and LC-5 (45.46) gave maximum number of leaves/plant, whereas average leaf weight was highest in LS-18 (11.54 g). The leaf area was maximum in SS-12 (246.84 cm^2) followed by LS-18 (242.90 cm^2). Genotype LS-11 and LS-17 were early in picking recording the value of 45 days under the investigation during individual as well as on pooled data basis. LC-18 and LS-19 were late in picking which took 53 days and 60 days, respectively, with less picking duration of 16 days on pooled data and individual basis. The LS-2 genotype can be recommended for cultivation in this area as they are high yielding and early in picking and given good performance during winter as well as in summer.

Key Words: Evaluation, Improvement, *Lactuca sativa* L., Lettuce, Selection, Variability

Introduction

Lettuce (*Lactuca sativa* L.) is an important salad vegetable and popular in USA, Australia and Europe. Now a days, it has started gaining importance in India especially in big markets of metropolitan cities. It is rich source of Vitamin C, pro-vitamin A and minerals such as calcium, phosphorous, potassium and iron. Vitamins, fibre, folic acid, high potassium and high volume of water make it a heart healthy green vegetable as it helps in lowering cholesterol, blood pressure and other risk factors for heart diseases and also have medicinal properties (Sharma, 2002). Lettuce is used fresh in salads, sandwiches and for garnishing. Besides domestic markets, it has great potential for exporting to neighbouring Middle East countries. The present study was, therefore, undertaken to identify suitable genotypes with desirable yield potential and horticultural characteristics for Kashmir region.

Materials and Methods

The present investigation was carried out at Sher-e-Kashmir University of Agricultural Science and Technology, Kashmir, Srinagar, during winter 2006 and summer 2007. Twentyfive genotypes of lettuce were utilized for the study in randomized block design with three replications. Sowing was done in mid August 2006 for winter crop in raised bed and first week of February 2007 in hot beds for summer crop. Hot beds prepared with the help of bamboo sticks and paddy straw, and beds covered by polythene-sheet during night for protection of nursery from cold air in winter. Five- week- old seedlings were transplanted in the field at 45×45 cm spacing in three rows of 2.25 m accommodating 15 plants of each genotypes in each replication on 15th September and 8th March for winter and summer season, respectively. The FYM and fertilizers were applied as per recommended package of practices *i.e.* 20 tonnes FYM and 120:90:60 kg NPK/ha. Irrigation was applied at the time of transplantation and subsequent as and when required. Intercultural operations like hoeing, weeding and insecticide application were carried out according to the normal practice to raise a successful crop.

For each growing season, lettuce genotypes were picked when they reached commercial size and subsequent picking was done at 10 days interval. The observation was recorded on five randomly selected plant for each genotype replication-wise on 8 quantitative characters *viz.* plant height (cm), plant spread (cm), number of leaves/plant, average leaf weight (g), leaf area (cm^2), days to first picking, duration of picking and leaf yield/plant (g). Statistical analysis was done according to the methods suggested by Panse and Sukhatme (1967).

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Results and Discussion

Analysis of variance showed highly significant differences among genotypes for all the character under study. The genotypes tested, expressed significant variability for all the traits both in winter as well as in summer indicating a good amount of variability in the present material. The data pertaining to leaf yield and its contributing characters and best five genotypes on mean performance were given in Table 1 and 2, respectively. In regards to plant height, highest plant height was noted in SS-11 during winter, summer as well as on pooled basis, but it was at par with Simpson and LS-2 during winter as well as on pooled basis. The plant spread was recorded as the average spread from North to South and East to West direction which varied from 16.76 cm (LS-19) to 36.33 cm (LC-4) with over all mean value of 29.99 cm during winter and 24.93 cm (LS-20) to 39.13 cm (LC-4) with over all mean of 34.91 cm during summer season. The maximum plant spread was recorded in LC-4 (37.73 cm) which was statistically at par with LS-15 (37.01 cm), LS-2 (35.98 cm) and SS-12 (35.46 cm) on pooled basis.

