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Assessment of Qualitative and Quantitative Traits in Commercial Iranian Lettuce (*Lactuca sativa* L.) Genotypes

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ABSTARCT

Lettuce (Lactuca sativa L.) is one of the major leafy and salad vegetables. Identification and assessment of the genetic potential of lettuce germplasm is crucial in the breeding programs. Assessment of qualitative and quantitative traits of Iranian lettuce germplasm collected from different provinces was conducted in the research field of seed and plant improvement institute, Karaj in March 2010. Genotypes were sown on rows with the length and spacing 3 m and 60 cm, respectively. Morphological characteristics were evaluated based on IPGRI descriptors. Results revealed high variability amongst genotypes. Three types of lettuce were identified including stem, leaf and romaine for the first time in Iranian lettuce. There were significant positive correlations between growth period to bolting and flowering in genotypes. Qom genotype and lines 15 and 25 were sensitive to bolting, and Pich-e-Ahvaz, Siah-e-Dezful, Sefid-e-Neyshaboor, Siah-e-Neyshaboor and Varamin 3 were detected resistant. Genotypes were separated into three groups based on cluster analysis in which some groups had above average values for some traits. Genotypes with desirable characteristics can be identified to improve traits and use in breeding programs can be used later.

Key words: breeding, germplasm, IPGRI descriptor, lettuce, qualitative and quantitative traits

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INTRODUCTION

Assessment of qualitative and quantitative traits for plant breeding programs and conservation reserves are critical to the application of inheritance [11]. *Lactuca sativa* L. (family Asteraceae; subfamily Chicorideae) is annual plant, dicotyledonous, self pollinate and 2n=2x=18 [8, 10]. Lettuce is one of the major vegetables that its cultivation area in the world is about 1.7 million hectares [7]. Primary center of lettuce is in the Mediterranean region and central and south west Asia. Lettuce is one of the major leafy crops that use mainly for salads and fresh [13]. Different types of lettuce includes; Romaine (Cos), Iceberg (Crisp head), Butter head, Stem (Asparagus), Leaf (Cutting) and Oilseed [1, 17]. Based on the studies of Lebeda et al. [14], the number of different varieties of lettuce (*Lactuca* spp.) are 98 species out of which, 17 are from Europe, 15 from African, 12 from American, 3 from Australia and 51 species from Asia. The greatest diversity of this 51 species in Asia is in Iran, India and Pakistan with 15, 18 and 23 species, respectively [14].

Lettuce is a rich source of minerals like calcium, iron, phosphorus, potassium, vitamins, flavonoids and fiber. World production of lettuce has increased dramatically over the last two decades. The main reasons for the increased lettuce products in the world are development of gene pool, production of varieties that resistant to various biotic and abiotic stresses, nutritional value and importance of antioxidant activity [4, 16, 18]. Cheng et al. [2] studied the effect of sowing date on lettuce varieties in fall season, and concluded that the head convoluted is associated largely with the sowing date and cultivars. Rounded and flat cultivars resistant to head convoluted, while long leaves cultivars had better answer to it. Duman et al. [6] were classified diversity of seeds color in lettuce cultivars to the white, brown and black. Damjanovic et al. [3] and Wilhelm [21] examined overwintering ability and quality of the lettuce varieties and according to the needed cultivars for farm and greenhouse cultivation, they achieved of excellent varieties with the same goals. The cultivars Reval and R63 were suitable for growth in farm and LR67 and DUA varieties recommended for cultivation in the greenhouse. Zani et al. [22] in their studies evaluated more than 84 varieties of lettuce with various types to the cultivation of winter, summer and spring and released tolerant varieties to the cold and diseases. Gong (1998) investigated lettuce cultivars under high temperature, and found two cultivars, 9547 and 9542, with good performance for summer cultivation.

In order to achieve an international standard providing a comprehensive descriptor for assessment of morphological characters of lettuce, the characteristics of seeds, transplanting, leaves, heads, stems, flowering, resistance to biotic and abiotic stresses are considered ([12]. Despite the custom use of molecular markers in the recent years, morphological descriptor in genetic diversity analysis is still worthwhile. Different cultivars use in order to discover the genetic distance and crossing programs that were classified. The use of analysis of genetic relationships is necessary among breeding materials. Under various environmental conditions and altitudinal differentiation in Iran, there is great diversity between Iranian lettuce genotypes that it has economic importance. Traditionally, morphological characteristics are used to develop quantitative estimates of genetic similarities and relationships between the cultivated relatives [15]. The multivariate analysis and in particular principal component and cluster analyses have been important strategies for characterization, evaluation and classification of plant genetic resources, especially when large numbers of genotypes are to be assessed for several characters [19].

