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Morphological, anatomical and numerical taxonomy studies for some species of the fabaceae family

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Abstract

Morphological, anatomical, geographical and numerical taxonomy studies suggested in an attempt to provide us more detailed descriptions of six species for the Fabaceae family newly added to the flora of Iraq. This species are: *Trifolium pratense* L., *Cicer arietinum, Lathyrus vinealis*, *Melilotus alba, Vicia sativa, Medicago polymorpha*. Results showed that the species *Melilotus alba* recorded the highest rate of stem length which ranged from 50cm-110 cm while the species *Cicer arietinum* recorded the lowest rate ranged from 15 cm-30 cm, also the species *Trifolium pretense* recorded highest rate of stipuleslength ranged from 20mm to 45mm andin anatomical studies the same species recordedhighest rate of epidermis thickness which was 40.51µm but the lowest rate recorded by the species *Medicago polymorpha* which was 15.13 µm. The grographical results showed that *the altitude range* of *the species* between 1000-3000 m. Finally, the numerical taxonomy used to clarify genetic relationships among these species.

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Introduction

The Fabaceae family content about 727 genera and 19,325 species (Haerinasaband Rahiminejad, 2012) includes herbs, shrubs, trees, and the climbers (Ceter *et al*., 2013). The family has a variety distribution in cold mountainous regions in Europe, Asia and North America, so abundant in central Asiawitha very economic importance (Sheikh, 2016). Legumes are among the three largest families of flowering plants, which being the main sources of gums, dyes, oils, insecticides, fibre, fuel, timber, medicinals and pulses (Wang, 2005).So that the morphological, anatomical geographical characteristics in many articles of the genus and species of Fabaceae family were reported and examined by Several previous studies as a study of Siahpoosh *et al.* (2015) and Çeter *et al.* (2012). This variationin studies and articles have been used by many authors and researcher toput the plant in various taxa (Marwat, 2009 Haerinasab Rahiminejad, 2011). The purpose of ourpre sent studies was todetermine all the general and specific taxonomy differences features and morphology, anatomy, geography and numerical taxonomy in to throw light on the problematic aspects for taxonomy of these species, and to determine and tracing the close relationships among various species.

Materials and methods

Morphological studies

Some of the six species of the fabaceae family was fresh obtained from different localities of Iraq with dry specimens from some Iraqi herbaria during the period march 2015 - August 2015.These specimens are identified according to Townsend and Guest (1974).

Anatomical studies

The anatomical slides were performed on cross-sections of fresh samples of leaves and stems at Iraq natural history research center and museum, university of Baghdad, using hand sectioning method (Nasrullah, 2007).

Geographical distribution

In our study the distribution of the six species was evaluated, and also the geographical and habitat of all specimen examined had its data recorded on an index card such us: scientific name, date of collection, locality, altitude, Soil, habitat, abundance.

Numerical taxonomy

The data of this way using for comprehensive, evaluating and analyzing in order finding the relationship among the genus and species which we studies. In numerical taxonomy the programs of computer multivariate data analysis in morphological, anatomical and geographical data which except for the all or none traits (namely variables coded as 1 or 0).

Results and discussion

In our studies the morphlogical features of the six species are summarized in table (1).

Some of the species are annual or biennial such as *Melilotus alba* and *Medicago polymorpha* or annual such as *Cicer arietinum*, *Vicia sativa* and *Lathyrus vinealis* except *Trifolium pretense* which is perennial species.

Our studies and analysis for these species grown in Iraq revealed that they were differentiated and varied both the external and internal morphology examined and could be distinguish these species according to these morphological characteristics. The measurements were recorded among the studied species in length of stem, leaves, Stipules, pedicels, corolla, pod and seed. According to our results we found that the species *Melilotus alba* recorded the highest rate of stem length which ranged from 50 cm to 110 cm while the species *Cicer arietinum* recorded the lowest rate ranged from 15 cm-30 cm, also the species *Trifolium pratense* is distinguished by not containing pedicel.

The species *Lathyrus vinealis* recorded the highest rate of pod length ranged from 30mm to 40mm while the species *Melilotus alba* recorded the lowest rate

ranged from 3mm to 5mm. our study agrees with results of many authors such as Özbek *et al.* (2014) when they studied the species *Melilotus bicolor* which belongs to same family the fabaceae. Moreover, In Anatomical featuresthe epidermis in cross section in stem of all speciesis covered by a thin layer of cuticle, anlessthe species *Medicago*.

Polymorpha covered by a thick layer (table 2). The species *Trifolium pratens* recorded highest rate of epidermis thickness which was 40.51 µm but the lowest rate recorded by the species *Medicago polymorpha* which was 15.13 µm these data in agreement with result of Cetin (2009).

Table 1. Morphological features of the six species.

