

## Research Paper

# Structural variations of cypselas of some taxa of the tribe Calenduleae (Asteraceae), on the basis of morphological observation

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## Abstract

Present observation has been carried out on the detailed morphological characters of mature cypselas in 3 species (*Calendula arvensis* L., *Calendula maderensis* Dc. and *Osteospermum vaillantii* (Decne.) Norl.), with the help of light microscope. In cypselas of *Osteospermum vaillantii* and *Calendula maderensis*, laterally expanded wings are present whereas in *Calendula arvensis*, wing is absent. In *Calendula arvensis*, surface is provided with spine like structure. In remaining studied species, this structure is absent. In all the studied cypselas, at the upper part, beak like structures are present. In *Calendula maderensis*, among the disk cypselas, beak like structure is absent. In *Osteospermum vaillantii*, carpodium is triangular in shape whereas in *Calendula maderensis* and *Calendula arvensis*, carpodia are symmetric and complete ring like. However, in all the studied species, carpodial cells are not quite distinct from the cells of the cypselar wall. An artificial key is made for the easy identification of studied taxa on the basis of morphological characters.

**Keywords:** Cypselar morphology, Calenduleae, Asteraceae.

## Introduction

Calenduleae is the most complex and heteromorphic tribe in Asteraceae, by Mukherjee and Sarkar<sup>[1]</sup>. Calenduleae was first reported by Cassini<sup>[2]</sup> as a natural group. It is currently comprises of 12 genera and about 120 species, by Jeffrey<sup>[3]</sup>. According to Norlindh<sup>[4]</sup>, this tribe is fairly well understood at the species level. In most of the earlier studies, little attention has been taken on the morphological structures of the cypselas, by Jana and Mukherjee<sup>[5]</sup> and Lude<sup>[6]</sup>. According to Nordenstam<sup>[7]</sup>, Calenduleae is the most complex tribe in the Asteraceae, on the basis of morphological observation. Generally, in this tribe, cypselas are homomorphic-polymorphic, terete, triquetrous or flattened, winged or wingless, straight or curved, glabrous or pubescent. In this tribe, pappus is absent. The present study deals with the details morphological features of mature cypselas of three taxa of the tribe Calenduleae, with the help of light microscope, stereomicroscope and Scanning electron microscope.

## Materials and Methods

Three species of the tribe Calenduleae, were studied for cypselas characters under stereomicroscope (OLYMPUS), compound light microscope (Metzer) and Scanning electron microscope (Model No: SM 1500, manufactured by: H M R C, Howrah, India). The studied species and their sources are given in the Table 1.

**Table 1: Studied species and their sources**

Studied species	Sources
1. <i>Calendula arvensis</i> L.	Botanic Garden of the University of Copenhagen, Denmark. (DK). E2822-0001* AG
2. <i>Calendula maderensis</i> Dc.	Botanic Garden of the University of Copenhagen, Denmark. (DK). E2822-0015*A G
3. <i>Osteospermum vaillantii</i> (Decne.) Norl.	Botanischer Garten der Universität Zurich, Switzerland. ( Z ). XXOMJG 19- 46840

The following characters were studied under microscope.

