International Journal of Plant & Soil Science

34(19): 35-43, 2022; Article no.IJPSS.87364
ISSN: 2320-7035

Evaluation of Newly Introduced Leaf Lettuce Genotypes under Mid Hills Conditions of Solan District of Himachal Pradesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i1931086

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/87364

Original Research Article

Received 07 March 2022
Accepted 14 May 2022
Published 18 May 2022

ABSTRACT

Lettuce is one of the major leafy vegetables used in salads, soups and occasionally lightly cooked. Leaf lettuce has garnered a central role in human nutrition, as it combines pleasing organoleptic properties with a rich content of nutraceutical compounds. Leaf lettuce can bring about a diversification in the tomato/bell pepper production system in the summer season. The cultivation of lettuce has already started picking up in Himachal Pradesh in summers. The produce from hilly areas are available at time when these cannot be grown in the plains due to high temperature, thus bringing lucrative returns to the growers. Twenty two diverse genotypes of lettuce were evaluated in Randomized Complete Block Design (RCBD) with three replications at KVK, Kandaghat, including standard check cultivar, Solan Kriti, to ascertain the extent of variability. The observations were recorded on various morphological and horticultural traits in leaf lettuce. On the basis of studies, it was concluded that genotypes viz., KGT-1, Lettuce C1, KGT-5 and LS-2 Selection-3, performed better in terms of yield and other horticultural traits over the standard check, Solan Kriti. So, these genotypes offer an ample scope for their release in the mid hill conditions of Himachal Pradesh after multilocational testing.

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Keywords: Genotypes; variability; leaf lettuce; summer cultivation; Himachal Pradesh.

1. INTRODUCTION

Lettuce is one of the major leafy vegetables used in salads, soups and occasionally lightly cooked. It belongs to the family Asteraceae and sub family Chicoridae. Lettuce leaves exude milk like sap when cut hence, its name has been derived from the latin word *lactuca* meaning 'milk'. It is believed to be originated in the Mediterranean region, Central Asia and South west Asia. In world, lettuce and chicory is cultivated over an area of 1.27 million hectare with the production of 27.25 million tonnes. In India, production of lettuce and chicory is around 1.22 million tonnes over an area of 0.19 million hectare [1]. Leaf lettuce has garnered a central role in human nutrition as it combines pleasing organoleptic properties with a rich content of nutraceutical compounds [2]. The health-promoting properties of leaf lettuce have been attributed to minerals, vitamins B_9, C, K, A and E, bioactive terpenoids and polyphenols such as carotenoids, phenolic acids and flavonoids. Lettuce has a high content of phytonutrients combined with a low content of dietary fats, which makes lettuce an attractive low-calorie food, whose consumption is highly suggested within weight-loss dietary plans. Mid hills of Himachal Pradesh are a major supplier of solanaceous vegetables i.e. tomato and bell pepper to the plains in summer-rainy season. Intensive cultivation of solanaceous vegetables has resulted in a greater incidence of insects-pests and diseases in the fields of farmers. Hence, leaf lettuce can bring about a diversification in the tomato/bell pepper production system in the summer season. The cultivation of lettuce has already started picking up in Himachal Pradesh and farmers are cultivating lettuce in summers in some pockets. The produce from hilly areas are available at time when these cannot be grown in the plains due to high temperature, thus bringing lucrative returns to the growers. In spite of such an economic importance of the crop, the work has not been done in leaf lettuce to identify and evaluate the high yielding and superior quality genotypes especially for summer seasons.

The role of genetic variability in a crop is of paramount importance in selecting the best genotypes for making rapid improvement in yield and desirable characters as well as to select most potential parents for further breeding programme.

