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REGULAR ARTICLE

CHARACTERIZATION OF SOME ALGERIANS AND FOREIGN LENTIL ACCESSIONS BY QUALITATIVE TRAITS

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ABSTRACT

In the present study an attempt has been made to characterize lentil accessions based on qualitative traits. There were variations among 44 lentil accessions. Erect growth habit was observed in 24 % of the accessions where 8% were from Algeria. Conversely, prostrate growth habit was observed in 34% of the accessions. The majority of the remaining accessions (41.32%) were intermediate. Stem with anthocyanin pigmentation was showed in 44% of the accessions, whereas, 56% had no pigmentation (green stem). About half of the accessions had grey green leaves (53%) and 23% of accessions were light green. Among the characters, flower color showed the highest variation. White flowers were observed in 64% accessions and violet flowers were found in 36% accessions. Flowers, with violet stripes in the standard petal (SVE) were observed in 44% accessions and the majority (56%) lacked violet stripes. Yellow cotyledons were observed in 61% accessions, while the rest (39%) had red cotyledons. The majority of accessions (81%) were observed with brown testa while 14% were green and 5% had yellow testa. Absence of seed coat pattern was observed in 69% accessions. However, 8% accessions with spots, 5% with dots, 16% were marbled and the remaining 2% were complex. Flattened seed shape was observed in 60% of accessions. Conversely, globose shape was observed in 40% of the accessions, among of them 27% were from Algeria.

Keywords: Qualitative traits, Erect growth habit, Flower color, Lentil accessions, Algeria

INTRODUCTION

Lentil plant is mostly growing as an annual plant with branches covered with hairs. Stems are mainly narrow and light green [1]. Generally, there are cultivated as well as wild varieties [2]. Considerable variations among phenotypic traits have been reported earlier [3-5]. But there are certain limitations for this phenotypic characterization due to the environment impact on the structural traits [6]. Due to this fact, it is considered that, the phenotypic variations are results of both environmental and genetic attributes [7]. But the morphological markers are significant in analyzing hybridity and keeping genetic purity [4]. Keeping these in view, the objectives of this investigation was to characterize different lentil accessions from Algeria and abroad on the basis of qualitative traits.

MATERIALS AND METHODS

Two field experiments were conducted in two consecutive years of 2011/2012 and 2012/2013. Sowing was performed on December 9th, 2012 at INRAA station and on January 7th, 2013 at ITGC station. A total of 44 accessions of cultivated lentil (*Lens culinaris* M.), comprised landraces and modern cultivars representing geographically and phenotypically wide variation, were used in this study. Among these, 18 were collected in Algeria (nine *microsperma* and nine *macrosperma*). In addition, a collection reference of 26 accessions including released popular cultivars and selected advanced lines was received from ICARDA (8 accessions), USDA (12 accessions) and ATFCC (6 accessions) under standard material transfer agreement during 2011. Relevant passport data of these accessions are given in table 1.

The first experiment carried out at experimental station of INRAA with 18.5 m altitude, in a sub-humid zone. The soil was clay-muddy with a 7.9 pH. A low temperature (4 °C) was recorded in February at seedling stage which caused certain leaf damage and cold injury.

The second field trial was located at the experimental farm of ITGC (Institut Technique des Grand Cultures), at Constantine district in the semi-arid region, about 713 m above the sea level. Similar to the first location cold injury was noticed during February when the temperature was below 5 °C. A durum wheat crop had been grown during the previous season for both experimental locations.