The present study was aimed to analyze the qualitative and quantitative variation in Iranian lettuce genotypes to derive their evolutionary relationships and determined variety of morphological characteristics and commercially valuable between the genotypes for used to breeding program.

MATERIALS AND METHODS

In this study, we evaluated 42 genotypes of lettuce seeds that were collected by various research centers in Iran. An important common feature noticed in genotypes selected in the present study is high yielding and economic importance. Profile of genotypes is shown in Table 1. Genotypes were planted in March 2010 in the research field of Seed and Plant Improvement Institute, Karaj (51˚/10 east, 35˚/48 north and 1321 m altitude).

Experiment was performed as a randomized complete block design (RCBD) with 42 genotypes and was run in triplicate. Seeds of each genotype were sown on rows of 3 m length with row spacing's 60 cm and plant spacing's 30 cm. During the growth period, we evaluated of qualitative and quantitative traits of all genotypes. Traits were measured using five random plants from each row. Observation on 14 quantitative traits and 7 vegetative qualitative traits (Tables 2 and 3) were scored at foliage stage of all genotypes, mainly based on IPGRI descriptor. Traits may be classified into five groups; group 1 related to leaf characters including length, width, thickness, number, dry matter percentage, leaf position, color, shape and position of leaf tip, group 2 related to stem consisting length, diameter, fresh weight and dry matter percentage, group 3 related to plant including head fresh weight, head compactness and the presence or absence of anthocyanin, group 4 related to flower consisting bolting, flowering time and flowering stem length, and group 5 related to seed namely seed weight and seed color. Descriptive statistics were including minimum, maximum, range, mean standard deviation, and F value of all traits, as well as simple correlation coefficients between traits were calculated in order to examine the relationships between them by SPSS and Excel Software Similarity between genotype was obtained by UPGMA method using Euclidean distance square technique.

RESULTS AND DISCUSSION

Range, coefficient of variation and results of statistical analysis to examine the genetic diversity of 42 Iranian lettuce genotypes are listed in Tables 2, 3 and 4. Descriptive statistics on each of the genotype studied revealed high genetic diversity for most traits of different genotypes. Also qualitative variables evaluated for all genotypes were listed in Table 5. The maximum length (35.70 cm) and width (18.26 cm) of leaves was obtained from Jahrom genotype. Also, the minimum length (21.74 cm) and width (11.87 cm) of leaves was calculated from Borazjan genotype (Table

3). The highest (1196 and 1129 g) and lowest (492.23 g) heads weight means were obtained from Jahrom (line 23) and Borazjan genotypes. This result showed in a positive and effective role of length, width and number of leaves on yield and head weight. Borazjan genotype with 5.5 and 3.4 cm had minimum length and stem diameter, respectively. Largest stem length (18.94 cm) and stem diameter (5.71 cm) were seen in line 19 and Parsabad genotypes, respectively (Table 2). Also the highest percentage of stem dry weight belonged to the Qom genotype with 20.6% and the lowest percentage of stem dry weight to line 30 with 13.46%. Our results revealed that Qom genotype was the only genotype that contains anthocyanin. This result is consistent with the findings of other researchers [18, 20]. Also, we found six colors (black, brown, maroon, white, gray white and cream) in the seed genotypes and seven color group (yellow green, light green, green, dark green, gray green, blue green and red) in mature leaves of genotypes. Results of this study also are consistent with other researcher's findings, that there is diversity in seed color and leaf type of lettuce genotypes [5, 12, 20]. Piche-Ahvaz and Shadegani genotypes, with 1.80 and 1.47 g have the highest thousand seed weight, and lines 19 and 17 with 0.63 and 0.68 g, had the lowest weight, respectively (Table 2). Similarly, Kristkova et al. [12] reported that the variety of lettuce thousand seed weight is less than 0.9 g to more than 1.2 g. As we can see in Table 2, the most sensitive genotypes to the bolting were Qom, lines 15 and 18, respectively, and the most resistant genotypes to the bolting were Sefide-Neyshaboor, Siahe-Neyshaboor, Varamin 3 and Siahe-dezful. Also, the shortest period to beginning of flowering related to line 19 and Qom with 58 and 59 days and the longest period of growth to beginning of flowering was related to the Dezful and Sefide-Neyshaboor with 97.33 and 96 days, respectively. In the firmness of the head genotypes, Piche-Ahvaz, Shadgani, Qom, Sefide-Neyshaboor, Siahe-Neyshaboor, Varamin 1 and 2 were without firmness and others genotypes were with fully head firmness. Pearson's correlation coefficient indicated a significant ($p<0.01$) positive correlation between the number of leaves and leaf length and width (r=0.4, 0.38). There were a positive and significant correlation between bolting and flower initiation and flowering stem length (r=0.89, 0.33). Also a significant ($p<0.01$) positive correlation was observed between flowering stem length and stem length and stem fresh weight (r=0.47, 0.60). Similarity, a significant ($p<0.05$) correlation between circumference of stem fresh weight and head fresh weight and leaf length and stem (r=0.87, 0.31, 0.35) was seen. There was negatively ($p<0.01$) correlated between the stem dry weight and leaves number (r=-0.41).