2. MATERIALS AND METHODS

The experiment was laid out in Randomized Complete Block Design (RCBD) in three replications. Twenty five plants of each genotype were transplanted at a spacing of 45×30cm in a plot of 1.80m×1.50 m in the month of February, 2020. Description of lettuce genotypes with sources is given in table 1The Experimental Farm of Krishi Vigyan Kendra is situated at an elevation of 1425 m above mean sea level with 30.9702° N latitude and 77.1054° E longitude, representing mid hill zone of Himachal Pradesh. The area being in temperate zone of HP has January-February the coldest and May-June the hottest months, in the year. The annual precipitation at Kandaghat generally ranges from 1350-1390 mm. The maximum rainfall occurs from July-September. The soil texture is gravelly loam to gravelly clay loam with pH ranging from 6.85-7.04. The observations were recorded on ten randomly selected plants from each plot on the following traits viz., Days taken to marketable maturity, Leaf colour, Leaf Texture, Fresh leaf weight, Dry leaf weight (g), Leaf length (cm), Leaf breadth (cm), Leaf area (cm^2),Leaf shape, Leaf blistering, Leaf taste, Plant spread (cm), Plant height (cm), Number of leaves per plant, calcium content (mg/100g), Iron content (mg/100g), β carotene content (µg/100g), 1000 seed weight (g), Yield per plant (g). The data recorded on different parameters has been statistically analyzed by using Randomized Complete Block Design (RCBD) given by Gomez and Gomez [3].

Table 1. List of lettuce genotypes with sources

Sr. No.	EC Number/ Name	Source
1.	KGT-1	YSPUHF, Solan
2.	KGT-3	YSPUHF, Solan
3.	KGT-5	YSPUHF, Solan
4.	KGT-6	YSPUHF, Solan
5.	SBS	CAZRI, Leh
6.	Leh Local Selection	CAZRI, Leh

Sr. No.	EC Number/ Name	Source
7.	Revolution Red	SKUAST, Kashmir
8.	Lollo Rosa	SKUAST, Kashmir
9.	Simpson	SKUAST, Kashmir
10.	LS-2 Selection-1	CAZRI, Leh
11.	LS-2 Selection-3	CAZRI, Leh
12.	Lettuce Gentilina	CAZRI, Leh
13.	Lettuce Lob Joits	CAZRI, Leh
14.	Lettuce Red Leaf	SKUAST, Kashmir
15.	Lettuce C1	CAZRI, Leh
16.	Samson Selection-1	SKUAST, Kashmir
17.	Ballmoral	SKUAST, Kashmir
18.	Lettuce Revolution Selection-4	SKUAST, Kashmir
19.	Lettuce Revolution Selection-9	SKUAST, Kashmir
20.	Chinese Yellow	YSPUHF, Solan
21.	LS-2	CAZRI, Leh
22.	Solan Kriti	YSPUHF, Solan

3. RESULTS AND DISCUSSION

3.1 Quantitative Traits

Significant difference among different genotypes of lettuce was recorded for all the traits understudy. Earliness is of economic importance in lettuce as it helps to fetch premium price in the market and is one of the major objectives in breeding early cultivars. Among all the genotypes KGT-1 (40.42 days) was found earliest in maturity while the cultivar LS-2 took maximum days to marketable maturity (47.99 days). Leaf length is one of the most important trait which is directly associated with the yield and yield contributing traits. Maximum leaf length was recorded in genotype KGT-1 (23.19 cm) and minimum leaf length was found in the genotype LS-2 Selection-3 (16.47 cm). Wide variation for this character was also reported by Mousavi et al. [4], Kumar et al. [5] and Sapkota et al. [4]. Leaf breadth is one of the most important aspect of lettuce governing the broadness of the leaf which further enhances the use of the lettuce leaf in various European cuisines. For the trait leaf breadth, maximum was observed in the genotype, KGT-1 (15.12 cm) and minimum leaf breadth was observed in genotype, Simpson (10.60 cm). The fresh leaf weight is an important yield contributing character and has a direct effect on the plant yield. Maximum fresh leaf weight was recorded in genotype KGT- 1 (12.10 g) while minimum was recorded in the genotype, Ballmoral (8.07 g).These results were in conformity with these reported by Kumar et al. [5], and Rather et al. [6]. Plant height is considered an important trait, because it indicates the yield capability of lettuce plants. For the trait plant height, maximum plant height was recorded in the genotype KGT-1 (35.42 cm), while it was recorded minimum for the genotype Leh Local Selection (28.56 cm). Plant spread is one of the most important aspect in breeding of lettuce. Plant spread helps us to determine the space needed for cultivation and in post harvest processing of lettuce leaves. Maximum plant spread was observed in the genotype KGT-1 (36.63 cm) and minimum observation was recorded in the genotype Lollo Rosa (30.43 cm). The mean performance depicted that maximum number of leaves per plant were recorded in the genotype KGT-1 (34.69) while it was recorded minimum in the genotype, Lettuce Red Leaf (30.29). Leaf area is one of the most important aspect of leaf parameter and is directly associated with the horticultural and yield traits. The observations recorded on leaf area revealed significant differences among the various genotypes, maximum leaf area was recorded in the genotype KGT-1 (331.05 cm^2) and minimum was observed in the genotype Lettuce Red Leaf (155.33 cm^2). The results are in line with the earlier findings of Son and Oh [7] , Dolma and Gupta [8] , Chatterjee [9]. The main focus of cultivating the crop is to have maximum yield per plant for better returns. Higher yield per plant is the primary goal of every crop breeding programme and hence it requires the highest consideration. It is one of the most important factor in adaptation of variety by farmers. The maximum yield per plant was observed in the genotype KGT-1 (420.18 g) while the minimum was observed in the genotype, Lettuce Revolution Selection-9 (231.21 g). Significant differences were observed among genotypes for dry leaf weight. Maximum dry leaf weight was observed in the genotype, Lettuce Lob Joits (5.09 g) while it was recorded minimum in the