**Cypselas:** Shape, colour, size, surface with lateral wings, spine like outgrowth, Stylopodium.

**Beak:** Length.

**Corpopodium:** Shape, position, diameter of carpopodium.

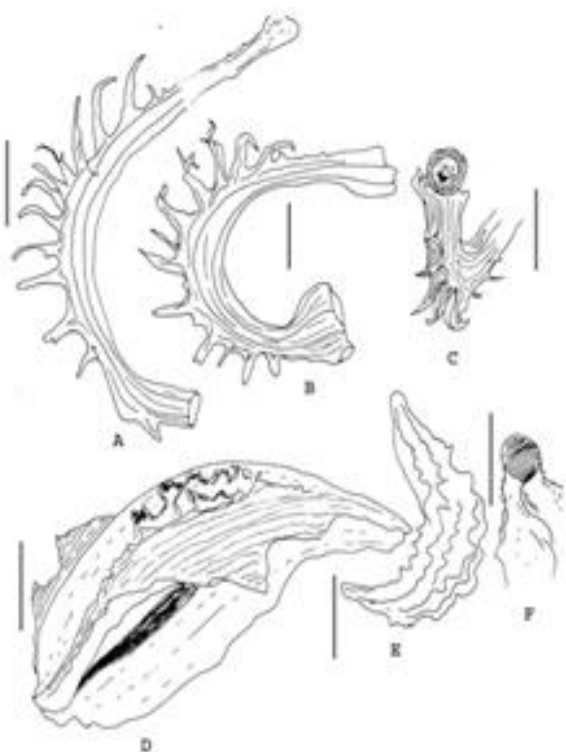
## Results and Discussion

Morphological observations are given in Table 2.

**Table 2: Morphological observations**

Morphological features	<i>Calendula arvensis</i> Figure 1 A-C, Fig 3 A-E	<i>Calendula madrensis</i> Figure 1 D-F, 4 A-D	<i>Osteospermum vaillantii</i> Figure 2 A-D, 4 E-F
Homomorphism/ Heteromorphism	Cypselas heteromorphic.	Cypselas heteromorphic.	Cypselas heteromorphic.
Size	Ray cypselas 13 mm x 1.5 mm including beak, 9 mm x 1.5 mm excluding beak whereas disk cypselas 4 mm x 1.05 mm including beak, 3.05 mm x 1.05 mm excluding beak.	Ray cypselas, 13 mm x 5 mm including beak, 10 mm x 5 mm excluding beak whereas disk cypselas 6 mm x 1.05 mm in size.	Ray cypselas 8 mm x 1.5 mm whereas disk cypselas 6 mm x 1.5 mm in length.
Shape	Linear	Ovate	Oblanceolate
Beak/ Without beak	At the upper part of cypselas, prominent beak present, 4 mm in length.	Prominent beak present in ray cypselas whereas in disk cypselas, beak absent.	Beak absent
Wing/ Without wing	In the surface of cypselas, wing like structure absent.	In the surface of cypselas, lateral wing present.	In the surface of cypselas, lateral wing present.
Colour	Ray cypselas light brown in colour whereas disk cypselas pale yellow in colour.	Ray cypselas white yellow in colour whereas disk cypselas yellow brown in colour.	Both ray and disk cypselas, black brown in colour.
Surface	With in the surface, spine like structure present, otherwise the	In ray cypselas, surface is rough and hairy whereas in disk cypselas,	Rough in texture in both cypselas.

	surface smooth in texture.	surface rough in texture.	
Stylopodium	Absent.	Absent.	Absent.
Carpopodium	Basal in position, complete ring like. carpopodial cells not quite distinct from the cells of the cypselar wall.	Basal in position, complete ring like. carpopodial cells not quite distinct from the cells of the cypselar wall.	Basal in position, triangular, carpopodial cells not quite distinct from the cells of the cypselar wall.



