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Path analysis and comparison of seed yield and some agronomic traits of common ecotypes of *Lallemantia* (*Lallemantia iberica* Fisch. et C. A. Mey)

Soheila Abdoli*[1], Jalil Shafagh-Kolvanagh[1], Mohammad Moghaddam[2], Mohsen Sabzi Nojadeh[3]

[1]*Department of Plant Eco-physiology, Faculty of Agriculture, University of Tabriz, Tabriz, Iran*

[2]*Department of Plant Breeding and Biotechnology, Faculty of Agriculture, University of Tabriz, Tabriz, Iran*

[3]*Ahar Faculty of Agriculture and Natural Resources, University of Tabriz, Tabriz, Iran*

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Abstract

Lallemantia iberica is an annual herb of the Lamiaceae family known for its stimulant, diuretic, and expectorant effects in Iranian folk medicine. The present study was conducted at a field experiment in 2015 to comparison of yield and some traits of 49 common ecotypes of *Lallemantia*. The experiment was arranged as square lattice design (7×7) with three replications. Results showed that there were significant differences among *Lallemantia* ecotypes. *Lallemantia* seed yield per plant had the highest correlation with seeds per plant and seeds per main stem, respectively. Path analysis showed that the seeds per plant had the highest direct effect (0.988) on seed yield per plant. Cluster analysis showed that *Lallemantia* ecotypes grouped in two clusters. Ecotypes of cluster II, compared with other ecotypes (cluster I) had the higher mean of seed yield per plant. Thus, the accurate selections of the appropriate *Lallemantia* ecotype in each region are considerably important and essential factors to achieve the high yield in this plant.

***Corresponding Author:** Soheila Abdoli ✉ abdoli.soheila931@gmail.com

Introduction

Medicinal plants are valuable sources in Iranian natural resources whose understanding and scientific cultivation can play an important role in people's health and job creation. The species of *Lallemantia* have been distributed in Afghanistan, India, Iran and Turkey (Kirtiakar and Basu, 2001). *Lallemantia iberica* Fisch. et C.A. Mey. belonging to the Labiatae family (Naghibi, 2005), is an aromatic plant, which grows wild in Azerbaijan, Golestan, Isfahan, Kurdestan, Mazandaran, Qazvin and Tehran provinces of Iran (Zargari, 1990). This plant is an annual herb growing to an average height of around 40 cm. That cultivated for its oil seeds, the seed contains up to 30% of a drying oil (Usher, 1974).

The genus *Lallemantia* has 5 different species distributed in different regions of Iran. *Lallemantia iberica*, also recognized in the literature by such other scientific names as *Lallemantia sulphuraea* and *Dracocephalum ibericum* (Bieb.), is locally known as Balango Shahri in Iran. The seeds and leaves of the plant have wide applications in folk medicine. The leaves are used as a potherb in Iran. People also use its leaves, oil, and seeds as a stimulant, diuretic, expectorant, general tonic, and aphrodisiac in traditional Iranian medicine (Razavi *et al*., 2017).

Analysis of the amount and distribution of genetic variation within and among ecotype of a species can increase understanding of the historical processes underlying the genetic diversity and can also provide important basic information for breeding programmes and for the establishment of programmes to conserve genetic resources. The distribution of genetic diversity within and among ecotype is a function of the rate of gene flow between ecotypes (Scott and Reynolds, 1984).

Path coefficient analysis is a reliable statistical technique which provides means not to quantify the interrelationships of different yield components but also indicates whether the influence is directly reflected in the yield or takes some other path way for ultimate effects.

Farahani and Arzani (2009) in their studies showed that cluster analysis, however, used both genetic variations between genotypes and traits, and hence is considered as a superior method for grouping the genotypes.

It is claimed that having knowledge of the nature of association between seed yield and its components can determine the appropriate characters to use in indirect selection for seed yield improvement (Siva Prasad *et al*., 2013).

Therefore, correlation analysis can be used to understand the relationships existing between yield and yield components associated with it (Mukthar *et al*., 2011). This technique measures the degree of relationship existing between various plant characteristics; and as well predicts the plant characters that can be selected for plants improvement with respect to associated complex character-yield (Gelalchaand Hanchinal, 2013).