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Table 1: Source of collection and country of origin of 44 lentil accessions

N	Accessions Code	Accession name	Status	Origin	Source of collection
01	ALG3. lens	Unknown	Population	Algeria	Farmer/Algeria
02	ALG4. lens	Unknown	Population	Algeria	Farmer/Algeria
03	ALG6. lens	Syrie229_1	Cultivated variety	Algeria	ITGC/Algeria
04	ALG7. lens	Balkan755	Cultivated variety	Algeria	ITGC/Algeria
05	ALG8. lens	Ibla	Cultivated variety	Algeria	ITGC/Algeria
06	ALG12. lens	Blande de Chili_1	Cultivated variety	Algeria	Farmer/Algeria
07	ALG15. lens	Unknown	Population	Algeria	Farmer/Algeria
08	ALG16. lens	Unknown	Population	Algeria	Farmer/Algeria
09	ALG18. lens	Radjas	Cultivated variety	Algeria	ITGC/Algeria
10	ALG19. lens	Flip 90 31C	Hybrid line	Algeria	ITGC/Algeria
11	ALG21. lens	Setif628	Cultivated variety	Algeria	ITGC/Algeria
12	ALG22. lens	Flip 48 L	Hybrid line	Algeria	ITGC/Algeria
13	ALG23. lens	Flip 97-11C	Hybrid line	Algeria	ITGC/Algeria
14	ALG25. lens	Metropole_3	Cultivated variety	Algeria	Farmer/Algeria
15	ALG28. lens	Unknown	Population	Algeria	Farmer/Algeria
16	ALG29. lens	Unknown	Population	Algeria	Farmer/Algeria
17	ALG30. lens	Metropole_4	Cultivated variety	Algeria	Farmer/Algeria
18	ALG31. lens	Unknown	Population	Algeria	Farmer/Algeria
19	IG5511	Unknown	Breeding material	Syria	ICARDA
20	IG1647	Cundina		Colombia	ICARDA
21	IG26	ILL26	Unknown	Syria	ICARDA
22	IG1828	ILL1828	Unknown	Bio	ICARDA
23	IG8	ILL8	Unknown	Bio/Chili	ICARDA
24	IG572	ILL572	Improved cultivar	Jordan	ICARDA
25	IG5160	ILL5160		Turkey	ICARDA
26	IG4872	DEU146	Breeding material	Jordan	ICARDA
27	PI431640	ILL1017		Afghanistan	USDA
28	PI619099	Mason	Breeding material	Iran	USDA
29	PI374120	ILL1941		USA	USDA
30	PI490289	Mariette	Breeding material	Morocco	USDA
31	PI486127	Unknown		France	USDA
32	PI320936	Daghestan	Hybrid line	USA	USDA
33	PI468902	Populacao	Improved cultivar	Russia	USDA
34	PI320937	ILL505		/Brazil	USDA
35	PI297787	ILL319	Other	Germany	USDA
36	PI533690	PARDINA	Cultivar	Greece	USDA
37	PI472126	33-0690000	Breeding material	Spain	USDA
38	PI374119	ILL1940		India	USDA
39	V69-10010	Flash	Unknown	Morocco	ATFCC
40	ILL5722	Digger	Unknown	Australia	ATFCC
41	ILL5728	Cobber	Unknown	Australia	ATFCC
42	ILL5823	Matilda	Unknown	Australia	ATFCC
43	ILL7180	Nugget	Unknown	Australia	ATFCC
44	Unknown	Cassab	Unknown	Australia	ATFCC
			Unknown	Australia	
			Improved cultivar		
			Improved cultivar		
			Improved cultivar		
			Improved cultivar		

Table 2: Descriptors used for morphological assessment for qualitative traits of lentil in the study [8, 9]

N	Descriptors	Acronyms	Definition	When measured	Unit
			Qualitative traits		
1	Growth habit	GHA	The branching pattern recorded on plot basis	After flowering	Erect=1 Intermediate=3 Prostate=5
2	Stem pigmentation	SPG	Color at the base of the stem	Seedling stage	Absent=1 Present=9
3	Leaf color	LCL	Recorded on plot basis	50% flowering	Dark green=3 Light green=5 Grey green=7
4	Flower color	FLC	Recorded on plot basis	First few flowers	White=1 Pink=2 Blue=3
5	Violet stripes of standard	SVE	Flowers white petals with blue veins	First few flowers	Absent=1 Present=9
6	Plant vigor	PLV	Recorded on plot basis	First few flowers	Weak=3 Medium=5 Strong=7
7	Cold tolerance	CTL	Damage caused to leaf manifested by violet color	Seedling stage	No symptom=1 Plant killed=9
8	Cotyledon color	CCL	Cotyledon color of 100 good seeds	Freshly harvested seeds	Yellow=1 Orange=2 Green=3
9	Seed ground color	SGC	Ground color of testa of 100 good seeds	Freshly harvested seeds	Brown=1 Yellow=2 Green=3 Grey=4 Black=5
10	Seed coat pattern	SCP	Pattern of testa of 100 good seeds	Freshly harvested seeds	Marbled=1 Striped=2 Dotted=3 No pattern=4 Complex=5
11	Seed shape	SSH	Seed shape of 100 good seeds	Freshly harvested seeds	Globus=1 Flattened=2