genotype KGT-3 (1.85 g). Calcium is one of the major dietary minerals present in the lettuce leaves which helps to keep the body energized and provides strength to our bones. Maximum calcium content was observed in the genotype, Lettuce C1 (13.77 percent) and minimum calcium content was observed in the genotype Lettuce Revolution Selection-9 (6.63 percent). These results are in conformity with those reported by Han and Lee [10], Thakur [11], Sublett et al. [12] (and Sublett et al. [13]. Iron contents helps in the formation of red blood cells in the human body. The observation recorded on this trait revealed significant differences among the genotypes. Maximum iron content was observed in the genotype KGT-1 (3.17 mg/100g) while it was recorded minimum for the genotype LS-2 Selection-1 (1.13 mg/100g). The observation recorded on β carotene content (µg/100g) showed significant variation among the genotypes. Vitamin A is essential for normal vision and maintaining the integrity of epithelial tissues. Vitamin A is derived from beta carotene.Yellow orange colour of β carotene is hidden by green chlorophyll pigments in lettuce leaves. Dark green leaf lettuce is especially rich in the antioxidant β carotene. Maximum β carotene content was observed in the genotype, KGT-1 (6.04 µg/100g) and the minimum content was observed in the genotype, Simpson (1.47µg/100g). 1000 seed weight was found maximum in genotype KGT-1 (0.952 g) and the minimum was observed in the genotype, SBS (0.837 g) [14].