As regard to number of leaves/plant, genotypes LS-2 (49.26) proved best among all the genotypes studied under this experiment for obtaining maximum number of leaves/plant in both season as well as on pooled basis while, LS-15 (47.16), LC-5 (45.46) and Simpson (44.62) being similar in the respect to descending order. Further, it ranged from 23.30 (LS-20) to 49.26 (LS-2) with over all mean of 37.92 on pooled data basis. In respect of average leaf weight, LS-18 (12.93 g) had highest leaf weight among all the genotypes during winter and on pooled basis, but second position in summer and statistically par with LS-11 (12.53 g) during winter. The leaf area ranged from 151.90 (LS-20) to 277.76 cm^2 (SS-12) with mean value of 221.59 cm^2. Maximum leaf area was found in SS-12, during both the seasons, while it was statistically at par with LC-9 (272.50 cm^2) and RM (266.18 cm^2) during winter and LC-29 (244.00 cm^2) and Simpson (222.56 cm^2) during summer season.

Genotypes LS-11, LC-24, LS-17, SS-12 and LS-2 were early in picking recording 45 days from date of transplanting with picking duration of 30 days while genotypes LS-19, LS-20 and LS-8 were late in picking recording 65.0, 61.66, and 58.33 days from date of transplanting with picking duration of 13.33, 23.33, 20.0 days, respectively, during winter indicating that these genotypes required considerably more period of time for their initial establishment in the field than the other genotypes. Whereas in summer, genotypes DPHL-1, LS-11, LC-24, LS-17 and LS-2 were early in picking and recording 45 days from date of transplanting with picking duration of 30 days. LS-19, LS-20 and LS-8 were late in picking, recording 55 days from date of transplanting with picking duration of 20.0, 26.66 and 26.66 days, respectively.

In critical analysis of the data on leaf yield/plant, it was observed that the genotypes LS-2 (362.66g) proved it superiority over rest of the genotypes, except that it was statistically comparable with LS-17 on pooled and winter season, however, during winter. DPHL-1 record highest leaves yield (385.0g) and were statistically at par with LS-2 (347.60 g), Simpson (322.66 g) and LS-17(321.33 g). Similar observation on mean performance were observed by Singh *et al*. (2000), Sharma (2003) and Araujo *et al.* (2007) for leaf yield/plant in lettuce; Leeper and Scully (1991), Komissarov *et al*. (1980) and Ledo *et al.* (2001) for different traits in lettuce.

Mean performance of the genotypes (Table 1) in both the seasons revealed that no single genotypes were superior for all the traits. Different genotypes were identified to be superior for different traits. The genotypes SS-11, Simpson, LS-2, SS-7 and LC-15 were superior in respect of plant height, and LC-4, LS-15, LS-2, SS-12, LC-15 were desirable in respect of plant spread in both the seasons. The genotypes which were desirable for number of leaves in both the seasons were LS-2, LS-15, LC-5 and LS-17. The desirable genotypes in respect of leaf area were SS-12, Simpson, LS-2 and LS-21, while LS-18 and LS-11 for average leaf weight in both seasons. The desirable genotypes in respect of early picking were LS-11, LS-17, SS-12, LC-9, LS-2, LC-24 and DPHL-1, while the genotypes LC-29, LC-5, LS-18, LS-19, LS-20 and LS-8 were in general late in picking as these genotypes required considerably more period of time for their initial establishment in the field than the other genotypes in winter as well as in summer. Genotypes, LS-2, LS-17, LC-24 and LC-4 exhibited better performance for leaf yield/plant in both the seasons. However, DPHL-1 performed better only in summer.

An overall perusal of Table 2, indicated that the genotypes LS-2, LS-17, in both seasons; LC-24, LC-4 and LC-9 in winter; Simpson, LC-5 and LS-15 in summer besides being high yield also exhibit superior performance for other important yield attributing traits

Table 1. Mean performance of various lettuce genotypes for different characters under winter and summer season

