

Systematic Consideration of Petiole Anatomy of Some Taxa of Brassicaceae in Libya

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Abstract: Brassicaceae is considered as one of the most important families which have attracted the attention of many taxonomists. This work was carried out on fifteen taxa collected from different localities in Libya. It was observed that the micro-morphological characters of petiole are considered fundamental characters at the generic and specific level. The vasculature types of the petiole of the studied taxa are of six in number, three of them are compatible with those described by earlier researchers and the other three are recorded as new ones.

Key words: Systematic • Petiole • Brassicaceae • Anatomy • Libya

INTRODUCTION

Brassicaceae (Cruciferae) is a large and natural family widely distributed throughout the world [1, 2] and comprising approximately 380 genera and more than 3350 species in 10 poorly defined tribes [3]. In Libya the family Brassicaceae are mostly comprising of annual, biennial or perennial herbs [4, 5]. Sometimes are shrubs, spiny such as *Zilla spinosa*. Leaves in Cruciferae are minute to very large; alternate; can often form rosettes of basal leaves; fleshy or herbaceous; petiolate, sub-sessile or sessile; foetid, or without marked odour; simple or compound when compound, pinnate. Lamina when simple, dissected to entire, pinnatifid or runcinate, one-veined, or pinnately veined. Leaves are exstipulate. Lamina margins are entire, serrate or dentate.

The purpose of this anatomical study is to support or contradict the classification of the examined specimens. The petiole is a leaf organ, which connects the lamina with the stem. Although its tissues are comparable to the primary tissues of the stem, a considerable variation exists in the distribution of vascular bundles [6, 7]. The petiole anatomy has received considerable attention of anatomists from time to time Al-Nowaihi *et al.* [8]. Superficial characters and vascular pattern of the petiole can be of descriptive and taxonomic value, whose systematic level does vary from one taxon to another. In some cases families can be recognized, in other cases genera, species or varieties can be distinguished. Howard

[9] surveyed the petiole vasculature in a large number of dicotyledonous families and found this structure to be of great taxonomic value. Metcalfe and Chalk [10] reported that in the transverse sections through the distal ends of the petioles from a random selection of different members of the family revealed three main but intergrading types of vascular structure.

MATERIALS AND METHODS

In the present study 15 taxa of Brassicaceae have been collected representing 11 genera, 12 species, two subspecies and four varieties. The specimens represent wild taxa collected from different localities as shown in Table 1. The studied taxa were matched against the taxa kept in Herbaria of Garyounis University (CHUG) and identified according to [11, 12, 13]. Sectioning for anatomical investigations was performed by fixation and preservation of fresh material in 40% formalin, ethyl alcohol, glacial acetic acid amounting 5, 90 and 5ml respectively. The petiole were sectioned from the middle at 10–20 μ m, then double stained using safranin and light green [14].

Microphotographs of petiole and sections were performed to show the specific aspects of each. Cumulative plates and tables are presented with certain micro-morphological attributes in order to explain the most significant investigated characters and clarify their states.

Table 1: Collection data and sources of collection

No	Taxa	Source of collection
1	<i>Biscutella didyma</i> L.	Benghazi University Area
2	<i>Brassica tournefortii</i> Gouan	Benghazi University Area
3	<i>Cakile maritima</i> Scop.	Gwarsha Fields Area
4	<i>Carrichtera annua</i> (L.) DC.	Benghazi University Area
5	<i>Didesmus aegyptius</i> (L.) Desv.	Benghazi University Area
6	<i>D. bipinnatus</i> (Desf.) DC.	Gwarsha Fields Area
7	<i>Enarthrocarpus pterocarpus</i> (Pres.) var. <i>hispidus</i> Pamp.	Gwarsha Fields Area
8	<i>E. pterocarpus</i> (Pres.) var. <i>pterocarpus</i> (Pres.) DC.	Gwarsha Fields Area
9	<i>Eruca sativa</i> Mill. var. <i>longirostris</i> (Uechtr) Ray	Gwarsha Fields Area
10	<i>E. sativa</i> Mill. var. <i>oblongifolia</i> Passq.	Gwarsha Fields Area
11	<i>Mathiolla longipetala</i> (Vent) DC. ssp. <i>hitra</i> (Conti)	Benghazi University Area
12	<i>M. longipetala</i> (Vent) DC. ssp <i>livida</i> (Delile) Maire.	Benghazi University Area
13	<i>Rapistrum rugosum</i> (L.) All.	Gwarsha Fields Area
14	<i>Sinapis alba</i> L.	Gwarsha Fields Area
15	<i>Sisymbrium irio</i> L.	Benghazi University Area