The experiments were carried out following an Alpha Lattice design with four replicates. Unit plot size was 3 m^2 (3 m × 1 m). Row to row and plant to plant distances were 50 cm and 10 cm, respectively. All recommended cultural practices and plant protection measures were followed to raise a healthy crop.

The standard descriptors for lentil [8] and UPOV descriptors [9] have been used as guidelines in the phenotypic characterization. Observations were recorded from 4 replications of 3 plants. The details of all traits taken into account, is given in table 2.

RESULTS AND DISCUSSION

The frequencies for all qualitative characters are summarized in Table 3. Lentil genotypes showed large differences in growth habit (GHA). Erect growth habit was observed in 24 % of the accessions. Conversely, prostrate growth habit was observed in 34% of the accessions. The majority of the remaining accessions (41.32%) were intermediate. In this study, 44% of the accessions showed stem with anthocyanin pigmentation (SPG), whereas, 56% had no pigmentation (green stem). The stem color of other accessions from ICARDA, USDA, and ATFC were either purple or green. The green color of the leaf (LCL) has three variants: light green, gray green and dark green. About half of the accessions had grey green leaves (53%) and 23% of accessions were light green. The dark green color was observed in 25% of accessions. White flowers were observed in 64% accessions and violet flowers were found in 36% accessions. Flowers, with violet stripes in the standard petal (SVE) were observed in 44% accessions and the majority (56%) lacked violet stripes.

In both experiments, plants were affected by cold that occurred in February. Observation of cold tolerance revealed that response to cold among genotypes varied from one accession to another. While the majority of accessions showed moderate symptoms (95%), few accessions (5%) were susceptible to the cold and died, which was the case for ALG16 (microsperma), IG5511 (macrosperma) from Syria, IG5160 (microsperma) from Jordan and IG4872 (microsperma) from Afghanistan. The local cultivated varieties: ALG7 (Balkan755: microsperma), ALG8 (Ibla: macrosperma), ALG18 (Radjas: microsperma), ALG21 (Setif 628: microsperma), a hybrid line ALG22 (microsperma), and two accessions from abroad: IG572 (microsperma) from Turkey and PI374120 (macrosperma) from Morocco did not show any damage.

Yellow cotyledons were observed in 61% accessions, while the rest (39%) had red cotyledons. The majority of accessions (81%) were observed with brown testa (STC) while 14% were green and 5% had yellow testa. The majority of Algerian accessions had brown testa (35.06%). Absence of seed coat pattern (SCP) was observed in 69% accessions and 30% were from Algeria. However, 8% accessions had spots, 5% had dots, 16% were marbled and the remaining 2% were complex. Flattened seed shape (SSH) was observed in 60% of accessions. Conversely, globose shape was observed in 40% of the accessions, among of them 27% were from Algeria.