UPGMA cluster analysis with 21 variables revealed three principal clusters which separated all the genotypes at the Euclidean distance of 1.6 (Fig. 1). In the first principal cluster, genotypes were included Shadegani, Gorgan 1, lines 22, 28, 30, Varamin 2, 3 and Jahrom that formed 25.65% of all genotypes. Important traits of this group are leaf length, leaf width, leaf number, head fresh weight, stem length and shoot fresh weight that considered the most important vegetative traits in lettuce. This group has two subgroups, the first subgroup, line 22 and Jahrom, had significant difference, leaf length, leaf width, leaf number and head fresh weight with the other genotypes in the same group and were the highest average among all genotypes evaluated, also during the growth period until bolting in this group was less than the average of all genotypes. The second group were includes; Abtavil, Borazjan, Siahe-Dezful, Sefide-Neyshaboor, Varesh, Piche-Babol, lines 15, 16, 17, 18, 20, 21, and 24 genotypes that were included 33.33% of all genotypes. This group has two subgroups; in the first subgroup were Borazjan and Abtavil genotypes, average traits such as leaf length, leaf width, leaf number, head fresh weight, stem length, stem diameter and shoot fresh weight in them have significant difference with the other genotypes, and have the lowest average among above characteristics were investigated in all genotypes. In the second group, the mean percentage of leaf and stem dry weight during the growth period until beginning bolting had higher than the genotypes average. So, it seems this group for warm areas to be more suitable genotypes, also this group had the lowest average stem fresh weight and their average was also lower than to average of all genotypes. The third group consists of Piche- Ahvaz, Qom, Siahe-Neyshaboor, Gorgan 2, lines 14, 19, 23, 25, 26, 27, 29, 31, Varamin 1, Shiraz, Zirehii, Parsabad, Ardebil and the Fasa that were included the total of 44.7% of all genotypes. Distribution diagram (PCA) based on the first and second components separated genotypes into three groups. The greater importance of such characteristics was revealed in cluster and PCA. The Qom (6) genotype is distinguishable and stood far apart from all genotypes in the study due to the presence of anthocyanin, the highest stem length (20.06 cm), the highest leaf and stem dry weight (7.81 and 20.6%, respectively). Shadegani (5) genotype is distinguishable and stood far apart from the all genotypes due to presence the highest leaf length (35.44 cm) and thousand seed weight (1.8 g). Also, Abtavil and Borazjan (1, 2) had the lowest leaf number, leaf width, head fresh weight, stem length, stem diameter and stem fresh weight and were distinguished and stood far apart from the all genotypes. Cluster and principal component analysis on qualitative and quantitative characters revealed the existence of variability among the investigated genotypes. The greater importance of such characteristics was revealed in cluster and PCA. Leaf length, leaf width, head fresh weight, stem length, stem fresh weight, stem flowering length had positive values in PC1. At the same time, thousand seed weight and bolting were positive values in PC2. In this study and for the first time, we observed three types of growth in different Iranian lettuce genotypes. Qom genotype was stem lettuce and Sefide-Neyshaboor, Siahe-Neyshaboor, Varamin 1 and 2 were Leaf lettuce and other genotypes were the Romaine type. The result of this study is consistent with findings of other researchers that there are different types of lettuce growth in different genotypes [1, 17].

