

CORRESPONDENCE

Glandular trichomes on vegetative and reproductive organs of *Lamium orientale* (Lamiaceae)

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Abstract

The types of glandular trichomes and their distribution on the vegetative and reproductive organs of *Lamium orientale* (syn. *Wiedemannia orientalis*) are studied for systematic purposes in this paper. Two morphologically different types of glandular trichomes (peltate and capitate) are described. Peltate trichomes are characterized by a short stalk, which is connected with a large spherical head composed of four cells in a single layer. Capitate glandular trichomes are subdivided into capitate type A and capitate type B. On the vegetative organs peltate trichomes are abundant, while on reproductive organs capitate trichomes are numerous and the peltate trichomes are rare or absent.

Keywords: *Lamium orientale*, Lamiaceae, trichomes

Introduction

Lamiaceae Martinov is one of the largest plant families represented by about 258 genera and 3500 species in the world (Duarte & Lopes 2007). According to Davis (1982), Lamiaceae family has 45 genera and about 546 species distributed in Turkey. Turkey is a gene center of this family to which genus *Lamium* L. belongs (Başer 1993).

The most important characteristic of the Lamiaceae are glandular trichomes distributed

on vegetative and reproductive organs (Werker 2006). These trichomes produce essential oils and their structure has been studied for systematic purpose (Hanlidou *et al.* 1991; Vrachnakis 2003). The commercial value of these essential oils is recorded in lots of special studies, as well as in relation with the morphology, structure and secretion of trichomes (Amelunxen *et al.* 1969; Heinrich *et al.* 1983; Dudai *et al.* 1988; Antunes & Seviniate-Pinto 1991).

Plant organ	Capitate glandular trichomes						Peltate trichomes	
	Type A			Type B			Center cell	Peripheral cells
	Head cells	Stalk cells	Base cells	Head cell	Stalk cells	Base cells		
Stem	1	2	2	-	-	-	1	4
	2	1	1	-	-	-	-	-
Leaf	-	-	-	-	-	-	1	4
Petiole	-	-	-	-	-	-	1	4
Calyx	1	2	1	1	1	1	1	4
	2	1	1	-	-	-	-	-
	2	2	1	-	-	-	-	-
Corolla	1	2	1	1	2	1	-	-
	1	1	1	1	1	1	-	-
	2	1	1	-	-	-	-	-
	4	1	1	-	-	-	-	-

Table 1. Glandular trichomes variation in *Lamium orientale*.

This paper provides first comparative investigation on glandular trichomes of *L. orientale* (Fisch. et C.A. Mey.) E.H.L. Krause formerly known as *Wiedemannia orientalis* Fisch. et C.A. Mey. (Mill 1982) and nested in *Lamium* genus on the base of recent phylogenetic studies (Bendiksby *et al.* 2011; Atasagun *et al.* 2015). It is aimed to evaluate the usefulness of characters of glandular trichomes for systematic purpose.

Material and methods

Plant material of *L. orientale* was collected in Amasya (on roadside between Yedikuğular Bird Paradise protected area and Ortaova village, 500 m, April 2008, İ. Öztürk Çalı 376), which is a city in the Black Sea region of Turkey. The specimens were kept as a herbarium material deposited at Gazi University Herbarium (GAZI). Flora of Turkey (Davis 1982) was used for taxonomical description.

The plant material was fixed in 70% alcohol for trichome evaluation properties. Glandular trichomes were obtained from transverse and surface sections of vegetative (stem, leaf blade, petiole) and reproductive organs (calyx, corolla) of *L. orientale*. Glandular trichomes preparations were made by hand using commercial razor

blades under a Leica ICC50 HD binocular light microscope. Sartur reagent was applied to the sections for investigation of anatomical tissues (Çelebioğlu & Baytop 1949). The types of glandular trichomes and their distribution were described and classified according to Metcalfe & Chalk (1972), Payne (1978) and Navarro & El Oualidi (2000).

Results and discussion

The great diversity of plant trichomes has interested botanists by their adaptive and taxonomic values. The morphology and distribution of glandular trichomes are often applied as taxonomic characters at subfamilial level in Lamiaceae family (El-Gazzar & Watson 1970; Abu-Asab & Cantino 1987; Cantino 1990).

There are two different types of glandular trichomes on vegetative and reproductive organs of *L. orientale* – peltate and capitate (Tab. 1).