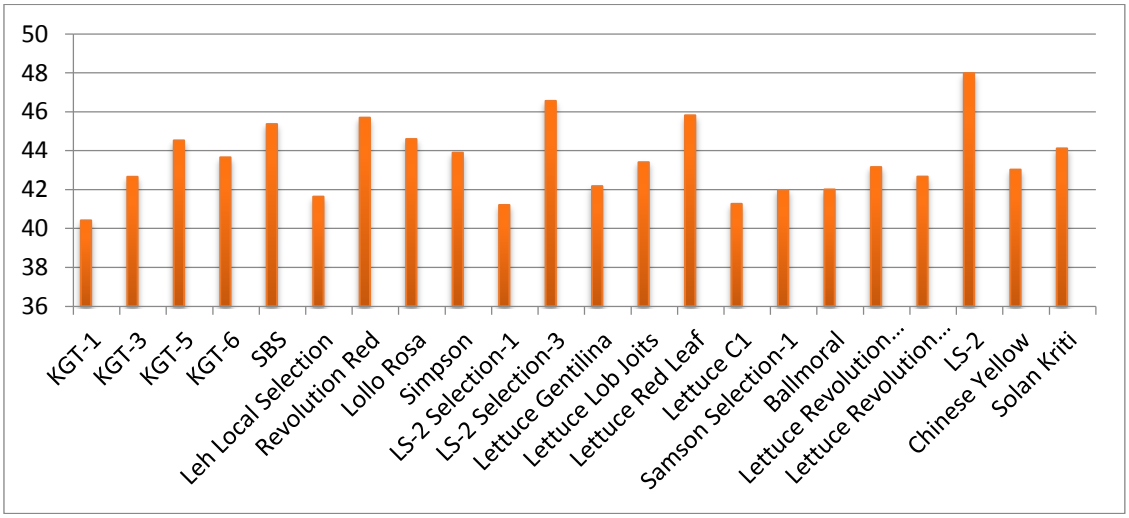

Fig. I. Mean performance for earliness in lettuce

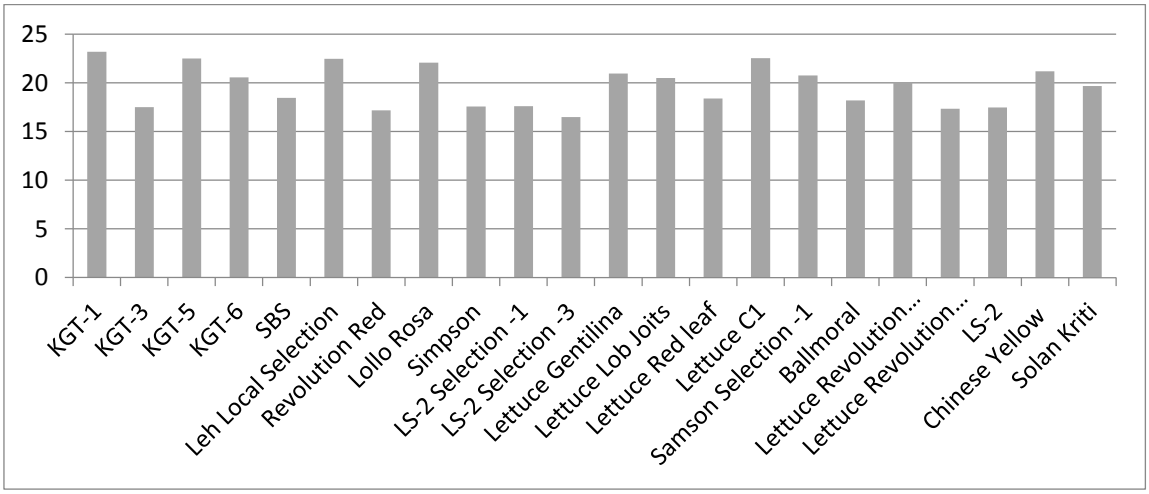

Fig. II. Mean Performance for leaf length in lettuce

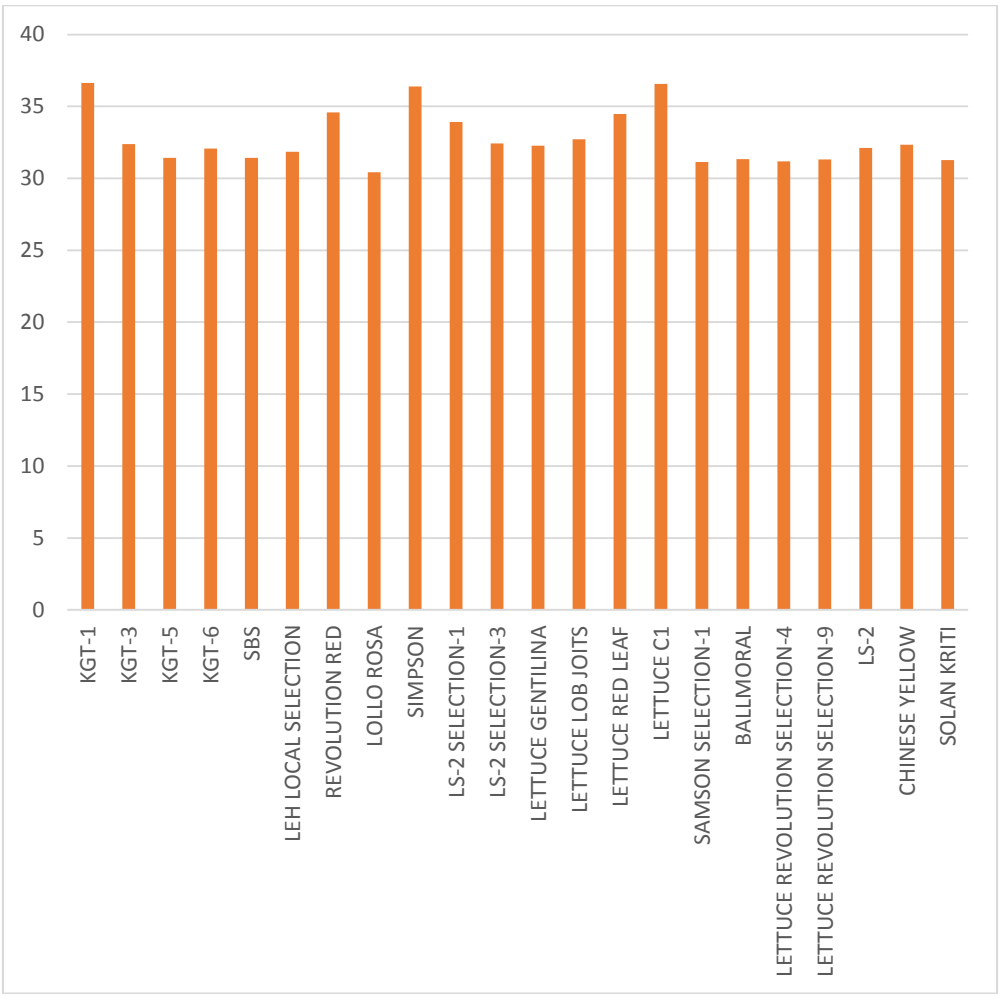

Fig. III. Mean performance for plant spreads in lettuce

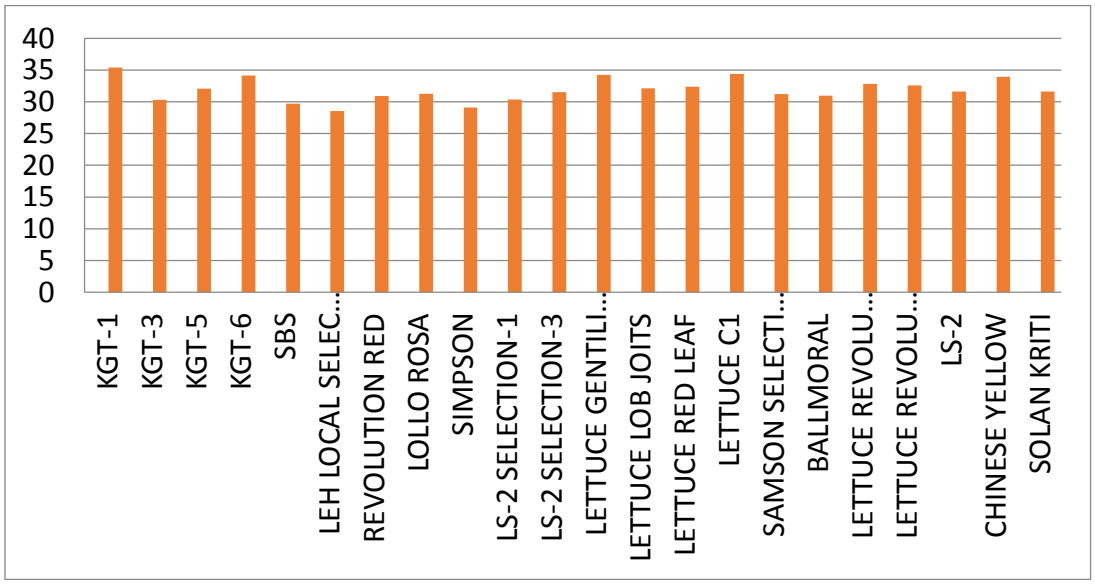

Fig. IV. Mean performance for plant height in lettuce

Table 2. Mean performance of lettuce genotypes for different quantitative traits

Genotypes/Traits	DTMM	FLW	LL	LB	PH	PS	L/P	LA	Y/P	CA	IRON	β	DLW	1000 SW
KGT-1	40.42	12.10	23.19	15.12	35.42	36.63	34.69	331.05	420.18	6.90	3.17	6.04	4.41	0.952
KGT-3	42.66	9.58	17.49	12.23	30.31	32.38	32.07	279.05	305.40	8.35	2.85	2.45	1.85	0.917
KGT-5	44.53	11.43	22.48	14.05	32.09	31.43	34.22	290.68	387.46	7.13	1.23	3.59	3.42	0.923
KGT-6	43.66	8.45	20.56	13.67	34.16	32.06	30.35	280.43	320.61	7.59	2.77	5.38	3.45	0.910
SBS	45.37	10.78	18.44	12.38	29.72	31.42	30.62	283.68	326.72	12.27	1.34	5.51	3.93	0.837
Leh Local Selection	41.64	11.36	22.45	14.25	28.56	31.85	34.56	280.57	365.57	10.45	1.41	2.49	4.02	0.893
