6 HWID is greater than 10.5 microns 8
7 Hair is approximately divided into thirds by the bands ... *Pipistrellus subflavus*
7 Proximal one-half to three-fourths of the hair is dark .... *Lasionycteris noctivagans*
8 HWID is greater than 12.5 microns ... *Lasiurus cinereus*
8 HWID is less than or equal to 12.5 microns .... *Lasiurus borealis*
9 HWID is less than 11.5 microns 10
9 HWID is greater than or equal to 11.5 microns 11
10 Hair is darkly pigmented along its entire length ..... *Eptesicus fuscus*
10 Distal one-third of hair is lightly pigmented .... *Myotis leibii*
11 Base is slightly darker than tip, hair almost uniform in color .....*Myotis austroriparius*
11 Base is distinctly darker than tip..... *Myotis keeni, Myotis sodalis, Nycticeius humeralis*

Muridae

1 HWID greater than 85.0 microns 2
1 HWID less than or equal to 85.0 microns 5
2 MHRAT less than 0.60..... *Ondatra zibethicus*
2 MHRAT greater than or equal to 0.60 3
3 HWID less than or equal to 115.0 microns ..... *Sigmodon hispidus*
3 HWID greater than 115.0 microns 4
4 MWID greater than 103.0 microns .... *Rattus norvegicus*
4 MWID less than or equal to 103.0 microns ..... *Rattus rattus*
5 HWID less than or equal to 55.0 microns; if not, MWID less than or equal to 42.0 microns 6
5 HWID greater than 55.0 microns; if not, MWID greater than 42.0 microns.....15
6 HWID less than 37.0 microns; if not, MWID less than 28.5 microns.....7
6 HWID greater than or equal to 37.0 microns; if not, MWID greater than or equal to 28.5 microns 11
7 MHRAT greater than 0.80.....8
7 MHRAT less than or equal to 0.80 9
8 MHRAT less than 0.85..... *Microtus chrotorrhinus*
8 MHRAT greater than or equal to 0.85 ... *Mus musculus*
9 Hairs never with reddish-brown pigment granules, pigment granules black or dark brown 10
9 Hairs with at least some reddish-brown pigment granules ..... *Ochrotomys nuttali*
10 MHRAT less than or equal to 0.70 ... *Reithrodontomys humulis*
10 MHRAT greater than 0.70..... *Peromyscus maniculatus, Peromyscus leucopus*
11 HWID less than or equal to 48.0 microns.....12
11 HWID greater than 48.0 microns 14
12 Distal edge of cuticular scales within shield crenate 13
12 Distal edge of cuticular scales within shield smooth ..... *Reithrodontomys fulvescens*
13 MHRAT less than 0.65..... *Microtus pennsylvanicus*
13 MHRAT greater than or equal to 0.65 ..... *Peromyscus gossypinus*
14 Cortex darkly pigmented in distal region of shield, medulla pattern difficult to determine, length less than 11 mm ..... *Reithrodontomys fulvescens*
14 Cortex lightly pigmented in distal region of shield, medulla pattern easily determined, length greater than 11 mm ..... *Neotoma floridana*
15 Smaller guard hairs having light area in shield region .... *Microtus ochrogaster*
15 Smaller guard hairs, if present, having no light area in shield region 16
16 MHRAT less than 0.82 ..... *Clethrionomys gapperi*
16 MHRAT greater than or equal to 0.82 17
17 Cortex lightly pigmented in distal region of shield, hair reddish-brown in color ..... *Microtus pinetorum*
17 Cortex darkly pigmented in distal region of shield, hair primarily dark brown in color.....18
18 Distal margin of cuticular scales within shield crenate to rippled ..... *Oryzomys palustris*
18 Distal margin of cuticular scales within shield smooth .... *Synaptomys cooperi*

Acknowledgments

The authors wish to thank Naomi Roberts and Lewis Coons for their help in making the electron micrographs, and Farrokh Tabatabai for his help in testing the keys. We also wish to thank Michael L. Kennedy and Terry L. Yates for critically reviewing an earlier version of the manuscript, and Rayann Robino for proofreading the final manuscript.

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Journal of the Tennessee Academy of Science
Volume 58, Numbers 3 & 4, July - October, 1983

CUTICULAR DIFFERENTIATION IN *LAMIUM AMPLEXICAULE* L. AND *LAMIUM PURPUREUM* L.

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Abstract

Two species of *Lamium* (Labiatae) were studied for their leaf cuticular features to determine if these cuticular features could be used for taxonomic purposes in the genus. Stomatal frequency, length of smallest stoma on both the adaxial and abaxial surfaces, epidermal wall undulations

on the adaxial surfaces, and lengths of the longest and shortest trichomes on the abaxial surface were found to be reliable features for the identification of two species *Lamium amplexicaule* and *Lamium purpureum* of Labiatae. Trichome type and subsidiary cell complex were found to be reliable at the generic level.

INTRODUCTION

Lamium amplexicaule and *Lamium purpureum* are commonly found, low growing herbaceous plants of the eastern United States. They are found growing in a wide variety of habitats beginning early spring and can be seen in bloom fairly late in autumn in many parts. In some respects they represent some morphological similarities although a close examination of their morphological features reveals significant differences.