Peltate glandular trichomes of *L. orientale* have a basal epidermal cell, a very short monocellular stalk and a broad round multicellular secretory head consisting of four cells in the single shield (Tab. 1; Fig. 1 A, B). The anticlinal wall of the stalk cell is cutinized.

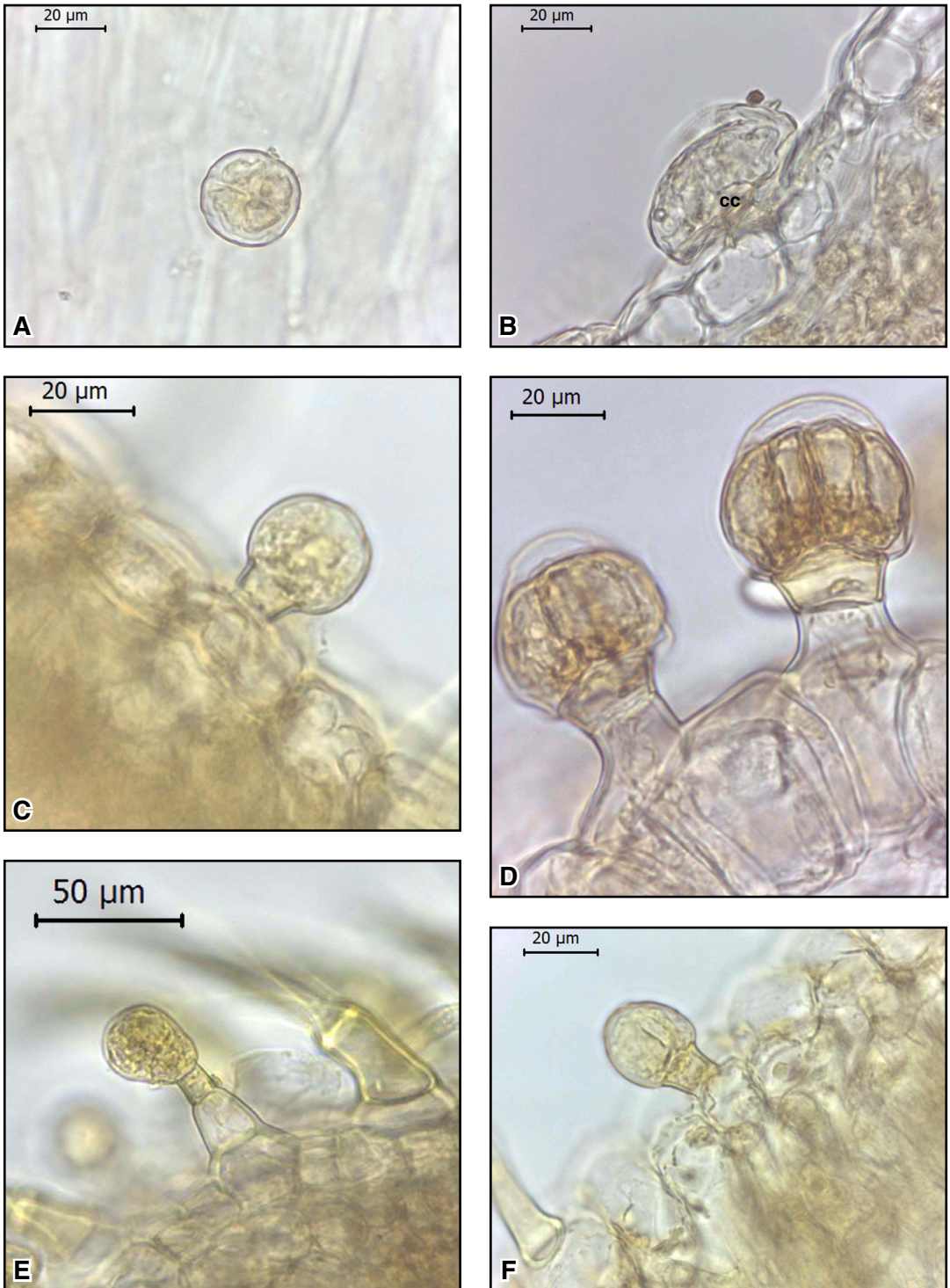


Fig. 1. Different types of glandular trichomes of *Lamium orientale*. Peltate glandular trichomes on the leaf (A, B). Capitate glandular trichomes type A on calyx (C) and corolla (D). Capitate glandular trichomes type B on corolla (E) and calyx (F). cc – center cell.