Table 1: Code, origin and geographical location of different Iranian lettuce genotypes

		Geographic coordinates				
		Longitude		Latitude		Altitude (m)
0	Origin	Minute	Degree	Minute	Degree	
1	Abtavil	27	50	46	28	0
2	Borazjan	38	51	21	29	0
3	Siahe-Dezful	17	49	28	30	52
4	Piche-Ahvaz	17	48	25	31	30
5	Shadegan	23	48	45	30	45
6	Qom	53	50	38	34	930
7	Karaj	27	51	48	35	1360
8	Sefide-Neishaboor	47	58	12	36	1210
9	Siahe-Neishaboor	47	58	12	36	1210
10	Gorgan 1	17	53	28	36	45
11	Amol	12	53	34	36	45
12	Gorgan 2	17	53	28	36	45
13	Babol	12	53	34	36	45
14-31	Mazandran-Lines	12	53	34	36	45
32	Varamin 1	39	51	19	35	915
33	Varamin 2	39	51	19	35	915
34	Varamin 3	39	51	19	35	915
35	Shiraz	22	52	37	29	1540
36	Zirehii	24	51	25	29	985
37	Hamadan	31	48	48	34	1851
38	Nahavand	21	48	32	34	1615
39	Parsabad	38	48	28	38	1280
40	Ardabil	28	48	18	38	1311
41	Jahrom	33	53	30	28	1050
42	Fasa	39	53	56	28	1370

Table 2: Analysis of variance of morphological characteristics in different of Iranian lettuce genotypes

		MS														
S.O.V	df	Leaf length	Leaf width	Leaf thickness	Leaf number	Leaf dry weight	Head fresh weight	Stem length	Stem diameter	Stem fresh weight	Stem dry weight	Flowering stem length	Thousand seed weight	Bolting	Flowering	Head firmness	Anthocyanin
Replication	41	33.66**	10.37**	.0059**	185.73**	69820.6**	1.22**	27.55**	1.27**	985.23**	7.34**	568.2**	.195**	235.61**	294.50**	1.54**	1.12**
Genotype	2	1.44*	.35^{ns}	.0002^{ns}	50.39*	1095.07^{ns}	.017*	.035*	.105^{ns}	3.4*	.029*	4.22^{ns}	.002^{ns}	1.96*	.22*	0^{ns}	0^{ns}
Error	82	.38	.14	.00006	5.87	568.26	0.44	0.100	0.49	4.82	0.12	2.19	.002	2.93	1.85	0	0
CV%	-	2.11	2.37	1.91	6.64	3.01	3.33	3.09	5.31	3.04	1.96	2.65	4.12	2.69	1.638	0	0