No	Species	Habit	Stem cm	Leaflets mm	Stipules mm	Pedicels mm	Corolla			Ovary mm	Pod mm	Seed
							Standard mm	Wings mm	Keel mm			
1	*Trifoliumpratense*	perennial	80-20	15-30× 5-15	20-45	-	15-18× 2-3	15-18	5-8	2-3	4-5	2
2	*Cicer arietinum*	annual	15-30	7-15× 2-6	10	1-2	6-12× 3-6	8-10	4-6	3-4	20-30	5-10
3	*Lathyrus vinealis*	annual	20-65	25-60× 2-4	12-20	3-4	10-12× 7-10	5-6	8-10	3-3.5	40-50	3-4
4	*Melilotus alba*	annual or biennial	50-110	10-20× 11-5	5-6	2	4-5× 3-4	3-4	4	2-3	3-5	1-2
5	*Vicia sativa*	annual	15-55	10-30 15-5 ×	3-8	1.5	10-11× 7-8	3-4	1-3	2-4	5-10	2-5
6	*Medicago polymorpha*	annual or biennial	20-60	10-20× 15-5	8-10	1	4-3× 3-2	3-4	2-3	4-5	5-10	23×

Table 2. Anatomical features of the stem of the six species.

No	Species	Cuticle thickness	epidermis	Cortex thickness			vascular tissue thickness	pith thickness
				collenchyma	chloranchymal	parenchyma		
1	*Trifolium pratense*	4.21	40.51	147.73	15.55	60.62	190.61	421.05
2	*Cicer arietinum*	3.32	36.33	154.88	13.66	62.73	195.88	400.63
3	*Lathyrus vinealis*	3.86	39.98	155.62	14.72	60.33	190.76	433.97
4	*Melilotus alba*	2.89	24.64	176.81	26.81	73.87	215.81	530.78
5	*Vicia sativa*	2.65	22.26	175.72	25.17	70.42	218.74	510.11
6	*Medicago polymorpha*	6.33	15.13	188.41	33.64	90.44	240.96	540.35

Table 3. Anatomical features of the leaves of the six species.

No	Species	cutical	adaxial epidermal thickness	abaxial epidermal thickness	mesophyll		vascular tissue + sclerenchyma
					palisade cells	spongy cells	
1	*Trifolium pratense*	3.52	42.84	34.44	91.81	120.77	220.65
2	*Cicer arietinum*	2.88	44.50	31.77	93.67	90.66	180.72
3	*Lathyrus vinealis*	4.45	39.08	33.21	92.91	131.11	2.11**24**
4	*Melilotus alba*	5.40	40.98	26.58	111.09	88.42	380.60
5	*Vicia sativa*	6.36	44.03	25.66	111.31	100.43	260.66
6	*Medicago polymorpha*	4.65	28.96	20.49	110.45	89.11	250.92

The upper and lower walls of the epidermis cells were more thickness than the lateral walls in the two species *Trifolium pretense*, *Lathyrus vinealis*. Sothere are much single cell trichomes on some of epidermal cells. Inthe species *Melilotus alba*, *Vicia sativa*, *Medicago polymorpha*, the collenchyma tissue which is under the epidermis layer is very close to the epidermis cells and in all species the endodermis, single and thin layered is located above the vascular bundles, this data agree with Zoric *et al.* (2012).

Table 4. Genetic distances among the six species.

1	0.000					
2	0.051	0.000				
3	0.078	0.134	0.000			
4	0.501	0.545	0.592	0.000		
5	0.297	0.545	0.640	0.150	0.000	
6	0.533	0.533	0.582	0.628	0.634	0.000

The stem characteristics seems to possess vary significant role in the differentiation among these species (Fig. 1.). The results agreed with the finding of Metcalf and Chalk (1950).