Plant organ	Capitate glandular trichomes				Peltate trichomes
	Type A		Type B		
	1 stalk cell	2 stalk cells	1 stalk cell	2 stalk cells	
Stem	+	+	-	-	++
Adaxial leaf surface	-	-	-	-	+++
Abaxial leaf surface	-	-	-	-	+++
Petiole	-	-	-	-	++
Calyx	+++	+	++	++	+
Corolla	+++	+	++	++	-

Table 2. Distribution of glandular trichomes on different organs of *Lamium orientale*. Presence of trichomes: - - absent; + - low; ++ - moderate; +++ - numerous.

Secretory materials of such trichomes together with an outer layer of the cell walls are secreted from the head into a space formed in result of elevation of their common cuticle (Özdemir & Altan 2005). Peltate trichomes of other Lamiaceae representatives usually have multicellular secretory head consisting of up to 16 cells, a monocellular stalk and a basal epidermal cell (Corsi & Bottega 1999; Hallahan 2000; Kamatou *et al.* 2006, 2007). In this study it was also found that peltate trichomes are more abundant on the vegetative organs and rare on the reproductive organs of *L. orientale* (Tab. 2), what confirms some previous findings for other species (Serrato-Valenti *et al.* 1997; Corsi & Bottega 1999).

Capitate glandular trichomes are the most common in Lamiaceae family, but they are more variable in stalk length and head shape. Presence of such trichomes is a significant taxonomic character playing also important role for pollination (Navarro & El Oualidi 2000). Such trichomes are composed of a basal epidermal cell, unicellular to multicellular stalk and a large unicellular, bicellular or multicellular secretory head. Capitate trichomes are subdivided into two types – capitate type A and capitate type B (Tab. 1). Capitate type A trichomes have unicellular, bicellular or multicellular head and stalk of one to two cells (Fig. 1 C, D). A high percentage of these trichomes have one roundish head cell. Capitate type B trichomes

have an oblong unicellular head and a short unicellular stalk. However, sometimes occur capitate glandular trichomes of type B with bicellular stalk (Fig. 1 E, F). This type of capitate trichomes was only observed on calyx and corolla (Tab. 2).

Presence of glandular trichomes, especially on the flowers of *L. orientale* is noteworthy. Such trichomes on reproductive organs of some Lamiaceae (*e.g.*, *Salvia* L.) have also been reported by Werker *et al.* (1985a, 1985b), but only a small number of Lamiaceae species has been already studied.

Conclusions

Features of glandular trichomes are useful tool for distinguishing species in *Lamium* genus. Presence of capitate type A, capitate type B, and peltate glandular trichomes on reproductive organs of *L. orientale* can be used for further taxonomic investigations in *Lamium*.

References

- Abu-Asab M.S., Cantino P.D. 1987. Phylogenetic implications of leaf anatomy in subtribe Melittidinae (Labiatae) and related taxa. *J. Arnold Arbor.* **68**: 1–34.
- Amelunxen F., Wahlig T., Arbeiter H. 1969. Über den Nachweis des atherischen Öls in isolierten Drüsenhaaren und Drüsenschuppen von *Mentha piperita* L. *Z. Pflanzenphysiol.* **61**: 68–72.