Genotypes	Plant height (cm)		Pooled	Plant spread (cm)		Pooled	Number of leaves/plant		Pooled	Average leaf weight (g)		Pooled
	Winter	Summer		Winter	Summer		Winter	Summer		Winter	Summer	
LC-2	14.80	18.00	16.40	31.80	35.40	33.65	32.60	39.40	36.00	10.73	8.00	9.36
LC-4	16.76	18.80	17.78	36.33	39.13	37.73	43.33	40.93	42.93	9.66	8.56	9.11
LC-5	17.26	19.36	18.31	32.03	35.70	33.86	38.06	52.86	45.46	9.06	7.00	8.03
LC-9	16.46	20.00	18.29	30.63	36.93	33.78	35.33	41.00	38.16	10.20	8.63	9.41
LC-14	16.33	17.16	16.74	30.13	35.00	32.61	32.80	53.46	43.13	7.40	6.20	6.80
LC-15	17.46	19.13	18.29	32.03	37.10	34.56	34.73	49.73	42.23	7.86	7.06	7.46
LC-16	17.13	17.60	17.36	28.76	38.60	33.68	33.00	38.80	35.90	10.13	7.96	9.04
LC-24	16.50	18.33	17.41	33.26	33.83	33.54	35.06	41.46	38.26	12.40	9.70	11.05
LC-29	13.40	18.63	16.01	24.36	28.73	26.54	22.66	27.0	24.83	10.46	9.66	10.06
LS-2	17.46	19.66	18.53	34.73	37.23	35.98	43.53	55.00	49.26	10.06	7.56	8.81
LS-8	14.20	19.40	16.80	30.16	34.83	32.54	34.36	43.66	39.01	7.06	7.00	7.03
LS-11	17.10	17.80	17.45	33.23	35.90	34.36	31.33	42.26	36.79	12.53	10.30	11.42
LS-15	16.33	18.90	17.61	36.00	38.03	37.01	39.86	54.46	47.16	8.70	6.96	7.83
LS-16	15.80	18.20	17.00	31.53	37.06	34.29	35.00	41.86	38.40	7.76	7.26	7.51
LS-17	17.46	19.33	18.39	34.80	33.90	34.35	35.73	48.93	42.33	10.73	7.10	8.91
LS-18	13.60	19.66	16.60	25.60	33.03	29.31	22.06	32.93	27.49	12.93	10.16	11.54
LS-19	10.86	17.46	14.16	16.76	32.00	24.38	22.46	33.33	27.89	10.40	9.40	9.90
LS-20	10.06	17.13	13.59	16.83	24.93	20.80	18.20	28.40	23.30	8.96	7.10	8.03
LS-21	13.40	18.03	15.71	27.83	31.10	29.46	29.20	27.33	28.26	11.60	8.33	9.96
SS-7	18.46	19.53	18.99	31.73	33.43	32.58	34.73	48.86	41.79	10.13	7.26	8.69
SS-11	18.66	21.53	20.09	32.16	35.70	33.93	33.73	45.26	39.49	10.46	7.46	8.96
SS-12	16.80	19.93	18.36	32.46	38.46	35.46	31.86	43.60	37.73	8.93	8.23	8.58
DPHL-I	16.33	18.66	17.46	28.10	35.50	31.80	33.40	53.73	43.56	9.96	7.76	8.86
Simpson	17.60	20.00	18.60	28.76	36.16	32.47	35.06	54.33	44.62	10.06	7.50	8.78
RM (C)	16.46	18.76	17.61	29.86	35.03	32.44	30.86	38.40	34.63	10.40	8.83	9.61
G. Mean	15.75	18.59	17.17	29.99	34.91	32.45	32.76	43.08	37.92	9.94	8.04	8.99
LSD at 5%	1.63	0.96	1.29	2.73	2.61	2.67	2.42	4.66	3.59	1.12	0.84	0.98
SED	0.81	0.48	0.64	1.36	1.30	1.33	1.20	2.32	1.76	0.55	0.41	0.48
CV%	6.30	3.16	4.73	5.56	4.56	5.06	4.50	6.59	5.54	6.88	6.36	6.62