Daniya *et al*., (2013) noted that the concept of path analysis also measures the relative importance of causal factors which provide information for effective selection during crop improvement programme.

This research was carried out to investigate association between grain yield and some traits and to comparison of seed yield and some agronomic traits in common ecotypes of *Lallemantia*.

Materials and methods

Study areas

A square lattice design (7×7) with three replications was conducted in 2015 at the Research Farm of the Faculty of Agriculture, University of Tabriz, Tabriz, Iran (Latitude 38°05´N, Longitude 46°17´E,

Altitude 1360m above sea level) to comparison of yield and some traits of 49 common ecotypes of *Lallemantia* (*Lallemantia iberica* Fisch. et C.A. Mey) (Table 1). The climate is characterized by mean annual precipitation of 245.75mm per year and mean annual temperature of 10°C.

Table 1. The origin of 49 common ecotypes of Lallemantia.

Ecotype number	Origin	Ecotype number	Origin	Ecotype number	Origin
1	Kolvanaq 1	18	Tabriz 8	35	Param village 2 (Heris)
2	Kolvanaq 2	19	Kolvanaq 10	36	Peyghamm village (Kaleybar)
3	Kolvanaq 3	20	Kolvanaq 11	37	Alvar village (Bostanabad)
4	Kolvanaq 4	21	Kolvanaq 12	38	Dehlan village (Hashtrud)
5	Ahar 1	22	Kolvanaq 13	39	village (Jolfa)Komar-e Sofla
6	Kolvanaq 5	23	Tabriz 4	40	Gondak village (Bijar)
7	Kolvanaq 6	24	Kolvanaq 14	41	Sero (Urmia)
8	Kolvanaq 7	25	TazehKand	42	Aralan village (Marand)
9	Sarab	26	Kolvanaq 15	43	Majareh village (Khalkhal)
10	Kolvanaq 8	27	Param village 1 (Heris)	44	Lilab village (Varzaqan)
11	Kolvanaq 9	28	Zarnaq	45	Kharvana
12	Tabriz 2	29	Varzaqan 1	46	Kurdistan 2
13	Tabriz 5	30	Ahar 2	47	Takab
14	Tabriz 3	31	Tazehkand	48	Zanjan
15	Tabriz 1	32	Malekan	49	Nazarlu and DarvishBaqqal villages
16	Tabriz 7	33	Mashhad		
17	Tabriz 6	34	Varzaqan 2		

Agricultural operations

Each plot had 5 rows of 1.5m length, spaced 20 cm apart. The seeds were sown on 28 May 2015 in 1cm depth of a sandy loam soil. All plots were irrigated immediately after sowing. The next irrigations were applied when needed. Weeds were controlled by hand during crop growth and development as required. At maturity, plants of 1m² in the middle part of each plot were harvested and some important agronomic traits (stem diameter, fertile branches, seeds per main stem, seeds per plant, 1000 seed weight and seed yield per plant) were measured.

Analysis method

The analysis of variance (ANOVA) for each character was performed followed by Duncan's multiple range test to test the significance difference between means. Linear correlation analyses were applied pairwise to all the studied traits. Path analysis for grain yield based on characters entered into the model in stepwise multivariate regression analysis. Data analysis was performed using software's MSTAT-C and SPSS-18.

Results and discussion

Results of analysis of variance revealed significant differences among common ecotypes of *Lallemantia* for all the studied traits (Table 2).

These results showed that there was high genetic variation among ecotypes. This diversity can be used in breeding programs.

Table 2. Results of Analysis of variance (MS) for different traits of common ecotypes of *Lallemantia*

Source		Df	Mean Square: Stem diameter	Fertile branches	Seeds per main stem	Seeds per plant	1000 seeds weight	Seed yield per plant
Replications		2	0.116^{ns}	0.263^{ns}	2581.87^{ns}	2430.43^{ns}	0.177^{ns}	0.039^{ns}
Treatments	Unadjusted	48	0.111^{ns}	1.688^{ns}	1205.63^{ns}	1873.13^{ns}	0.169**	0.049*
	Adjusted	48	-	1.840**	1228.42*	1933.99*	-	0.051*
Blocks within Reps (adj.)		18	0.089	2.05	1297.76	2070.19	0.058	0.046
Error	Effective	96	-	1.012	765.02	1238.42	-	0.030
	RCB Design	96	0.093	1.301	815.84	1316.38	0.067	0.032
	Intrablock	78	0.094	1.128	704.63	1142.42	0.070	0.028
CV (%)			16.16	54.43	27.75	29.52	5.36	30.14

Ns,* and **: Non significant, significant at P≤0.05 and P≤0.01, respectively.