**: Significant at α = 1%, *: Significant at α = 5%, ns= Not significant

Table 3: Means of different traits of Iranian lettuce genotypes

Genotypes	Head fresh weight (g)	Leaf dry weight (%)	Leaf number	Leaf thickness (mm)	Leaf width (cm)	Leaf Length (cm)
1	536.33op	7.27ab	52.66i-m	0.42ef	12.37q	25.79pq
2	492.33p	7.16a-d	44.66m	0.43def	11.87r	21.74s
3	658.67Lm	6.48d-f	65.66a-i	0.37j-l	15.07k-n	23.39rs
4	761.67jk	7.54a	69.33a-e	0.32o	14.64m-p	31.56f-j
5	964.33b-d	7.13a-d	58.33c-l	0.41fgh	17.6b-d	35.44a
6	752.00jk	7.81a	46.33k-m	0.37j-l	16.11f-k	30.84 g-j
7	651.00lm	7.13a-d	55.00f-m	0.46qbc	13.39pq	27.06n-p
8	697.00k-l	6.48d-g	53.00h-m	0.4ghi	17.7bcd	27.64n-p
9	880.67e-g	6.59b-f	68.00a-f	0.47ab	18.25b	30.71g-k
10	918.00d-f	6.32e-h	77.33a	0.47ab	17.59bc	31.05f-i
11	662.67lm	7.26a-c	57.33a-m	0.39hi	17.13b-g	27.8n-p
12	789.00j-i	6.69b-e	67.33a-f	0.41fgh	17.09b-g	26.51o-q
13	811.00g-k	6.24efgh	61.33c-k	0.27j-l	17.54b-e	31.99e-h
14	756.00jk	6.49d-g	68.00a-f	0.48a	16.91c-h	28.96n-p
15	700.67kl	6.20efgh	66.66c-k	0.36k-m	17.15b-g	27.09n-p
16	576.67no	6.24efgh	60.33c-k	0.41efg	13.94n-p	24.74q-r
17	614.00mno	6.12ghij	57.66e-l	0.34m-o	16.34e-j	28.95j-n
18	695.67kl	5.34l-m	50.66k-m	0.33no	16.74c-h	30.46g-k
19	840.67f-i	5.18m	55.66f-m	0.35l-n	17.63bcd	32.5c-g
20	698.67kl	5.28l-m	57.66e-m	0.37i-l	16.59d-i	26.96n-p
21	665.00lm	5.91f-l	56.00f-m	0.39hij	15.98g-l	28.14l-o
22	1129.00a	5.26l-m	71.00abcd	0.44cde	2.69a	34.16a-c
23	746.67k	5.76h-m	67.33a-f	0.42efg	16.24f-k	28.3l-o
24	629.33l-n	6.26efgh	58.66c-l	0.47ab	13.41p-q	24.51a-r
25	794.33j-i	6.16e-i	62.33c-j	0.49a	16.08f-k	31.14f-i
26	794.33j-i	6.34e-h	60.66c-k	0.38h-k	14.00m-p	29.9 i-m
27	761.33jk	6.70e-j	59.00c-l	0.35l-n	15.13k-n	30.17h-l
28	1040.33b	6.26e-h	71.33abc	0.70i-l	17.92bc	33.72a-e
29	864.33f-h	6.20efgh	66.6b-j	0.32o	14.7l-o	30.09h-m
30	998.00bc	6.26efgh	66.00a-h	0.38i-k	15.79h-m	33.03b-f
31	748.33jk	6.57c-f	51.66j-m	0.41fgh	17.19b-g	24.8q-r
32	808.33g-j	6.35e-h	58.00d-l	0.42ef	15.94g-l	28.09m-o
33	1020.33bc	6.43e-h	71.33abc	0.43def	16.55d-i	32.05d-h
34	959.33c-e	5.81g-k-m	62.33c-j	0.47ab	16.57d-i	32.48c-g
35	654.33l-n	5.49i-m	55.33f-m	0.45bcd	15.34j-m	27.05n-p
36	857.33f-i	5.47jklm	48.33km	0.42ef	16.77c-h	35.08ab
37	964.33b-d	6.16fghi	54.00h-m	0.44cde	17.26b-e	34.08a-c
38	755.00jk	6.60b-e	59.00c-l	0.41fgh	13.61o-q	26.94n-p
39	818.67g-j	6.70b-e	51.00j-m	0.44cde	15.15j-n	28.68k-m
40	754.67jk	5.44klm	49.00km	0.43def	15.18j-n	21.34l-o
41	1195.00a	6.68b-e	75.66ab	0.44cde	18.26b	35.70a
42	823.67f-i	5.32l	55.33h-m	0.42efg	15.98g-l	27.62n-p

Means with similar letters in each column are not significantly different at 1% probability level (DMRT)