Genotypes	Leaf area (cm^2)		Pooled	Days to first picking		Pooled	Duration of picking (days)		Pooled	Leaf yield/ plant (g)		Pooled
	Winter	Summer		Winter	Summer		Winter	Summer		Winter	Summer	
LC-2	204.51	148.43	176.47	48.33	48.33	48.33	26.66	26.66	26.66	297.00	251.60	274.30
LC-4	240.46	183.63	212.04	51.66	48.33	49.96	26.66	30.00	28.33	335.60	288.60	312.30
LC-5	182.28	148.00	165.04	51.66	48.33	49.96	23.33	26.66	24.99	258.66	291.60	275.13
LC-9	272.50	177.34	224.92	45.00	45.00	45.00	26.66	30.00	28.33	333.60	285.60	194.60
LC-14	180.71	151.92	166.32	55.00	51.66	53.30	20.00	23.33	21.65	250.30	262.30	256.30
LC-15	195.96	207.70	201.83	51.66	51.66	51.66	20.00	20.00	20.00	241.00	285.30	263.15
LC-16	215.83	170.53	193.18	51.66	48.33	49.96	23.33	26.66	24.99	258.00	244.00	251.00
LC-24	259.74	199.30	229.52	45.00	45.00	45.00	30.00	30.00	30.00	363.33	306.00	334.66
LC-29	206.95	224.00	215.47	51.66	48.33	49.96	33.33	36.66	34.99	189.66	179.06	184.36
LS-2	252.16	227.60	239.88	45.00	45.00	45.00	30.00	30.00	30.00	377.60	347.60	362.60
LS-8	193.63	199.34	196.49	58.33	55.00	56.65	20.00	26.66	23.30	214.60	250.30	232.45
LS-11	241.53	193.29	217.41	45.00	45.00	45.00	30.00	30.00	30.00	322.66	356.00	314.33
LS-15	179.77	188.38	184.07	51.66	45.00	48.33	30.00	30.00	30.00	317.00	293.60	305.00
LS-16	193.56	144.73	169.15	48.33	48.33	48.33	20.00	23.33	21.65	256.30	222.60	239.45
LS-17	247.29	161.00	204.15	45.00	45.00	45.00	30.00	30.00	30.00	373.33	321.33	342.31
LS-18	262.15	223.76	242.90	55.00	51.66	53.30	23.33	23.33	23.33	225.66	266.60	246.13
LS-19	191.66	192.41	192.04	65.00	55.00	60.00	13.33	20.00	16.66	202.60	259.33	230.97
LS-20	151.90	142.86	147.38	61.66	55.00	58.30	23.33	26.66	24.99	138.00	125.33	131.67
LS-21	246.01	216.83	231.16	51.66	51.66	51.66	30.00	30.00	30.00	285.30	276.30	280.80
SS-7	242.10	188.40	215.30	48.33	48.33	48.33	26.66	26.66	26.66	296.33	274.60	285.47
SS-11	187.88	207.11	197.49	48.33	45.00	46.65	20.00	20.00	20.00	317.66	266.00	291.83
SS-12	277.76	217.93	246.84	45.00	45.00	45.00	30.00	30.00	30.00	266.60	283.60	275.10
DPHL-I	192.50	198.23	195.36	48.33	45.00	46.66	23.33	30.00	26.66	272.00	385.00	328.50
Simpson	254.80	222.56	238.68	48.33	45.00	46.65	26.66	30.00	28.33	278.60	322.66	302.30
RM (C)	266.18	148.60	207.09	48.33	48.33	48.33	23.33	26.66	24.99	262.33	260.00	261.17
G. Mean	221.59	187.34	204.44	50.60	48.33	49.46	25.20	27.20	26.20	277.37	276.25	276.81
LSD at 5%	16.14	11.91	14.02	7.70	6.69	7.19	6.84	6.46	6.65	20.19	23.60	21.89
SED	8.02	5.92	6.97	3.83	3.32	3.57	3.40	3.21	3.30	10.02	11.76	10.89
CV%	4.43	3.87	4.15	9.28	8.43	8.85	16.54	14.47	15.50	4.40	5.21	4.80

Table 2. Best five genotypes on the basis of mean performance for different characters in lettuce genotypes