RESULTS AND DISCUSSION

The various petiole micro-anatomical characters are summarized in Table 2 and Figs. I-VI. The legend no. in text and key and under photos refers to the number and names of taxa in Table 1. The present study on the petiole microanatomy revealed the presence of six main types of vascular structure (I – VI) based on the different anatomical aspects of the vascular system. In all the petiolated studied taxa the petiole vasculature is in the form of distinct bundles with different appearance and arrangement through the ground tissue as shown in the following types:

Type I: In which the petiole vasculature is in the form of one prominent median vascular bundle and group of small subsidiary bundles. The ridge bundles may be present or absent. All the bundles are un-dissected and increase in number towards the distal ends of the petiole. The main bundle supported by mass of lignified parenchyma. This type was recorded in *Biscutella didyma* (L.).

Type II: The petiole vasculature composed of one prominent median bundle which dissect longitudinally and group of un-dissected subsidiary bundles which increase towards the distal ends of the petiole. This type was recorded in taxa no. 8, 10 and 23.

Type III: The petiole vasculature composed of group of distinct bundles arranged in crescent or u-shape manner. All bundles are un-dissected and most of them are more

or less equal in their sizes. This type was recorded in the majority of the investigated taxa as shown in taxa no 3, 5, 6, 12 and 13.

Type IV: The fourth type was recorded in taxa no. 4, 7, 8, 9 and 10. The petiole vascular system is in the form of distinct vascular bundle arranged in crescent or u-shape manner. The prominent bundle only dissected longitudinally whereas the subsidiary bundles remain without splitting.

Type V: This type is characterized by the crescent form or u-shape petiole vasculature with distinct bundles. The median and the two adjacent subsidiary bundles are splitting longitudinally while the remainder bundles remain un-dissected. This type was characterized the taxa no. 13 and 14.

Type VI: The sixth type was recorded in taxa no. 6. The petiole vascular structure composed of distinct groups of vascular bundles in crescenti-form or u-shape manner. The large bundles of the main u-shaped group, each consisting of a ring or cluster of vascular strands arranged in rosette manner. The subsidiary bundles frequently more at the base than the distal ends.

From the microanatomical characters of petiole in the present study, it was observed that the petiole microcharacters proved to be of taxonomic significance at the generic and specific level with few exceptions. For examples, the species of *Brassica* exhibit the petiole vasculature type (VI), consequently the specific

Table 2: Microanatomical characters of petiole of the studied taxa

No	Outline	Dermal System			
		Cuticle		Epidermal cells	
		Thin	Thick	Radially	Tangentially
1	Ribbon-like	-	+	-	+
2	Half circle	+	-	+	+
3	Kidney shape	-	+	+	-
4	Shallow crescentiform	-	+	-	+
5	Terete	-	+	+	-
6	Shallow crescentiform	-	+	+	-
7	Crescentiform	-	+	+	+
8	Terete	-	+	+	-
9	Shallow crescentiform	-	+	+	-
10	Terete	-	+	+	+
11	Boat shape	-	+	+	-
12	Half circle	-	+	+	-
13	Crescentiform	-	+	-	+
14	Terete,shallow,concave adaxilly	-	+	+	+
15	Terete,shallow,concave adaxilly	-	+	-	+

(2)