Revolution Red	45.70	8.30	17.18	11.40	30.93	34.59	31.40	270.03	310.48	9.66	1.54	1.50	2.69	0.910
Lollo Rosa	44.60	9.62	22.07	14.07	31.27	30.43	31.45	257.82	360.16	12.75	1.21	3.09	4.40	0.890
Simpson	43.90	9.83	17.56	10.60	29.09	36.39	32.03	182.94	313.98	8.34	2.83	1.47	3.29	0.897
LS-2 Selection-1	41.21	10.14	17.59	11.48	30.34	33.91	34.25	282.38	387.85	6.86	1.13	4.11	2.04	0.890
LS-2 Selection-3	46.56	11.35	16.47	11.10	31.52	32.43	31.76	276.97	347.32	7.26	1.17	5.82	4.40	0.933
Lettuce Gentilina	42.18	9.68	20.93	13.25	34.22	32.27	32.56	317.41	343.84	12.30	1.48	2.62	3.18	0.857
Lettuce Lob Joits	43.41	8.81	20.48	12.07	32.13	32.71	31.25	299.47	274.06	12.76	1.22	3.47	5.09	0.870
Lettuce Red leaf	45.82	9.22	18.37	11.21	32.37	34.47	30.29	153.33	327.53	10.86	1.18	2.99	3.55	0.865
Lettuce C1	41.27	11.73	22.52	14.36	34.39	36.56	34.21	305.79	388.62	13.77	2.91	5.44	3.84	0.943
Samson Selection-1	41.98	9.40	20.74	11.66	31.20	31.13	31.97	305.95	320.51	9.69	2.06	4.09	2.92	0.910
Ballmoral	42.01	8.07	18.20	12.33	30.94	31.33	34.11	229.86	298.69	8.30	2.82	3.98	1.91	0.890
Lettuce Revolution Selection-4	43.16	10.04	20.07	11.57	32.82	31.19	33.52	288.01	358.43	8.82	2.18	3.90	2.70	0.867