- Antunes T., Sevinate-Pinto I. 1991.** Glandular trichomes of *Teucrium scorodonia* L. morphology and histochemistry. *Flora* **185**: 65–70.
- Atasagun B., Aksoy A., Martin E. 2015.** Contribution to the systematic knowledge of *Lamium multifidum* and *L. orientale* (Lamiaceae). *Phytotaxa* **203**: 147–158.
- Başer K.H.C. 1993.** Essential oils of Anatolian Lamiaceae: A profile. *Acta Hortic.* **333**: 217–238.
- Bendiksby M., Brysting A.K., Thorbek L., Gussarova G., Ryding O. 2011.** Molecular phylogeny and taxonomy of the genus *Lamium* L. (Lamiaceae): Disentangling origins of presumed allotetraploids. *Taxon* **60**: 986–1000.
- Cantino P.D. 1990.** The phylogenetic significance of stomata and trichomes in Labiatae and Verbenaceae. *J. Arnold Arbor.* **71**: 323–370.
- Çelebioğlu S., Baytop T. 1949.** A new reagent for microscopical investigation of plant. *Publication of the Institute of Pharmacognosy* **10**: 300–301.
- Corsi G., Bottega S. 1999.** Glandular hairs of *Salvia officinalis*: New data on morphology, localization and histochemistry in relation to function. *Ann. Bot.* **84**: 657–664.
- Davis P.H. 1982.** Flora of Turkey and the East Aegean Islands. Vol. 7: 349–381. Edinburgh Univ. Press, Edinburgh.
- Duarte M.R., Lopes J.F. 2007.** Stem and leaf anatomy of *Plectranthus neochilus* Schltr., Lamiaceae. *Braz. J. Pharmacog.* **17** (4): 549–556.
- Dudai N., Werker E., Putievsky E., Ravid U., Palevitch D., Halevy A.H. 1988.** Glandular hairs and essential oils in the leaves and flowers of *Majorana syriaca*. *Israel J. Bot.* **37**: 11–18.
- El-Gazzar A., Watson L. 1970.** A taxonomic study of Labiatae and related genera. *New Phytol.* **69**: 451–486.
- Hallahan D.L. 2000.** Monoterpenoid biosynthesis in glandular trichomes of Labiatae plants. In: Hallahan D.L., Gray J.C. (eds), *Advances in botanical research: Plant trichomes*. Academic Press.
- Hanlidou E., Kokkini S., Bosabalidis A.M., Bessiere M. 1991.** Glandular trichomes and essential oil constituents of *Calamintha menthifolia* (Lamiaceae). *Plant Syst. Evol.* **177** (1–2): 17–26.
- Heinrich G., Schultze W., Pfab I., Boettger M. 1983.** The site of essential oil biosynthesis in *Poncirus trifoliata* and *Monarda fistulosa*. *Physiol. Veg.* **21**: 257–268.
- Kamatou G.P.P., Van Zyl R.L., Van Vuuren S.F., Viljoen A.M., Figueiredo A.C., Barroso J.G., Pedro L.G., Tilney P.M. 2006.** Chemical composition, leaf trichome types and biological activities of the essential oils of four related *Salvia* species indigenous to southern Africa. *J. Essent. Oil Res.* **18**: 72–79.
- Kamatou G.P.P., Viljoen A.M., Figueiredo A.C., Tilney P.M., Van Zyl R.L., Barroso J.G., Pedro L.G., Van Vuuren S.F. 2007.** Trichomes, essential oil composition and biological activities of *Salvia albicaulis* Benth. and *S. dolomitica* Codd, two species from the Cape region of South Africa. *S. Afr. J. Bot.* **73**: 102–108.
- Metcalfe C.R., Chalk L. 1972.** Anatomy of the dicotyledons. Vol. II. Oxford University Press, London.
- Mill R.R. 1982.** *Wiedemannia* Fisch. & Mey. In: Davis P.H. (eds), *Flora of Turkey and the East Aegean Islands*. Vol. 7: 148–149. Edinburgh Univ. Press, Edinburgh.
- Navarro T., El Oualidi J. 2000.** Trichome morphology in *Teucrium* L. (Labiatae), a taxonomic review. *An. Jard. Bot. Madrid.* **57**: 277–297.
- Özdemir C., Altan Y. 2005.** Morphological and anatomical investigations on endemic *Scutellaria orientalis* L. subsp. *bicolor* (Hochst.) Edmond and subsp. *santolinoides* (Hauskn ex Bornm). *Pak. J. Bot.* **37** (2): 213–226.
- Payne W.W. 1978.** A glossary of plant hair terminology. *Brittonia* **30**: 239–255.
- Serrato-Valenti G., Bisio A., Cornara L., Ciarallo G. 1997.** Structural and histochemical investigation of the glandular trichomes of *Salvia aurea* L. leaves and chemical analysis of the essential oil. *Ann. Bot.* **79**: 329–336.
- Vrachnakis T. 2003.** Trichomes of *Origanum dictamnus* L. (Labiatae). *Phyton* **43** (1): 109–133.
- Werker E., Putievsky E., Ravid U. 1985a.** The essential oils and glandular hairs in different chemotypes of *Origanum vulgare* L. *Ann. Bot.* **55**: 793–801.
- Werker E., Ravid U., Putievsky E. 1985b.** Structure of glandular hairs and identification of the main components of their secreted material in some species of the Labiatae. *Israel J. Bot.* **34**: 31–45.
- Werker E. 2006.** Function of essential oil-secreting glandular hairs in aromatic plants of Lamiaceae: A review. *Flavour Frag. J.* **8** (5): 249–255.