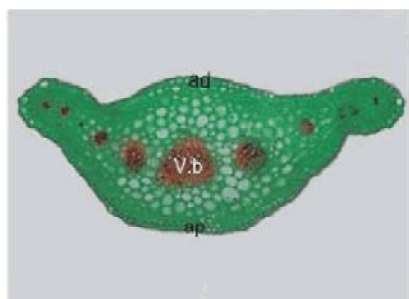
Dermal System				
Bulliform cells		Trichomes		
Solitary	Scattered	Occurence		Type
Solitary	Clustered			
+	-	+		Unicellular, hooked
-	-	+		Unicellular, unbranched
-	+	-		-
+	-	-		Unicellular, two armed
+	-	-		-
-	+	-		-
+	-	+		Unicellular, unbranched
+	-	+		Unicellular, unbranched
+	-	+		Unicellular, hooked
+	-	-		-
+	-	+		Unicellular, multicellular, stellate, two armed, dendroid
+	-	-		-
+	-	+		Unicellular., multicellular, curved
+	-	-		-
+	-	-		-

Table 3:

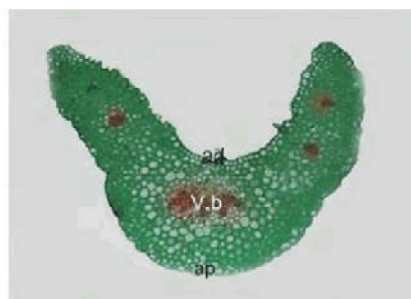
Ground system						
Tissues						
No.	Types	Chlorenchyma	Parenchyma	Collenchyma	Sclerenchyma	Idioblasts
1	2	+	+	-	-	-
2	3	+	+	+	-	-
3	2	+	+	-	-	+
4	2	+	+	-	-	-
5	2	+	+	-	-	-
6	3	+	+	+	-	-
7	3	+	+	+	-	+
8	3	+	+	+	-	-
9	2	+	+	-	-	-
10	2	+	+	-	-	-
11	2	+	+	-	-	-
12	2	+	+	-	-	-
13	2	+	+	-	-	-
14	3	+	+	+	-	+
15	2	+	+	-	-	-

Table 3: Continued

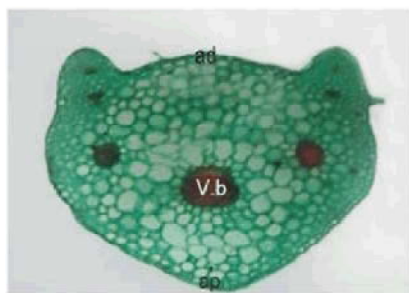
Aspects	Vascular system								
	No. Bundles			Type	Splitting of Bundles			Cavity	Wing
	Median	Subsidiary	Ridge		All un split	Median only	All split		
Distinct	1	2	4	I	+	-	-	-	-
Distinct	1	8	4	VI	-	-	+	-	+
Distinct	1	6	2	III	+	-	-	-	-
Distinct	1	6	6	IV	-	+	-	+	+
Distinct	1	4	4-6	III	+	-	-	-	+
Distinct	1	6	2-3	III	+	-	-	-	+
Distinct	1	4	2	IV	-	+	-	-	+
Distinct	1	5	2	IV	-	+	-	-	+
Distinct	1	6	4	IV	-	+	-	-	+
Distinct	1	4	0	IV	-	+	-	-	+
Distinct	1	5	0	III	+	-	-	-	-
Distinct	1	6	0	III	+	-	-	-	-
Distinct	1	6	2	V	-	+	-	-	+
Distinct	1	4	2	V	-	+	-	-	+
Distinct	1	6	2	III	+	-	-	-	+