Lettuce Revolution Selection-9	42.67	7.32	17.34	10.98	32.58	31.32	32.24	264.45	231.21	6.63	2.89	3.15	2.42	0.880
LS-2	47.99	9.66	17.46	12.08	31.64	32.12	32.25	178.41	330.42	8.94	1.74	3.26	2.86	0.947
Chinese Yellow	43.03	9.31	21.17	13.37	33.95	32.34	34.47	162.15	368.97	9.26	2.16	4.59	3.44	0.883
Solan kriti	44.12	9.34	19.65	11.70	31.63	31.26	33.03	183.97	307.09	10.20	1.50	2.53	3.95	0.922
Mean	43.54	9.80	19.65	12.50	31.88	32.72	32.60	258.68	334.47	9.51	1.90	3.70	3.35	0.90
SE (d)±	1.620	0.377	0.671	0.651	0.746	1.20	0.255	14.41	17.30	0.697	0.182	0.302	0.347	0.018
$CD_{0.05}$	3.281	0.763	1.360	1.318	1.512	1.191	0.517	29.201	35.04	1.470	0.360	0.611	0.703	0.036

DTMM: days to marketable maturity, FLW: fresh leaf weight (g), LL: leaf length (cm), LB: leaf breadth (cm), PH: plant height (cm), PS: plant spread (cm), L/P: number of leaves per plant, LA: leaf area (cm^2),Y/P: Yield per plant (g), CA: calcium content (%), IRON: Iron content (mg/100g), β: β carotene content (µg/100g), DLW: dry leaf weight (g), 1000 SW: 1000 seed weight (g)