Results of comparison of means for studied traits (Table 3) indicated that Varzaqan 1 ecotype (number of 29) had the highest means for stem diameter number and fertile branches. Kolvanaq 14 (number of 24) was superior ecotype in terms of seeds per main stem and seeds per plant. Varzaqan 2 (East Azarbaijan) ecotype (number of 34) had the highest mean with respect to 1000 grain weight. Maximum and minimum seed yield per plant were achieved by Kolvanaq 14 (number of 24) and Aralan village (Marand) (number of 42) ecotypes, respectively. Maximum seed yield per plant in Kolvanaq 14 can be related to high values of seeds per main stem and seeds per plant in this ecotype (Table 3).

Table 3. Comparisons of mean for studied traits of *Lallemantia* ecotypes

Ecotype number	Stem diameter	Fertile branches	Seeds per main stem	Seeds per plant	1000 seeds weight	Seed yield per plant (g)
1	1.87a-e	1.92b-h	98.91b-e	112.4b-g	4.53ef	0.51b-f
2	1.78a-e	1.09e-g	86.71b-f	97.32c-g	4.90a-f	0.47c-g
3	1.67a-e	1.55c-h	84.69c-f	98.27c-g	4.76a-f	0.47c-g
4	1.84a-e	1.34c-h	84.82c-f	97.91c-g	4.73a-f	0.46c-g
5	1.86a-e	1.35c-h	85.97c-f	108.5b-g	4.50ef	0.48c-g
6	2.09a-e	2.89a-f	142.6ab	175.3ab	4.86a-f	0.86ab
7	1.73a-e	1.72b-h	93.76b-e	119.2a-f	4.93a-f	0.58a-f
8	1.83a-e	2.99a-e	112.2a-e	130.1a-f	4.93a-f	0.63a-f
9	1.72a-e	1.32c-h	94b-e	106.8b-g	4.83a-f	0.51b-f
10	1.66b-e	2.12a-h	67.20d-f	76.88fg	4.73a-f	0.35fg
11	1.70a-e	1.20d-h	79.31c-f	94.36c-g	4.76a-f	0.45c-g
12	1.69a-e	0.33h	64.75ef	79.50e-g	4.83a-f	0.38fg
13	1.96a-e	1.56c-h	100b-e	121.5a-f	4.97a-e	0.59a-f
14	1.95a-e	2.78a-f	105a-e	119.3a-f	4.9a-f	0.58a-f
15	1.96a-e	3.26a-c	110.1a-e	131.9a-f	4.6d-f	0.60a-f
16	2.07a-e	2.57a-g	105.6a-e	130.4a-f	4.73a-f	0.63a-f
17	1.59c-e	0.91f-h	75.02c-f	86.26c-g	4.96a-e	0.41d-g
18	1.72a-e	1.15e-h	105.5a-e	126.1a-f	4.80a-f	0.60a-f
19	1.86a-e	1.06e-h	96.32b-e	108.8b-g	4.83a-f	0.52a-f
20	1.82a-e	1.55c-h	85.39c-f	104.5b-g	5.00a-e	0.52a-f
21	1.97a-e	1.73b-h	86.25b-f	108.5b-g	5.10a-d	0.55a-f
22	2.14a-e	1.92b-h	110a-e	135.8a-f	4.96a-e	0.67a-f
23	1.92a-e	2.01a-h	108.9a-e	128.4a-f	5.00a-e	0.64a-f
24	2.21a-c	3.65ab	157.4a	186.4a	4.70a-f	0.87a
25	1.82a-e	0.67gh	89.35b-f	106.1b-g	5.00a-e	0.53a-f
26	1.62c-e	1.27c-h	93.83b-e	109.4b-g	4.76a-f	0.51b-f
27	1.84a-e	1.50c-h	100.3b-e	123.7a-f	4.66b-f	0.57a-f
28	1.56de	0.60gh	78.21c-f	83.34d-g	4.86a-f	0.40e-g
29	2.29a	3.98a	127.3a-c	150.8a-e	4.93a-f	0.75a-e
30	1.51e	1.50c-h	110.1a-e	137.7a-f	4.56d-f	0.60a-f
31	1.93a-e	2.24a-h	105.5a-e	126.9a-f	5.03a-e	0.63a-f
32	1.92a-e	1.55c-h	99.75b-e	112.1b-g	5.00a-e	0.56a-f
33	1.60c-e	1.65b-h	80.78c-f	98.81c-g	5.03a-e	0.48c-g
34	2.00a-e	2.12a-h	107.3a-e	143.9a-f	5.23a	0.74a-e
35	1.58c-e	1.18d-h	79.83c-f	96.31c-g	4.86a-f	0.46c-g
36	2.02a-e	0.94e-h	92.18b-e	103.3c-g	5.03a-e	0.50b-f
37	2.08a-e	2.52a-g	117.2a-e	136.7a-f	5.16a-c	0.70a-f
38	1.94a-e	1.53c-h	103a-e	120.5a-f	4.70a-f	0.56a-f
39	2.06a-e	2.26a-h	116.3a-e	145.8a-f	4.83a-f	0.70a-f
40	1.87a-e	1.45c-h	103.6a-e	125.6a-f	5.00a-e	0.2a-f
41	2.16a-d	2.56a-g	122.2a-d	147.2a-f	4.63c-f	0.69a-f
42	1.97a-e	2.11a-h	37.21f	45.13g	3.83g	0.16g
43	1.86a-e	1.23c-h	96.04b-e	116.6a-f	4.40f	0.50b-f
44	1.95a-e	1.66b-h	106.1a-e	125.8a-f	5.03a-e	0.63a-f
45	1.73a-e	2.18a-h	129.3a-c	158.2a-c	4.80a-f	0.76a-d
46	2.25ab	3.23a-d	123.6a-d	152.6a-d	5.10a-d	0.78a-c
47	2.17a-d	1.96b-h	104.7a-e	128.5a-f	5.20ab	0.66a-f
48	1.75a-e	2.02a-h	98.93b-e	124.9a-f	4.96a-e	0.61a-f
49	2.06a-e	2.41a-g	120.6a-e	137a-f	4.53ef	0.62a-f
LSD 5%	0.49	1.63	44.96	57.20	0.43	0.28