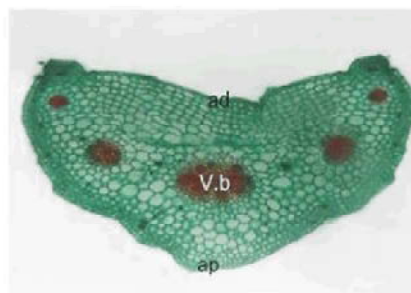
I



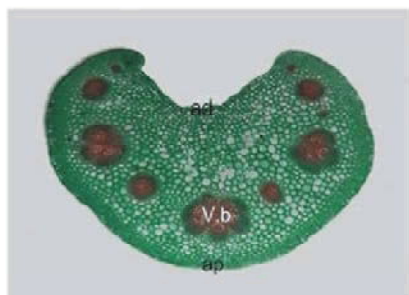
II



III



IV



V



VI

Figs. 1-5: The main six recorded petiole vasculature types in the studied taxa of Brassicaceae. Ab: abaxial epidermis, ad: adaxial epidermis, vb: vascular bundle.

delimitation based on another different petiole anatomical parameters. Another example was recorded in *Sisymbrium irio* (tribe Sysimberieae), all ssp. of *Matthiola* (tribe Matthioleae) and species of *Didismus* are categorized under type III of petiole vasculature with others. Therefore, our recent data are to some extent in agreement with that of [10] for some extent. The three vascular types I, IV and VI in the present study are the same types as recorded by [10] whereas the remaining types (type II, III and V) are considered new vascular types to Brassicaceae. In type I the prominent bundle supported by mass of lignified parenchyma and this contradict earlier finding by Metcalfe and Chalk [10].

CONCLUSIONS

The petiole microanatomy is of considerable taxonomic importance. It has undoubtedly played immense role in plant systematics and has solved many taxonomic problems. These results are in good agreement with those obtained by various authors e.g. Dahlgren [15].

REFERENCES

- Hickey, M. and C.J. King, 1981. 100 Families of flowering plants. pp: 150-153. Cambridge University Press.
- Al-Shehbaz, I.A., 1988. The genera of Brassiceae (Cruciferae; Brassicaceae) in the Southeastern United States. J. Arnold Arb., 67: 193-212.
- Heywood, V.H., 1993. Cruciferae–The mustard family. In Flowering Plants of the World, pp: 119-122. Bastsford, London.
- Andrews, F.W., 1950. The Flowering Plants of the AngloEgyptian Sudan. T. Buncle and Co Ltd., Arbroath, Scotland, 1: 60.
- Purseglove, J.W., 1968. Tropical crops dicotyledons. Volumes 1 and 2 combined. pp. 89-99. Society and Longman.
- Esau, K., 1960. Anatomy of seed plants. John Wiley and Sons, Inc.
- Metcalfe, C.R. and L. Chalk, 1979. Anatomy of the dicotyledons 2nd edition, vol. I. Systematic anatomy of leaf and stem, with brief history of the subject. Clarendon press, Oxford, London.
- Al-Nowaihi, A.S., S.F. Khalifa and I.F. Ishak, 1980. The significance of comparative anatomy of the petiole in the identification of some Malvaceae taxa. Bull. Fac. Sci. Riyadh Univ., II: 25-41.
- Howard, R.A., 1963. The vascular structure of the petiole as a taxonomic character. Adv. Hort. Sci., 3: 7-13.
- Metcalfe, C.R. and L. Chalk, 1950. Anatomy of Dicotyledons. Vol. 1. Oxford.
- Bailey, L.H., 1949. Manual of Cultivated Plants, pp: 347-351. The Macmillan Pub. Co., New York.
- Jafri, S.M.H., 1977. Flora of Libya. Vol. 23, Faculty of Science, El-Fateh University.
- Boulos, L., 1999. Flora of Egypt. Vol. I. Azolliaceae-Oxallidaceae. pp: 419-425. Al Hadara Publishing, Cairo.
- Johansen, D.A., 1940. Plant microtechnique. McGraw – Hill Book Company, Inc., New York.
- Dahlgren, R., 1980. A revised system of classification of the angiosperms. Bot. J. Linnean Soc., 80: 91-124.