**Figure 1: Morphology of cypselas**

**A-C *Calendula arvensis***

**A- Ray cypsel**

**B- Disk cypsel**

**C- Basal part of cypsel, showing carpopodium**

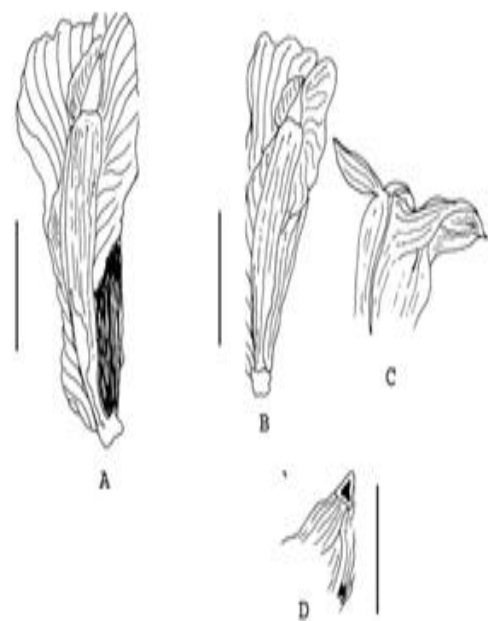
**D-F *Calendula madrensis***

**D- Ray cypsel**

**E- Disk cypsel**

**F- Basal part of cypsel, showing carpopodium**

**Bar—1mm**



**Figure 2: Morphology of cypselas**

**A-D *Osteospermum vaillantii***

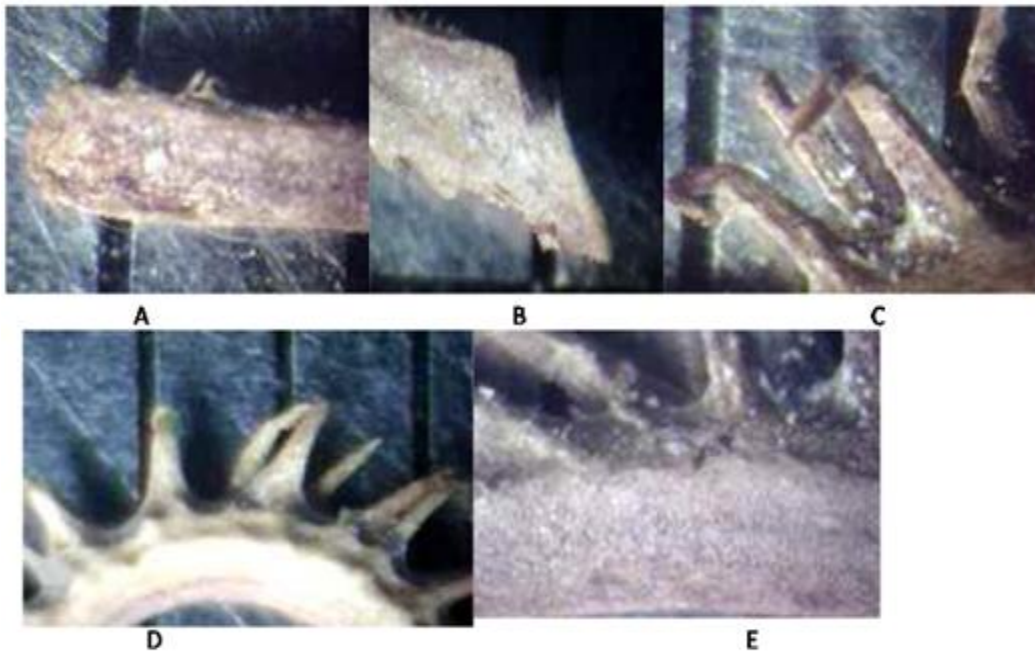
**A- Ray cypsel**

**B-Disk cypsel**

**C-Upper part of ray cypsel**

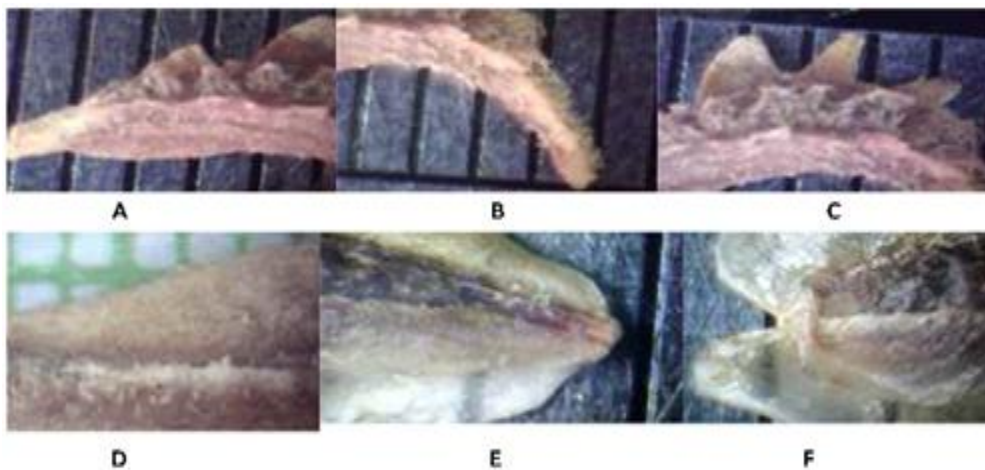
**D- Basal part of cypsel, showing carpopodium**