Different letters in each column indicate significant differences among means at probability level of %5.

Correlation coefficients of different traits showed that all of these traits positively correlated with seed yield per plant. Seeds per plant and seeds per main stem had the highest positive correlation with seed yield per plant, respectively (Table 4). Significant correlations of these traits with seed yield clearly indicate that these yield components strongly influence seed yield per plant of *Lallemantia* ecotypes.

Table 4. Correlation coefficients of studied traits for *Lallemantia* ecotypes

	Stem diameter	Fertile branches	Seeds per main stem	Seeds per plant	1000 seeds weight	Seed yield per plant
Stem diameter	1					
Fertile branches	0.721**	1				
Seeds per main stem	0.607**	0.609**	1			
Seeds per plant	0.610**	0.613**	0.979**	1		
1000 seeds weight	0.107	-0.073	0.219	0.237	1	
Seed yield per plant	0.634**	0.599**	0.953**	0.980**	0.408**	1

*,** Significant at $p \leq 0.05$ and $p \leq 0.01$, respectively.

To identify important traits affecting the yield of plants, we used correlation and path analysis (Leilah and Al-Khateeb, 2005). The former studies showed that the performance of path analysis to identify the relationships between the traits is better than correlation coefficients (Kozak and Kang, 2006; Bahraminejad *et al*., 2011; Darvishzadeh *et al*., 2011).

Correlation coefficient and path analysis have been used by several researchers (Talebi *et al*., 2007; Behradfar *et al*., 2009) to determine interrelationships between quantitative characters.