Table 3. Qualitative analysis of leaf lettuce genotypes

Genotypes/ traits	Leaf colour	Leaf blistering	Leaf taste	Leaf shape	Leaf texture
KGT-1	Green Group 143 C	Weak	Sweet	Broad Elliptic	Puckered Leaves
KGT-3	Green Group 143 A	Strong	Sweet	Obovate	Smooth Leaves
KGT-5	Yellow Green Group 144 B	Weak	Mildly Sweet	Broad Obtrullate	Smooth Leaves
KGT-6	Green Group 141 C	Very Weak	Mildly Bitter	Medium Elliptic	Puckered Leaves
SBS	Green Group 138 C	Weak	Sweet	Broad Elliptic	Toothed Margins of Leaves
Leh Local Selection	Yellow Green Group 144 C	Very Strong	Mildly Bitter	Triangular	Serrated Leaves
Revolution Red	Purple Group 79 B	Strong	Mildly Sweet	Broad Obtrullate	Puckered Leaves
Lollo Rosa	Purple Group 79 A	Very Strong	Mildly Sweet	Triangular	Toothed Margins of Leaves
Simpson	Green Group 143 A	Medium	Mildly Sweet	Transverse Broad Elliptic	Puckered Leaves
LS-2 Selection-1	Green Group 143 B	Medium	Mildly Sweet	Transverse Broad Elliptic	Puckered Leaves
LS-2 Selection-3	Purple Group 79 A	Very Strong	Mildly Sweet	Triangular	Smooth Leaves
Lettuce Gentilina	Green Group 143 B	Weak	Mildly Bitter	Broad Elliptic	Serrated Leaves
Lettuce Lob Joits	Yellow Green Group 144 C	Strong	Mildly Bitter	Broad Obtrullate	Puckered Leaves
Lettuce Red leaf	Violet Group 83 A	Medium	Mildly Bitter	Transverse Narrow Elliptic	Puckered Leaves
Lettuce C1	Purple Group 79 A	Very Weak	Sweet	Narrow Elliptic	Serrated Leaves
Samson Selection-1	Green Group 143 B	Weak	Sweet	Obovate	Smooth Leaves
Ballmoral	Purple Group 79 B	Weak	Mildly Bitter	Broad Elliptic	Smooth Leaves
Lettuce Revolution Selection-4	Purple Group 79 A	Strong	Mildly Sweet	Broad Elliptic	Serrated leaves
Lettuce Revolution Selection-9	Purple Group 79 A	Very Weak	Sweet	Narrow Elliptic	Toothed Margins of Leaves
LS-2	Yellow Green Group 144 A	Strong	Sweet	Obovate	Smooth Leaves
Chinese Yellow	Green Group 137 B	Strong	Sweet	Broad Obtrullate	Puckered Leaves
Solan Kriti	Green Group 137 C	Weak	Sweet	Broad Elliptic	Smooth Leaves

3.3 Qualitative Traits

Five qualitative traits were also observed during the investigation viz., leaf colour, leaf shape, leaf texture, leaf blistering and leaf taste. Leaf colour is very important which determines the speed at which the compounds act, so lettuce with red leaves have more amount of antioxidant as compared to green leaved lettuce. Majority of genotypes (10) had green leaves, while seven genotypes had purple leaves. Four genotypes had yellow green leaves and one genotype showed violet leaves. Leaf blistering is one of the most important quality aspect of leaf lettuce as it imparts mild flavour and extra crunchy properties. Medium, strong and very strong blistering is preferred as sandwich toppers or being tossed with heavy or creamy fillings, while very weak and weak leaf blistering is preferred where no heavy fillings are done. leaf blistering was characterized into five categories viz., Very weak, weak, medium, strong and very strong. Three genotypes were observed to be very weak in leaf blistering, seven genotypes weak in leaf blistering and six with strong leaf blistering. In addition to this, three genotypes had shown very strong leaf blistering, and medium leaf blistering, respectively .Leaf taste is another important criterion and is determined by the type of leaf. Leaf taste was grouped into three unique tastes viz., mildly sweet, sweet and bitter. Nine genotypes were observed to be sweet in taste, seven genotypes were found mildly sweet, however, six genotypes were observed to be bitter in taste. The genotypes understudy was having different leaf shapes. Six genotypes showed Broad Elliptic shape and four genotypes had Broad Obtrullate leaf shapes. Three genotypes were having Triangular and Obovate shape respectively while two genotypes showed Transverse Broad Elliptic and Narrow Elliptic respectively. Medium Elliptic and Transverse Narrow Elliptic leaf shapes was shown by one genotype respectively. Leaf texture is an important character which determines the acceptability in the market for preparation of various cuisines. Eight genotypes showed Puckered leaves, seven had smooth leaves, four genotypes recorded Serrated leaves and three genotypes had Toothed margins of leaves. These results are represented in Table 3.