Table 3: Continued

Genotype	Stem length (cm)	Stem diameter (cm)	Stem fresh weight (g)	Stem dry weight (%)	Flowering stem length (cm)	1000 seed weight (g)	Bolting (day)	Flowering date (day)
1	6.96qrs	4.22d-k	54.34t-v	18.85c-h	46.27kl	0.77n-q	74abc	96.33a-c
2	5.50t	3.40l	42.34wx	17.95f-k	37.03pq	1.05n-k	71.66b-e	92.66bc
3	8.80ln	3.26l	57.55r-v	19.62abc	35.61q	1.13gh	75.66abc	97.33a
4	7.57o-q	4.77cd	43.52w	18.89c-g	43.63l-n	1.47b	75.33abc	94.66abc
5	18.04ab	3.7i-l	92.76cd	18.2e-k	64.06e-g	1.80a	64.66g-i	75.66k-n
6	17.05b	3.54kl	77.67gj	20.6a	96.95a	0.92j-l	44.66o	59.00r
7	5.97qrs	3.76fl	35.43x	19.22b-e	42.63l-n	1.17f-h	72.66b-e	92.00cd
8	8.43t	4.98abc	61.63p-s	17.49i-p	39.92n-q	1.15f-h	78.66a	96.66ab
9	8.73ln	3.65j-l	61.62p-t	17.49i-o	57.18h-I	1.35bcd	77.33ab	87.33e
10	11.03op	4.37c-k	77.73gj	17.66i-m	57.18h-i	1.22d-g	54.66l-n	67.00a
11	7.53ab	3.42l	56.01s-v	18.6c-i	68.29de	0.85l-n	62.33g-j	78.66j-k
12	8.58b	3.83h-l	60.19q-u	19.3b-e	47.55k	0.91k-m	64.66g-i	76.32k-n
13	9.30st	4.22d-k	64.02o-r	17.27k-p	45.98kl	0.77n-q	70.66c-f	88.00de
14	7.89l-o	3.97f-k	56.13s-v	16.4 n-r	42.16l-o	1.28c-f	55.00l-n	68.33p-q
15	11.39l-n	3.56kl	76.51h-k	17.3k-p	71.22cd	1.06h-i	52.33mn	66.66q
16	12.10c-f	4.24dk	81.92f-i	17.72h-m	74.34bc	0.9i-l	57.66j-m	74.00m-o
17	11.83o-q	3.56kl	80.41g-i	18.45d-j	60.24g-h	0.68pq	50.66n	58.00r
18	10.21l-o	3.63j-k	66.33m-q	17.42i-p	77.99b	0.84l-o	62.66g-j	76.00k-m
19	18.94a	4.73cd	123.26a	17.78g-l	56.45h-i	0.63q	65.33f-i	79.66i-k
20	12.46n-q	4.74cd	92.04cd	18.28d-k	63.27g-f	0.70o-p	68.00d-g	81.00h-j
21	12.52d	3.45h-l	90.34c-e	19.04b-f	71.34cd	0.94i-l	62.00h-j	81.00e-g
22	9.12k-m	3.75h-l	66.61m-q	16.59m-q	64.06eg	0.75n-q	65.33f-i	84.00e-i
23	9.48jk	4.66cde	71.96j-m	15.31r-t	46.15kl	0.78m-p	56.00k-n	73.66n-o
24	11.73d-f	4.70cde	87.71d-f	16.33p-s	63.67e-g	0.72n-q	52.33mn	76.00k-n
25	10.78f-i	3.62j-k	68.85l-P	16.62m-q	68.55de	0.77n-q	52.00mn	69.66o-q
26	12.18de	3.59j-l	89.77d-e	14.41tum	78.37b	1.05h-K	55.00l-n	74.00m-o
27	13.57c	3.65i-l	97.28c	16.37o-s	65.44e-f	1.14f-h	60.00i-l	72.00n-p
28	14.36c	3.30l	109.96b	14.43t-u	56.35ni	0.85l-n	63.66g-i	78.33j-m
29	11.48d-g	4.51c-g	88.39e-h	15.25st	67.51d-f	0.77n-q	67.00e-h	82.00g-j
30	7.38fq	4.31c-j	58.95r-v	13.46u	45.24k-m	0.85l-n	63.66g-i	81.66g-j
31	6.31rst	5.59a	54.23uv	17.93f-k	42.16l-o	1.17f-h	61.00i-k	79.00j-k
32	8.40m-p	5.49ab	69.33k-o	18.39d-k	48.48jk	1.07hi	51.00n	74.00m-o
33	9.15k-m	4.99abc	71.72j-h	17.58i-h	57.51h-i	1.12gh	54.00mn	75.00l-n
34	7.28qr	4.51c-g	56.44s-v	19.32b-en	45.15k-m	0.94il	77.33ab	94.66a-c
35	7.87n-q	4.38c-i	59.94r-u	18.9c-g	52.89ij	1.46b	73.33ed	85.66e-j
36	9.36j-m	4.47c-h	75.68i-l	20.06ab	46.55kl	1.32c-e	71.00c-f	85.33e-h
37	11.55d-g	3.33l	89.52de	19.42b-d	53.25ij	1.37bc	75.00abc	96.33a-c
38	7.30qr	4.58cf	51.94v	18.41d-k	53.25ij	1.18e-h	55.00l-n	85.33e-h
39	9.36j-m	5.71a	64.54n-r	17.28k-P	56.32hi	1.13gh	67.33e-h	88.00de
40	10.04ik	4.54cg	74.78i-l	16.74l-q	55.27i	1.14f-h	61.66h-k	78.33j-m
41	11.14e-h	4.60cf	88.91df	16.01q-s	71.25cd	1.71f-h	64.00g-i	82.33f-j
42	10.62g-i	3.36l	84.11e-g	17.31j-p	37.28o-q	0.85ln	74.00abc	86.66ef