Path analysis is widely used in breeding programs to identify direct and indirect effects of traits that affect yield and these results are used to increase yield of crops (Mohammadi *et al*., 2003; Ali *et al*., 2009). In the present study, path analysis was performed based on seed yield and related traits. In this analysis, the *Lallemantia* seed yield per plant was considered as the dependent variable and all traits were considered as independent variables (Table 5, Fig. 1).

The direct and indirect effects of the five grain yield related characters are shown in table 5 and Fig. 1. These characters showed positive (except the seeds per main stem) direct effects on grain yield. The lowest direct effect belonged to seeds per main stem (-0.113), followed by fertile branches (0.042), stem diameter (0.049) and 1000 seeds weight (0.196).

Seeds per plant had the highest direct effect (0.988). These traits could justify more of *Lallemantia* yield variation. Based on these results, we can introduce these traits as the most effective traits to improve seed yield; therefore any improvement in these traits can have positive direct or indirect effects on increasing seed yield. Similarly, Yasin and Singh (2010) reported that plant breeders commonly prefer yield components that indirectly increase yield. In addition, Bhagowati and Saikia (2003); Tuncturk and Çiftçi (2005) stated that the effective variables on the dependent variable considered as an early predictor variables and can be used to increase the dependent variable.

Table 5. Direct and indirect effects on grain yield via studied traits in *Lallemantia* ecotypes.

Characters	Direct[a] effect	Indirect effect via					Total correlation with grain yield
		Seeds per plant	1000 seeds weight	Stem diameter	Fertile branches	Seeds per main stem	
Seeds per plant	0.988	-	0.046	0.0298	0.026	-0.11	0.98
1000 seeds weight	0.196	0.234	-	0.0049	-0.0030	-0.025	0.408
Stem diameter	0.049	0.603	0.021	-	0.030	-0.069	0.634
Fertile branches	0.042	0.606	-0.014	0.035	-	-0.069	0.599
Seeds per main stem	-0.113	0.967	0.043	0.0297	0.026	-	0.953

[a]: residual effect = 0.1.

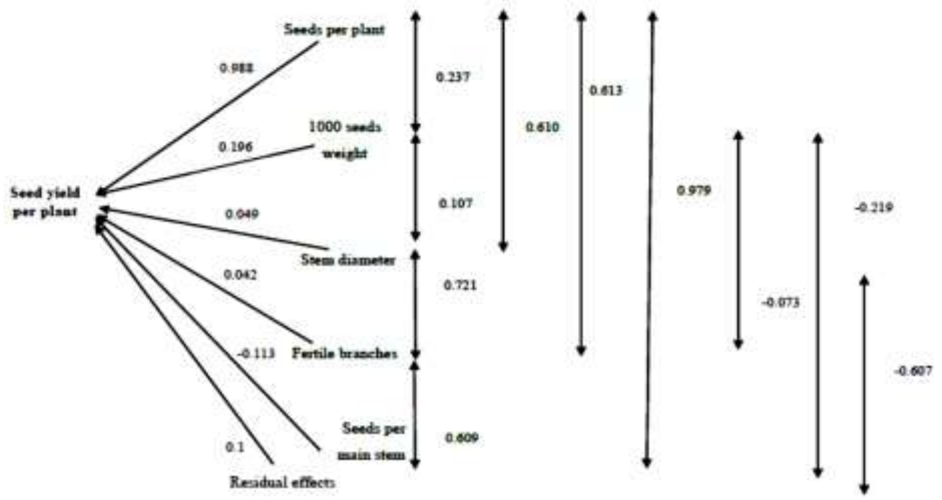

Fig. 1. Path analysis diagram of seed yield and related traits in *Lallemantia* ecotypes

Grouping and classifying different *Lallemantia* ecotypes was performed using grain yield and its related traits based on Ward's method by cluster analysis. The results of analysis (Fig. 2). Showed that 49 *Lallemantia* ecotypes were grouped in two clusters. To determination of cutting point of dendrogram, discriminant analysis was performed (Table 6).