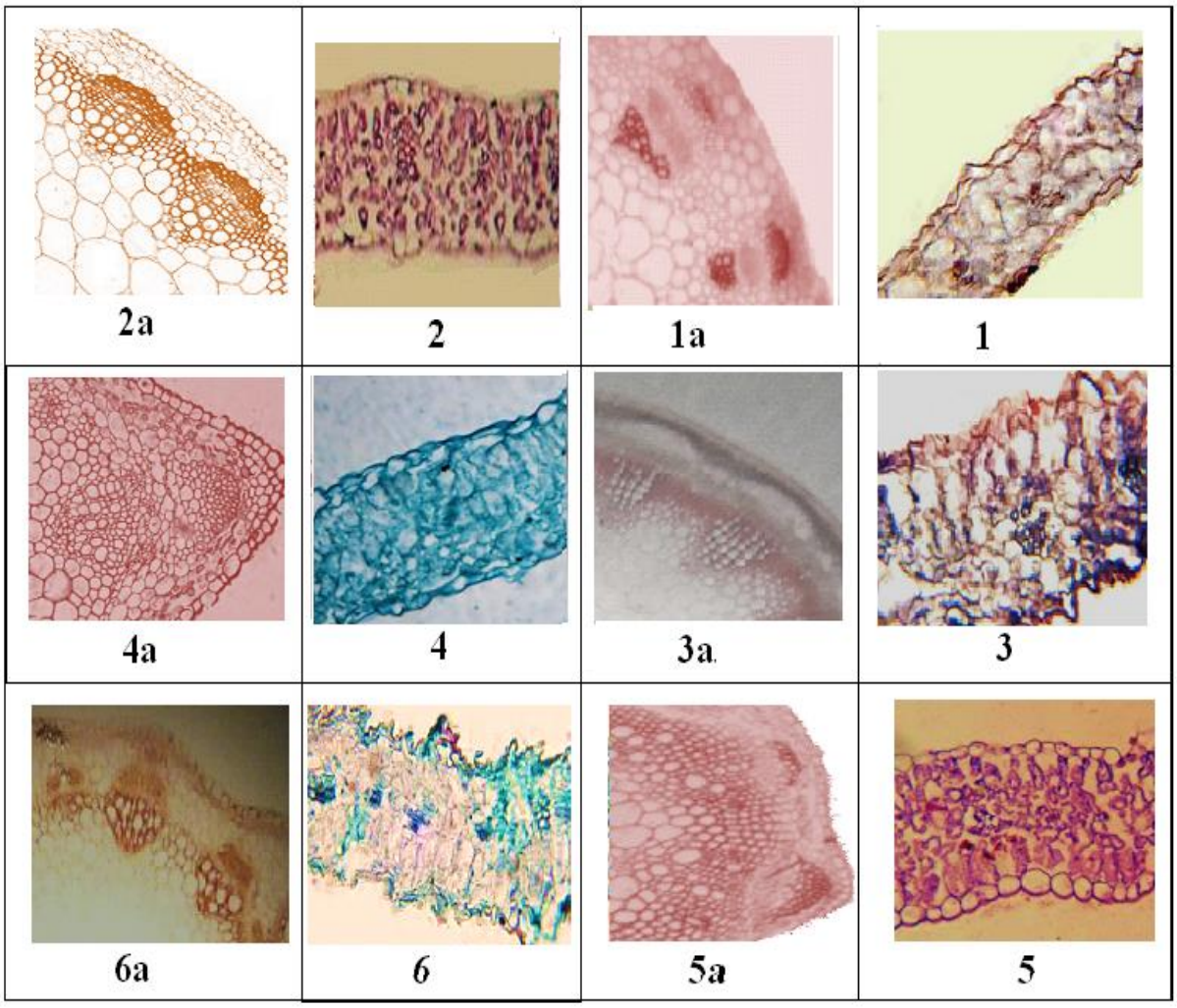

Fig. 1. Transver sections of stem and leaf (x= 100) of the six species *Trifolium pretense* (1-1a), *Cicer arietinum* (2-2a), *Lathyrus vinealis*(3-3a), *Melilotus alba* (4-4a), *Vicia sativa* (5-5a), *Medicago polymorpha* (6-6a).

According to the results of leaf anatomy we found that the species *Vicia sativa*has the thickest layer of cutical which was6.36 µm among our species, differences among species were also observed in the thickness of Adaxialand abaxialepidermal layer, the highest thikness of Adaxial epidermal layer was recorded in *Cicer arietinum* which was 44.50µm, while the lowest thikness of Adaxialepidermal layer

was recorded in *Medicago polymorpha* which was28.96µm. Also the thickness of palisade layer was 91.81 µm as minimum in *Lathyrus vinealis*, but as maximum was 111.31µm in *Vicia sativa*, this result was agree with studies of Kasem (2016), also Schnurr *et al.* (2007) reported the importance of anatomical differences in the distinction among species.