Means with similar letters in each column are not significantly different at 1% probability level (DMRT)

Table 4: Descriptive statistics for different quantitative traits of Iranian lettuce genotype

Traits	Minimum	Maximum	Mean	Standard deviation	CV	F values
Leaf length (cm)	21.34	35.7	29.24	3.57	2.11	33.66**
Leaf width (cm)	11.87	21.69	16.1	1.8	2.37	10.37**
Leaf thickness (cm)	0.27	0.7	0.41	0.067	1.91	0.0059**
Leaf number	44.66	77.33	60.02	8	6.64	185.73**
Leaf dry weight (%)	5.18	7.81	6.31	0.64	3.33	1.22**
Head fresh weight (g)	492.33	1195	791.4	152.5	3.01	6982.63**
Stem length (cm)	5.5	18.94	10.22	3.03	3.09	27.55**
Stem diameter (cm)	3.26	5.71	4.16	0.66	5.31	1.27**
Stem fresh weight (g)	35.43	123.26	72.19	18.22	3.04	985.23**
Stem dry weight (%)	13.46	20.6	17.61	1.56	1.96	7.34**
Stem flowering length (cm)	35.61	96.95	56.52	13.39	2.65	568.24**
Thousand seed weight (cm)	0.63	1.8	1.03	0.25	4.12	0.195**
Bolting (day)	44.66	78.66	63.81	8.86	2.68	235.61**
Flowering (day)	58	97.33	80.67	9.87	1.68	294.50**
Head firmness	1.00	3.00	2.21	0.72	0.00	1.54**
Anthocyanin	1.00	2.00	1.02	0.15	0.00	1.12**

**: Significant at p< 0.01 level

Table 5: Important qualitative variables evaluated for Iranian lettuce genotypes

Genotype	Achene color	Leaf position	Leaf color	Blade shape	Apex shape	Head firmness	Leaf anthocyanin
1	2	2	1	3	1	3	1
2	2	2	1	3	1	3	1
3	2	2	4	4	1	2	1
4	2	3	3	1	1	1	1
5	5	2	4	1	6	1	1
6	4	2	5	3	4	1	2
7	5	2	3	4	1	2	1
8	2	1	3	3	1	1	1
9	6	1	4	3	1	1	1
10	1	2	2	3	3	3	1
11	3	2	3	3	1	3	1
12	4	3	2	2	1	2	1
13	2	3	2	2	3	3	1
14	3	3	2	3	2	3	1
15	2	2	3	3	2	3	1
16	2	2	2	3	2	3	1
17	3	2	2	2	2	3	1
18	3	2	3	2	2	3	1
19	2	2	2	2	2	2	1
20	3	2	2	2	2	2	1
21	3	3	2	3	2	2	1
22	3	3	3	3	2	2	1
23	3	3	3	3	2	3	1
24	2	3	3	3	2	3	1
25	2	3	2	3	2	3	1
26	3	3	3	3	2	3	1
27	3	3	3	3	2	2	1
28	3	3	2	3	2	2	1
29	3	3	3	3	2	3	1
30	1	3	3	4	2	3	1
31	1	3	3	4	1	1	1
32	1	3	6	4	1	1	1
33	3	3	6	1	1	2	1
34	6	2	3	3	2	2	1
35	3	1	3	1	2	2	1
36	3	2	6	2	5	2	1
37	4	2	6	2	1	2	1
38	3	3	4	2	1	2	1
39	4	2	4	3	1	2	1
40	1	2	4	1	2	2	1
41	3	2	2	1	2	2	1
42	4	1	2	4	2	2	1

Achene color: 1- White, 2- Grey white, 3- Grey, 4- Maroom, 5- Brown, 6- Black; Leaf position: 1- Concave, 2- Flat, 3- Convex; Leaf color: 1- Yellow green, 2- Light green, 3- Green, 4- Dark green, 5- Gray green, 6- Blue green; Head firmness: 1- Low, 2- Medium, 3- High; Blade shape: 1- Oblong elliptic, 2- Elliptic, 3- Broad elliptic, 4- Orbicular; Leaf anthocyanin: 1- No, 2- Yes; Shape apex: 1- Rounded, 2- Mucronate, 3- Spathulate, 4- Subacute, 5- Truncate, 6- Obovate.