Table 6. Discriminant analysis for determination of cutting point of dendrogram

NO. Groups	Wilks, lambda	Chi-square	Significance
2	0.167	64.406	4.87×10^{-6}
3	0.452	29.014	0.066
4	0.451	28.705	0.052
5	0.459	27.645	0.049
6	0.546	20.906	0.231

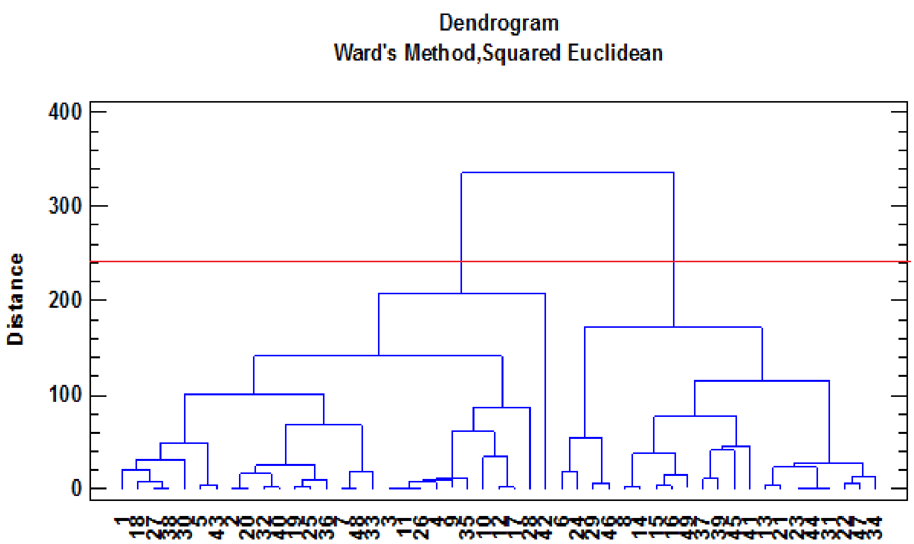

Fig. 2. Dendrogram among 49 common ecotypes of *Lallemantia* using Ward's method and squared Euclidean distance

Deviation from the mean for different traits showed that the group two ecotypes (6, 24, 29, 46, 8, 14, 15, 16, 49, 37, 39, 45, 41, 13, 21, 23, 44, 31, 22, 47 and 34) had the highest means for stem diameter, fertile branches, seeds per main stem, seeds per plant, 1000 grain weight and seed yield per plant (Table 7). These ecotypes can be used in breeding programs to increase grain yield and yield components.

Table 7. Deviation (%) from the total mean for different traits.

Group		Stem diameter	Fertile branches	Seeds per main stem	Seeds per plant	1000 seeds weight	Seed yield per plant
I: “1, 18, 27, 38, 30, 5, 43, 2, 20 32, 40, 19, 25, 36, 7, 48, 33, 3, 11, 26, 4, 9, 35, 10, 12, 17, 28, 42” ecotypes	Mean	1.76	1.37	88.59	104.90	4.77	0.50
	Deviation from the total mean (%)	-6.23	-25.43	-11.11	-12.00	-1/21	-13.38
II: “6, 24, 29, 46, 8, 14, 15, 16, 49, 37, 39, 45, 41, 13, 21, 23, 44, 31, 22, 47, 34” ecotypes	Mean	2.04	2.47	114.43	138.28	4.91	0.68
	Deviation from the total mean (%)	8.30	33.90	14.81	16.00	1.62	17.84
	Total mean	1.88	1.84	99.66	119.20	4.83	0.57

Conclusions

The results of this study showed that there were significant differences among *Lallemantia* ecotypes with respect to all studied traits. Thus, the accurate selections of the appropriate *Lallemantia* ecotype in each region are considerably important and essential factors to achieved high seed yield. In this study, it was found that Lallemantia seed yield per plant had the most correlation with seeds per plant and Seeds per main stem of *Lallemantia,* respectively. Cluster analysis showed that *Lallemantia* ecotypes grouped in two clusters. Ecotypes “6, 24, 29, 46, 8, 14, 15, 16, 49, 37, 39, 45, 41, 13, 21, 23, 44, 31, 22, 47, 34” (cluster II), compared with other ecotypes (cluster I) had the highest mean for stem diameter, fertile branches, seeds per main stem, seeds per plant, 1000 seeds weight and seed yield per plant.