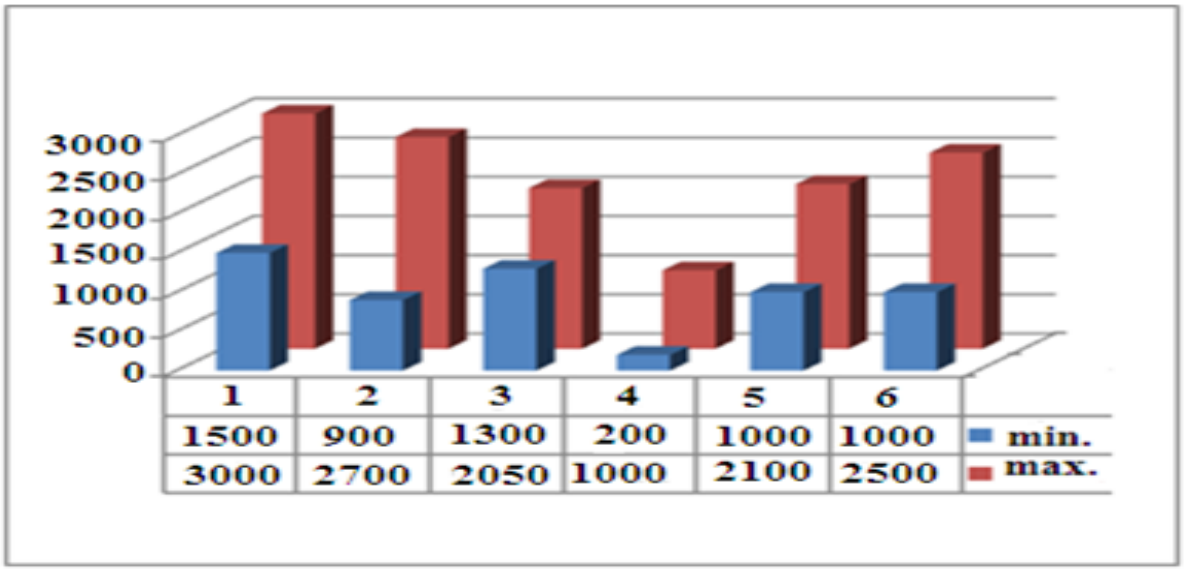

Fig. 2. geographical Analysis of the six specis.

The current study showed that the observation of geographical study for these six species showed very high level in the diversity and the dispersal for these species on their wide localities due to there ability of crossing-pollination and to the dispersal of pollen to distant localities.

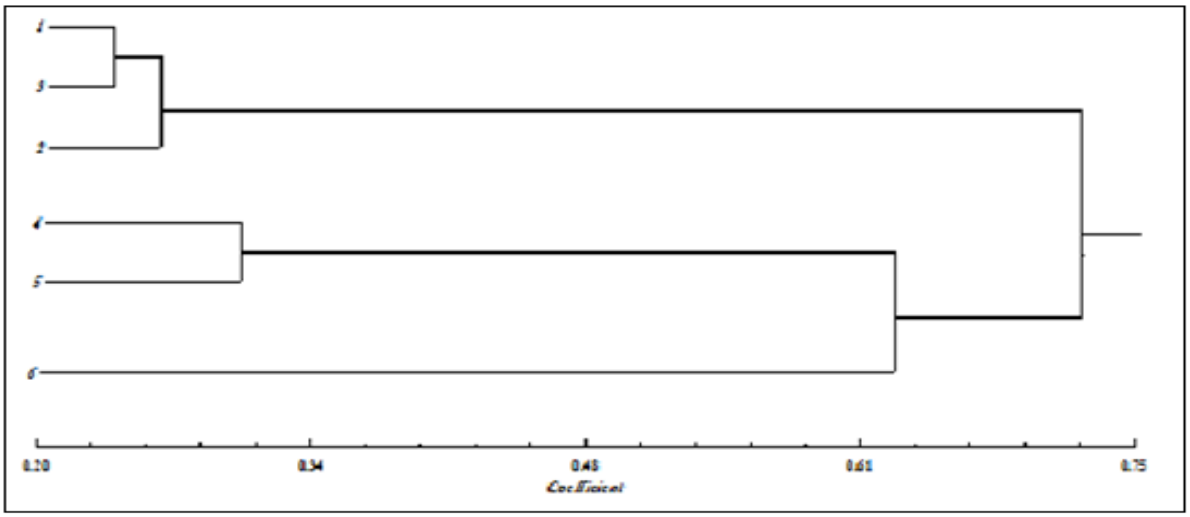

Fig. 3. The dendrogram showing the relationships among the species.

In geographical study we found that the points of the altitude for the six species ranged from 200 m. in *Melilotus alba* to 3000 m. in *Trifolium pratense* so the spread of species was within different geographical heights the result were identical to that found by Town send, and Guest (1974)(Fig. 4.).

According to this paper and to all our studies in the morphology, anatomy, geography results of the six species were scored and the data subjected to numerical taxonomic analyses to find the relationship among the specie (table 4). The six species divided in to two groups distinct taxa which one of them content

Trifolium pretense, *Lathyrus vinealis and Cicer arietinum* which are very close related to them, the reason is the similar among them inmorphological and taxonomical characters such as the thikness of cuticle, epidermis and palisade layer while the other group Include the remaining of these species (Fig. . By analyzing results of cluster showed the existence of six discrete clusters within these species based on the morphological, anatomical and geographical features, this agreement with Rasool and Qaiser (2011).

The morphology, anatomy, geography, and numerical taxonomy of our studies were determined for six species which they are very important economic plants. We think that this results will contribute to systematics of these species belong to fabaceae family in Iraq.

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