Traits	Winter	Summer	Pooled
Plant height (cm)	SS-11 (18.66)	SS-11 (21.53)	SS-11 (20.09)
	SS-7 (18.46)	LC-9 (20.00)	SS-7 (18.99)
	Simpson (17.60)	Simpson (20.0)	Simpson (18.60)
	LS-2 (17.46)	SS-12 (19.93)	LS-2 (18.53)
	LS-17 (17.46)	LS-2 (19.60)	SS-12 (18.36)
Plant spread (cm)	LC-4 (36.33)	LC-4 (39.13)	LC-4 (37.73)
	LS-15 (36.00)	LC-16 (38.6)	LS-15 (37.01)
	LS-17 (34.80)	SS-12 (38.46)	LS-2 (35.98)
	LS-2 (34.73)	LS-15 (38.03)	SS-12 (35.46)
	LC-24 (33.26)	LS-2 (37.23)	LC-15 (34.86)
No. of leaves/plant	LS-2 (43.53)	LS-2 (55.0)	LS-2 (49.26)
	LC-4 (43.33)	LS-15 (54.46)	LS-15 (47.16)
	LS-15 (39.86)	DPHL-1 (53.73)	LC-5 (45.46)
	LC-5 (38.06)	LC-14 (53.46)	Simpson (44.62)
	LS-17 (35.73)	LC-5 (52.86)	DPHL-1 (43.56)
Average leaf weight (g)	LS-18 (12.93)	LS-11 (10.3)	LS-18 (11.54)
	LS-11 (12.53)	LS-18 (10.16)	LS-11 (11.42)
	LC-24 (12.4)	LC-24 (9.7)	LC-24 (11.05)
	LS-21 (11.6)	LC-29 (9.66)	LC-29 (10.06)
	LC-2 (10.73)	LS-19 (9.4)	LS-21 (9.96)
Leaf area (cm^2)	SS-12 (277.76)	LS-2 (227.60)	SS-12 (246.84)
	LC-9 (272.50)	LC-29 (224.0)	LS-18 (242.90)
	RM (266.15)	LS-18 (223.76)	LS-2 (239.88)
	LS-18 (262.15)	Simpson (222.56)	Simpson (238.68)
	LC-24 (259.74)	SS-12 (217.93)	LS-21 (231.16)
Days to first picking	LS-11 (45.00)	DPHL-1 (45.00)	LS-11 (45.00)
	LS-17 (45.00)	LS-11 (45.00)	LC-24 (45.00)
	SS-12 (45.00)	LC-24 (45.00)	LS-17 (45.00)
	LC-9 (45.00)	LS-17 (45.00)	LS-2 (45.00)
	LS-2 (45.00)	SS-12 (45.00)	LC-9 (45.00)
Duration of picking (days)	LC-29 (33.3)	LC-29 (36.66)	LC-29 (34.98)
	LS-11 (30.0)	LS-11 (30.0)	LC-24 (30.0)
	LS-12 (30.0)	LC-24 (30.0)	LS-17 (30.0)
	LS-2 (30.0)	LS-17 (30.0)	LS-2 (30.0)
	SS-12 (30.0)	LS-2 (30.0)	SS-12 (30.0)
Leaf yield/plant (g)	LS-2 (377.60)	DPHL-1 (385.00)	LS-2 (362.6)
	LS-17 (373.33)	LS-2 (347.6)	LS-17 (342.31)
	LC-24 (363.33)	Simpson (322.6)	LC-24 (334.6)
	LC-4 (335.60)	LS-17 (321.33)	DPHL-1 (328.5)
	LC-9 (333.30)	LC-24 (306.0)	LS-11 (314.33)

namely, plant spread, number of leaves, leaf area, days to first picking and duration of picking. Since different genotypes were identified to be performing differently for yield attributing and quality traits, hence, these diverse genotypes with superior characters could be involved in the hybridization programme for assembling of desirable traits in single genotypes or could be very well utilized for commercial growing in the valley. Similar observations on mean performance of lettuce have been reported by Singh *et al.* (2000), Sharma (2003) and Araujo *et al.* (2007) for yield.

On the basis of above results the genotypes LS-2, LS-17, LC-4 and LC-24 was found to be performing better in terms of yield and yield attributing characters like number of leaves/plant, plant spread, early in picking which in turn gives longer duration of picking.

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