References

Ali MA, Nawab NN, Abbas A, Zulkiffal M, Sajjad M. 2009. Evaluation of selection criteria in *Cicer arietinum* L. using correlation coefficients and path analysis. Australian Journal of Crop Science **3,** 65-70.

Bahraminejad A, Mohammadi-Nejad G, Abdul Khadir M. 2011. Genetic diversity evaluation of cumin (*Cumin cyminum* L.) based on phenotypic characteristics. Australian Journal of Crop Science **5,** 304-310.

Behradfar A, Gorttapeh AH, Zardashty MR, Talat F. 2009. Evaluation correlated traits for seed and oil yield in sunflower (*Helianthus annuus* L.) through path analysis in under condition relay cropping. Research Journal of Biological Sciences **4,** 82-85.

Daniya E, Dadari SA, Ndahi WB, Kuchinda NC, Babaji BA. 2013. Correlation and path analysis between seed yield and some weed and quantitative components in two Sesame (*Sesamum indicum* L.) varieties as influenced by seed rate and nitrogen fertilizer. Journal of Biology, Agriculture and Healthcare **3,** 12-17.

Darvishzadeh R, Maleki HH, Sarrafi A. 2011. Path analysis of the relationships between yield and some related traits in diallel population of sunflower (*Helianthus annuus* L.) under well-watered and water-stressed conditions. Australian Journal of Crop Science **5,** 674-680.

Farahani E, Arzani A. 2009. Evaluation of genetic variation of durum wheat genotypes using multivariate analyses. Electronic Journal of Crop Production **1,** 51-64.

Gelalcha S, Hanchinal RR. 2013. Correlation and path analysis in yield and yield components in spring bread wheat (*Triticum aestivum* L.) genotypes under irrigated condition in Southern India. African Journal of Agricultural Research **8,** 3186-3192.

Kirtiakar KR, Basu BD. 2001. Indian Medicinal Plants. Oriental Enterprises, Uttranchal, India **9,** 2761-2763.

Kozak M, Kang MS. 2006. Note on modern path analysis in application to crop science. Communications in Biometry and Crop Science **1,** 32-34.

Leilah A, Al-Khateeb S. 2005. Yield analysis of canola (*Brassica napus* L.) using some statistical procedures. Saudi Journal of Biological Sciences **12,** 103-113.

Mohammadi S, Prasanna B, Singh N. 2003. Sequential path model for determining interrelationships among grain yield and related characters in maize. Crop Science **43,** 1690-1697.

Mukhtar AA, Tanimu B, Ibrahim S, Abubakar IU, Babaji BA. 2011. Correlations and path coefficients analysis between pod yield and some quantitative parameters in ground nuts (*Arachis hypogaea* L.). International Journal of Science and Nature **2,** 799-804.

Naghibi F. 2005. Labiatae family in folk medicine in Iran.

Razavi SM, Arshneshin H, Ghasemian A. 2017. In vitro callus induction and isolation of volatile compounds in callus culture of *Lallemantia iberica* (M. Bieb.) Fisch. & C. A. Mey. Journal of Plant Process and Function **5,** 65-68.

Scott ND, Reynolds RP. 1984. Phenotype variation of the Mexican duck in Mexico.

Siva Prasad YVN, Krishna MSR, Yadavalli V. 2013. Correlation and path analysis in F2 and F3 generations of cross JLSV 4 x TC 25 in sesamum (*Sesamum indicum* L.). Advanced Crop Science **3,** 370-375.

Talebi R, Fayaz F, Jelodar N-AB. 2007. Correlation and path coefficient analysis of yield and yield components of chickpea (*Cicer arietinum* L.) under dry land condition in the west of Iran. Asian Journal of Plant Sciences **6,** 1151-1154.

Tuncturk M, Çiftçi V. 2005. Selection criteria for potato (*Solanum tuberosum* L.) breeding. Asian Journal of Plant Sciences **4,** 27-30.

Usher G. 1974. A Dictionary of Plants Used by Man. Constable ISBN 0094579202.

Yasin AB, Singh S. 2010. Correlation and path coefficient analyses in sunflower. Journal of Plant Breeding and Crop Science **2,** 129-133.

Zargari A. 1990. Medicinal Plants. Tehran University Publications, Iran **4,** 112-113.