Table 3: Frequency distribution of 11 qualitative traits assessed in 43 lentil accessions

Character	Description state	Frequency %
Growth habit	Erect=1	24.38
	Intermediate=3	41.32
	Prostate=5	34.30
Stem pigmentation	Absent=1	56.21
	Present=9	43.79
Leaf color	Dark green=3	29.43
	Light green=5	17.09
	Grey green=7	53.48
Flower color	White=1	64.43
	Blue=3	00.00
	Violet=4	35.57
Violet stripes of standard	Absent=1	56.50
	Present=9	43.50
Cold tolerance	No symptom=1	04.12
	Moderate symptom	95.08
	Plant killed=9	00.79
Cotyledon color	Yellow=1	61.30
	Orange=2	38.69
	Green=3	00.00
Seed ground color	Brown=1	81.33
	Yellow=2	02.36
	Green=3	13.90
	Grey=4	00.00
	Black=5	00.00
Seed coat pattern	Marbled=1	16.39
	Striped=2	08.28
	Dotted=3	04.58
	No pattern=4	68.55
	Complex=5	02.36
Seed shape	Globus=1	40.07
	Flattened=2	59.92

DISCUSSION

In the present study, the nine qualitative traits allowed the discrimination of the accessions. The accessions included very different growth habit from prostrate, intermediate to erect growth habit. According to Erskine and Goodrich [10], lentil varieties vary in growth habit. The stems are generally light green in color but in several genotypes they may have varying degrees of anthocyanin pigmentation, ranging from only on the basal parts to the whole of the stems, while in others it could be completely absent [11]. In Italy, [12] the presence of anthocyanin pigmentation at the base of plants grown in dense stands in the majority of the entries. Contrary to our finding, the majority of accessions presented stem without anthocyanin pigmentation. In a collection of lentil landraces comprising 39 genotypes from the South East of Turkey, most of the landraces had seedling-stem pigmentation [13]. The local accessions present light green color foliage, compared to accessions from Asia (India, Afghanistan and Iran) and Europe (Spain, Germany, France and Turkey) which presented grey color of leaf. It is clear from previous studies, the foliage of Asian group, named grex pilosae, is grey green because of the presence of soft hairs, and it contrasts with the green color common for lentil [14,15]. Those results correlated with our finding where only a few accessions mainly from Morocco and USA presented dark foliage color. Flower color is important trait to characterize [4]. The standard petal is white, pink, purple, light purplish blue, or pale blue [16]. In this study, the majority of accessions had white flowers including some Algerian accessions. The remaining accessions had violet flower color. According to Erskine and Witcombe [17], lentil plants develop blue or pink flowers occasionally, that persist for one generation and do not develop in subsequent generations.

Another study [18] classified the ground color of testa. The predominance of brown grain tasta in local accessions is based on quality acceptance dictated by farmer and consumer preference. Also, in another study [19] in the global wild annual Lens taxa, originating from twenty-seven countries stated that the ground color of testa was mostly grey and brown. While, testa ground color was green in 90% of one hundred and one Spanish landraces of lentil [18]. One of the earlier research [21] reported that brown testa was completely dominant over tan testa. There are three kinds of cotyledon in lentil, red, green and yellow. Cotyledon color is an important trait for breeding lentil based on consumer preference in different regions [22]. Most Algerians accessions prefer yellow cotyledons. The majority of accessions from Asia (India, Afghanistan, Syria and Jordan) had red cotyledons. According to one study [23], there are strong preferences for small seed types with red cotyledons among consumers in the South Asian countries. Red cotyledon color is preferred for consumption in South Asia [5]. In both local and introduced accessions we found the two types of seed shape, flattened and globular. Lentil seeds may have a globose shape (diameter: thickness ratio ranging from 1.5 to 2.5) or flattened (diameter: thickness ratio ranging from 2.5 to 4) [11].

Cold tolerance was recorded for all the genotypes in this study and no relationship was found between seed type and cold tolerance. Although, large seeded varieties had

greater cold tolerance in comparison with small seed varieties [23]. They also stated that considering adaptation to other climatic conditions, pilosae germplasm (India and Pakistan) is strikingly more susceptible to cold damage than germplasm from West Asia (Syria and Jordan). While, in this study the Syrian and Jordan accessions were susceptible to cold damage. Previous study [3] reported that large number of plant with prostrate growth habit and purple pigment of the stem were injured by cold in the field. Contrary to our finding, all susceptible accessions had a stem without pigment with different growth habit (erect, intermediate and prostrate).

CONCLUSION

Significant differences among the accessions for different qualitative characters indicated variation among the accessions favorable for their use in future breeding programs.

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