**Bar— 1 mm**



**Figure 3: Camera photographs of different parts of cypsela**

**A-C- *Calendula arvensis* ( Ray cypsela): A-Upper part of cypsela, B-Basal part of cypsela, C-Surface of cypsela, showing spine like structure, D-F- *Calendula arvensis*( Disk cypsela): D-Middle part of cypsela, E- Middle part of cypsela, showing surface**



**Figure 4: Camera photographs of different parts of cypselas**

**A-C- *Calendula madrensis*( Disk cypsela ): A- Upper part of cypsela, B-Lower part of cypsela, C- Middle part of cypsela, showing surface structure, D- Middle part of *Calendula madrensis* ( Ray cypsela), showing surface structure, E-F- *Osteospermum vaillantii*( Disk cypsela ): E- Lower part of cypsela, F- Upper part of cypsela.**

Morphological variations of cypselas of 3 species of the tribe Calenduleae have been studied. All the studied species are strongly heteromorphic. According to Mukherjee and Sarkar<sup>[8]</sup>, Calenduleae are the most complex and heteromorphic tribe. So our observations are correct. Beak is found in only ray cypselas of *Calendula madrensis* and both ray and disk cypselas of *Calendula arvensis*. Presence of beak is an important morphological character, with the help of this character, we can distinguish among the taxa, by simple morphological study. Beak is also present in some species (*Crepis alpine*, *Crepis foetida* etc) of the tribe Lactuceae, by Jana and Mukherjee<sup>[9]</sup>. Except in *Calendula arvensis*, in other two studied species, lateral wings are present. Lateral wing plays an important role in the dispersal of cypselas. Stylopodia are absent in all the studied species. In *Calendula arvensis*, the structure of the surface tubercles are very important as they are smooth with blunt apex in disk cypselas but pointed apex in ray cypselas. In *Calendula arvensis* and *Calendula madrensis*, carpopodia are basal in position, symmetric and complete ring like whereas in *Osteospermum vaillantii*, carpopodium is basal in position, triangular in shape. However, anatomically the carpopodial cells are not quite distinct from the cells of the cypselar wall. Haque and Godward<sup>[10]</sup>, have reported the presence of carpopodium in *Calendula officinalis* by SEM which have slightly thickened walls in a complete ring of cells.

## Conclusion

With the help of above study, we can clearly separate the studied species from each other.

## Key to the studied species

1a. Cypselas heteromorphic, linear-ovate, presence or absence of wing like structure from the surface, presence or absence of spine like structure in the surface, colour varies from light brown to yellow brown, white yellow to pale yellow, carpopodia basal in position, symmetric, complete ring like.....(2)

2a. Cypselas heteromorphic, linear, wing like structure absent, ray cypselas light brown in colour whereas disk cypselas pale yellow in colour..... ***Calendula arvensis***

2b. Cypselas heteromorphic, ovate, wing like structure present, ray cypselas white yellow in colour whereas disk cypselas yellow brown in colour..... ***Calendula madrensis***

1b. Cypselas heteromorphic, Oblanceolate, black brown in colour, carpopodium symmetric, triangular..... ***Osteospermum vaillantii***

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