4. CONCLUSION

In the present investigation, it is concluded that genotypes viz., KGT-1, Lettuce C1, KGT-5 and LS-2 Selection-3 performed better in terms of yield and other horticultural traits over the standard check, Solan Kriti. So, these genotypes offer an ample scope for their release in the mid hill conditions of Himachal Pradesh after multilocational testing for the cultivation in summer season.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. FAO. Available:http://www.fao.org/faostat/site/default.aspx
2. Kim MJ, Moon Y, Tou JC, Mou B, Waterland NL. Nutritional value, bioactive compounds and health benefits of lettuce (*Lactuca sativa* L.). Journal of Food Composition and Analysis. 2016;49:19-34.
3. Gomez KA, Gomez AA. Statistical procedures for Agricultural Research. 2ed. John Wiley and Sons. Inc., New York. 1984;680.
4. Mousavi SH, Hassandokht MR, Choukan R, Sepahvand N and Khosrowchali M. Cytological study of chromosome and genome composition of Iranian lettuce (*Lactuca sativa* L.) accessions. European Journal of Experiment Biology. 2013;3:303-11.
5. Kumar D, Bhardwaj ML, Kumar S, Kaler R, Kumar R, Verma S, Sharma S, Gautam N, Chandra S. Comparitive performance of Cherry Tomato and Lettuce genotypes under different protected structures in low hills of Himachal Pradesh. Bulletin of Environment Pharmacology and Life Sciences. 2018;7:14-18.
6. Rather AM, Jabeen N, Bhat TA, Parray EA, Hajam MA, Wani MA, Bhat IA. Effect of organic manures and biofertilizers on growth and yield of lettuce. The Pharma Innovation Journal. 2018;7:75-77.
7. Son KH, Oh MM. Leaf shape, growth and antioxidant phenolic compounds of two lettuce cultivars grown under various combinations of blue and red light emitting diodes. Horticultural Science. 2013;48:988-95.
8. Dolma T, Gupta AJ. Evaluation of lettuce genotypes for growth and yield attributes in Kashmir valley. Indian Journal of Plant Genetic Resources. 2011;24:62-66.

9. Chatterjee R. Influence of Nutrient sources on growth yield and Economics of Organic Lettuce production under foothills of Eastern Himalyan Region. Emirates Journal of Food and Agriculture. 2015;27:460-62.
10. Han HS, Lee KD. Plant growth promoting rhizobacteria effect on antioxidant status, photosynthesis, mineral uptake and growth of lettuce under soil salinity. Research Journal of Agricultural and Biological Sciences. 2005;3:210-15.
11. Thakur M. Genetic evaluation of lettuce (*Lactuca sativa* L.) germplasm under protected conditions. M. Sc. Thesis. YSP University of Horticulture and Forestry Nauni Solan, Himachal Pradesh. 2013;65.
12. Sublett WL, Barickman TC, Sams CE. Effects of elevated temperature and potassium on biomass and quality of dark red Lollo Rosso lettuce. Horticulturae. 2018;4:1-11.
13. Sublett WL, Barickman TC and Sams CE. The effect of environment and nutients on hydroponic lettuce yield, quality and phytonutrients. Horticulturae. 2018;4:1-15.
14. Sapkota S, Sapkota S, Liu Z. Effects of nutrient composition and lettuce cultivar on crop production in hydroponic culture. Horticulturae. 2019;5:1-8.

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