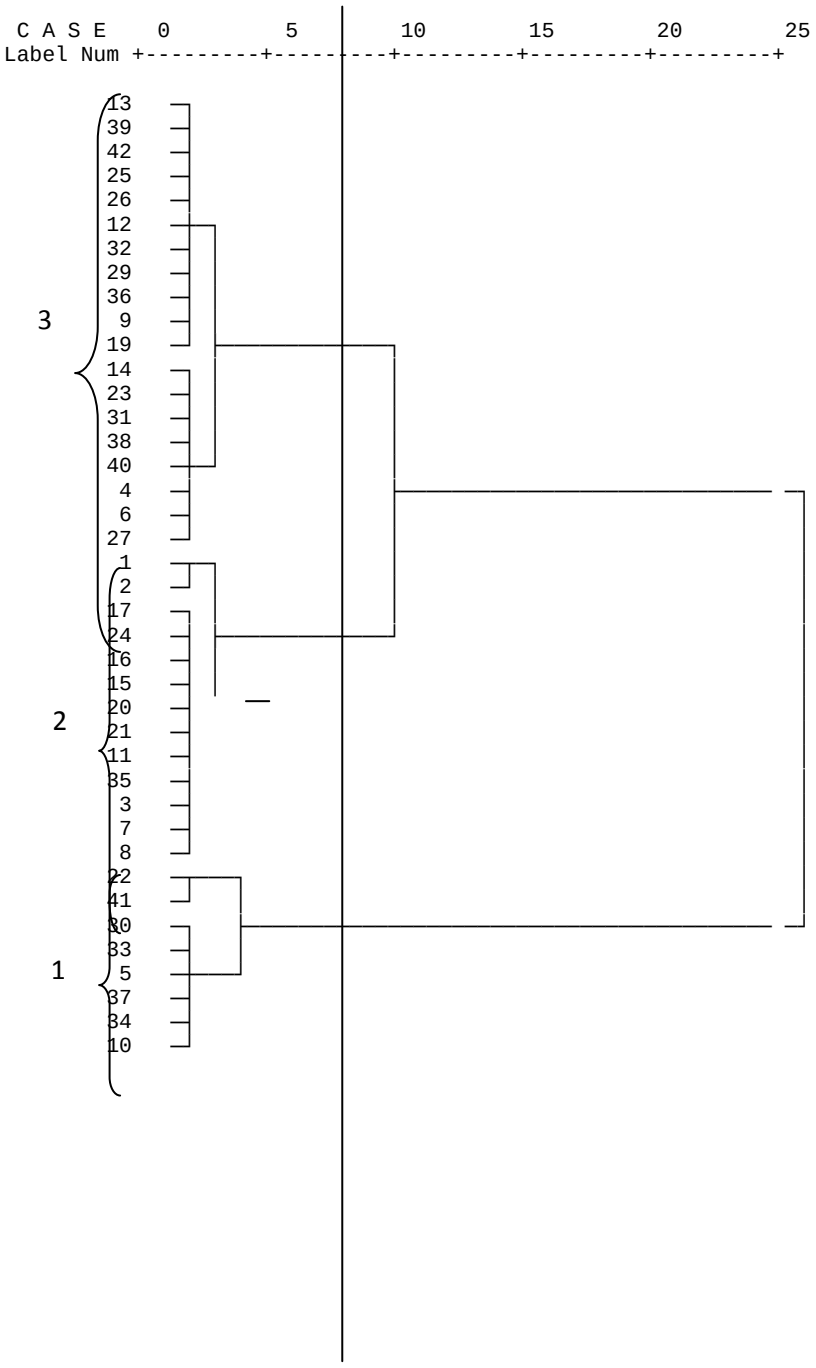

Fig. 1: Dendrogram obtained by cluster analysis of 42 Iranian lettuce genotypes using UPGMA

CONCLUSION

In conclusion, assessment of qualitative and quantitative Traits is important manageable tools that can be used for identification of various Iranian lettuce genotypes. Therefore, for practices such as determination of type, selection of seed sources and transfer zones, and genetic resource conservation programs, the genotypes with higher variation should first be defined with strong emphasis on elevation gradients. On the other hand, additional information about the genotypes based on this method and molecular markers can supplement to resolve breeding programs problems. Also, with classification, similar genotypes were identified for use to the possible hybridizations and the group that had been higher than average values for some traits can be used of those genotypes to enhance the value of attributes.

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