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Original Article

Domestication of Persian Shallot (*Allium hirtifolium*) as Cultivated Crop

Ali Jafari-Mofidabadi[1*] and Mohamad Bagher Rezaee [2]

[1]*Golestan Research Center of Agriculture and Natural Resources, P.O Box 4915677555 Gorgan, Iran*
[2]*Reassert Institute of Forests and Rangelands P.O.Box 116-13185 Tehran-Iran*

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Abstract

Due to highly consumption of extensive wild germplasm of *Allium hirtifolium* Boiss (Mooseer) in food and medicinal industry, exploration and domestication process have been done in Golestan province (Gorgan). Economic productions of domesticated Persian Shallot plants need to be improved through breeding process. The successes of domesticated accessions improvement program depend on the available genetic diversity, genetic similarity (genetic distance). In order to determine genetic distance, bulbs of four accessions from different parts of country were planted using a complete block design. Significant differences were observed for growth characters (bulb weight, plant height, leaf length, leaf width, date of bulb germination and bulb yield) at $\alpha \leq 0.01$ level. Duncan's multiple range tests showed that the accession of Persian shallot were significantly different for all evaluated parameters except bulb diameter and leaf length. Cluster analyzing (average linkage method), indicated that the accessions were classified into two main groups and showed significant relationship between genetic diversity and geographical origins. The results suggesting that heterotic effect could be observed from crossing between promising accession of two classified population gating favorable traits for varietal and hybridization programs.

Key words: *A. hitrofolium* "Mooseer", Bulb, Bluster analysis, Domestication, Genetic similarity and population

Introduction

Allium hirtifolium is one of *Allium* L. genus which is produced through bulbs and called Persian shallot [1]. Persian shallot is one of perennial medicinal and industrial plants which are naturally growing in high elevated lands. Due to high pressure on natural habitats by harvesting Persian shallot and high demand for food and medicinal consumption in Iran, it is necessary to domesticate it as cultivation crop [2-5]. Its fresh or dried bulbs are sold in small and medium quantities for domestic consumption and exported to Persian Gulf countries [6]. Bulbs of shallot are used as medicine for remedy of rheumatic and inflammatory disorders, relief of superficial wounds, and some stomach diseases, antispasmodic and also used as spice and flavoring agent in some foods such as salads, yogurt and pickles [7]. Therefore genetic improvement of this domesticated plant is an urgent task in the country. The success of any crop improvement program depends on available genetic diversity, genetic similarity and genetic distance [8]. Hetrosis breeding is a valuable breeding approach of plant improvement [9]. Superiority performance of progeny to its parents (heterosis) depend to the genetic distance (genetic similarity) of parents. Genetic distance can be calculated on the basis of individual relationship and the pedigree of individual. Mean performance evaluation of any species with different geographical source in an experiment is a simple method for determination of genetic distance and its subsequent occurrence of heterosis. A number of different methods of cluster analysis has been widely used for study of plant taxonomic and genetic variation (genetic similarity) base on number of phenotypic variables [10,11-15]. In this article, four different accessions of *A.*

*****Corresponding author: Golestan Research Center of Agriculture and Natural Resources, P.O Box 4915677555 Gorgan, Iran
E-mail Address: mofiadabad@yahoo.com

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hirtifolium (Mooseer) from different parts of country were studied to measure genetic diversity/relationships among *A. hitrofolium* "Mooseer" ecotypes and their classification.

Material and Methods

Investigations were conducted for domestication of *A. hitrofolium* "Mooseer" ecotypes. The bulbs of *A. hitrofolium* were collected from Hamedan, Meshad, Golestan and Kordestan provinces. Bulbs were vernalized in cold storage at 4°C for two weeks and then planted in the experimental station of Astrabad seed production private company at 1991-1992).The experiment were conducted based on Complete Randomized Block Design (RCBD) with 4 replications. Fifty bulbs were planted in a five rows with 60 centimeter row-spacing and 40 centimeters space between bulbs. Ten bulbs per rows were deeply (10 centimeters) planted in each experimental unit. All the recommended cultivation practices as weeding, fertilizers and irrigation were done properly at the required time.

Statistical Analysis

An analysis of variance was carried out for date of bulb germination, height of individual plants, length and wide of leaf and bulb weight. In order to determine genetic distance and establish a dendrogram, for getting a clear position of each population, cluster analysis was conducted on the base of different collected data.

Results and Discussion

Evaluation of qualitative characters

Five quantitative traits such as date of bulb germination, plant height, wide and length of leaf and bulb yield have been recorded during experiment and analyzed using ANOVA test. The Analysis of Variance (ANOVA) indicated that there was a highly significant difference between ecotypes for all measured characters at α=0.01 level (Table 1).