Sinclair and Sharma (1971) point out that cuticular characters, if properly interpreted, are being considered as important taxonomic tools and have so long been used in the taxonomic and phylogenetic interpretations. Recent studies by Dunn, Sharma, and Campbell (1965), Stace (1965), and Stebbins and Khush (1961) stress the significance of cuticular characters for taxonomic interpretations.

An investigation was, therefore, undertaken to ascertain the usefulness of leaf cuticular features for the taxonomy of *Lamium amplexicaule* and *L. purpureum.*

MATERIALS AND METHODS

Five plants of each of the two species of *Lamium* were randomly selected from a single site representing uniform habitat in close proximity to an abandoned field in northwest Tennessee. Five mature leaves from the lower portions of five plants were sampled for each species for cuticular studies. These leaves were washed with distilled water, and then dried. Duco cement was used to prepare epidermal imprints of the abaxial and adaxial leaf surfaces as described by Williams (1973). A small section from the central portion of these imprints was used to make slides for microscopic examination. Stomatal frequency, stomatal size, trichome density and trichome length, and subsidiary cell complex were studied from the slides of these imprints by selecting randomly 15 fields from each microscopic slide and using a 20x objective and 10x oculars.

RESULTS AND DISCUSSION

Data on the cuticular features of the two species of *Lamium* were analyzed (Table 1). Stomatal frequency values were higher on the lower leaf surface than on the upper surface in *Lamium purpureum* while the differences were insignificant in *Lamium amplexicaule.* Stomatal frequency was found to be significantly higher on the upper leaf surface of *Lamium amplexicaule* than on the upper surface of *Lamium purpureum.* Size of the largest stoma was larger on the upper than on the lower surface of *Lamium amplexicaule,* while the difference was insignificant in *Lamium purpureum.* In addition, size differences between the two species were not significant. However, for the smallest stoma, the size was larger in *Lamium purpureum* than in *Lamium amplexicaule* for both the upper and lower surfaces. While comparing the size of the smallest stoma between the upper and lower surfaces for the two species, no significant difference was discerned.

TABLE 1: *Statistical analysis of the cuticular features* of* Lamium amplexicaule *and* Lamium purpureum.

Trait	Lamium amplexicaule		Lamium purpureum	
	U	L	U	L
Stomatal frequency ($\bar{x} \pm \delta$)	13.2 ± 2.8	9.9 ± 2.5	5.1 ± 2.7	21.6 ± 6.3
Largest stoma (μm)	32.8 ± 4.6	20.8 ± 4.6	33.6 ± 4.4	26.8 ± 4.7
Smallest stoma (μm)	13.4 ± 4.1	12.8 ± 2.9	26.5 ± 4.7	19.2 ± 3.1
Epidermal wall undulations (number)	6.5 ± 1.2	5.9 ± 1.7	3.8 ± 0.6	8.2 ± 1.7
Trichome density per cm^2	516.7 ± 284.0	631.6 ± 202.7	470.7 ± 121.4	735.2 ± 439.1
Trichome length (μm) ($\bar{x} \pm \delta$)				
longest	421.1 ± 50.5	167.0 ± 54.4	519.3 ± 98.6	358.1 ± 85.8
shortest	298.2 ± 33.1	104.0 ± 42.0	298.8 ± 36.1	218.2 ± 45.1
Trichome type	unicellular	unicellular	unicellular	unicellular
Subsidiary cell complex (cells)	2-3	2-3	2-3	2-3

* The values represent means of 15 measurements ± standard deviation

**Mean stomatal frequency = stomata of the leaf surface observed through a 20x objective and 10x oculars (field area = 0.581 mm^2).

U = upper surface

L = lower surface

Epidermal wall undulations were found to be more on the upper leaf surface of *Lamium amplexicaule* than on the upper surface of *Lamium purpureum.* However, differences on the lower surfaces of the two taxa were not significant. *Lamium purpureum* had more undulations on the lower than on upper surface while no significant difference was observed in *Lamium amplexicaule.*

Trichome density values were not significantly different between the two species of *Lamium* and hence cannot be used for taxonomic purposes in this case.

Trichome length values for the longest and the shortest trichomes on the lower surface were higher in *Lamium purpureum* than in *Lamium amplexicaule* while comparative measurements for the upper surface were not significantly different in the two species of *Lamium.* Trichomes were found to be unicellular in both species.

Subsidiary cell complex consisting of two or rarely three cells flanking the stoma at right angles with the long axis of the guard cells remained the same in both species of *Lamium.*

It seems appropriate to suggest from the above data that some cuticular features of the two species of *Lamium* can be used for taxonomic purposes. Stomatal frequency on the upper surface of leaf is higher in *Lamium amplexicaule* than in *Lamium purpureum,* while the reverse in true for the lower surface. Length of the smallest stoma on both the upper and lower surfaces is greater in *Lamium purpureum* than in *Lamium amplexicaule.* There are more epidermal wall undulations on the upper surface of *Lamium amplexicaule* than in *Lamium purpureum.* Lengths of the longest and the shortest trichomes on the lower surface are higher in *Lamium purpureum* than in *Lamium amplexicaule.* Since the trichome type and subsidiary cell complex remained the same in both species of *Lamium,* these seem to be reliable characters for *Lamium* at generic level, but are of little significance for species differentiation. Additional studies are underway to determine whether cuticular features can be used for the identification of other taxa within Labiatae.