Bulbs germination was initiated 120, 105, 80 and 65 days after sowing for Gorgan, Meshad, Kordestan and Hamedan respectively. Earliest bulb germination was observed in ecotype of Hamedan (65 days after sowing) and showed significant differences with other (Table 2). The latest bulb germination was observed for Gorgan by initiation 120 days after sowing. For individual bulb weight, Hamedan ecotype with average values of 90 g produced higher bulb weight than Kordestan (64.5 g), Meshad (45.5 g) and Gorgan (32.75 g) (Table 2). For leaf size, Hamedan ecotype produced longest leaves length with average values of (65.25 cm) than that for Kordestan (38.57cm), Meshad (9.25 cm) and Gorgan (7.5 cm) (Table 2). The higher and lower leaves wide were observed for Kordestan and Gorgan with average values of 8 and 2.12 cm, respectively. Leaf color of Hamedan and Kordestan ecotypes was light green and Meshad and Gorgan populations had the darkest leaves. Leaf shape was long narrow strip in all of the populations surveyed, except for Meshad one that had short length and strip leaf shape. The same characters have also been used for genetic diversity and genetic similarities of different Persian shallot in different part of country [10, 12 and 16]. Analysis of collected data on individual height of plants, indicated that there is a significant differences between applied population at α=0.01% level. Highest average individual height was observed for Hamedan ecotypes (120.5cm), while Meshad showed lowest level of individual height (52.25 cm).

Table 1 Effect of *Allium hirtifolium* ecotypes on bulbs derived plants

Source of variation	Df	MS				
		date of bulb germination gr	Plant height (cm)	Leaf Length (cm)	Wide of leaf (cm)	Weight of bulb (gr)
Treatment	3	2433.33 **	2127.33 **	2247.22**	27.18 **	2479.33 **
Block	3	12.50 ns	22.50 ns	20.72 ns	0.4322 ns	39.39 ns
Error	9	14.277	14.055	9.22	0.654	28.06

**= significant at 0.01 probability level

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Table 2 Mean comparison of all measured characters of four *Allium hirtifolium* accessions using Duncan-Multiple range Test

Accessions	wide of leaf cm	leaf length cm	bulb weight gr.	plant height cm	bulb germination (days after planting)
Gorgan	2.12 c	9.25 c	32.75 c	57,00 c	120 d
Meshad	3.00 c	38.75 b	45.50 c	52.50 c	105 c
Kordestan	8.00 b	56.25 a	64.50 b	80.00 b	80 b
Hamedan	5.00 a	9.25 c	90.00 a	120.5 a	65 a

Different letters show significant differences between accession at α=0.01 level

Fig. 1 Genetic diversity of domesticated *Allium hirtifolium*
A= *Allium hirtifolium* ecotype of Hamedan B=*Allium hirtifolium* ecotype of Khorasan Razevi (Meshad):

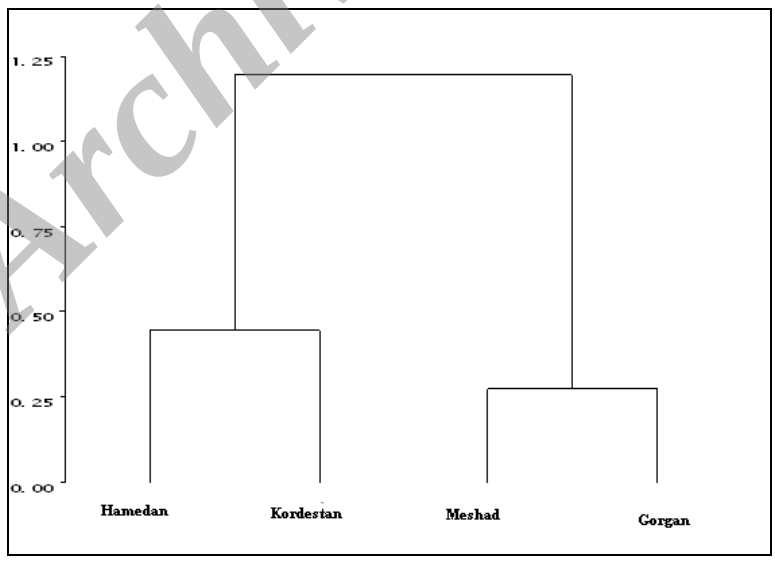

Fig. 2 Classification of four different populations (Hamedan, Kordestan, Meshad and Gorgan) based on five measured traits.

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