Journal for Research in Applied Sciences and Biotechnology

www.jrasb.com

ISSN: 2583-4053

Volume-2 Issue-6 || December 2023 || PP. 43-48

https://doi.org/10.55544/jrasb.2.6.8

Morphological Variation in Achenes in Certain Species Belonging to the Tribe Cardueae (Asteraceae) in Iraq

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www.jrasb.com || Vol. 2 No. 6 (2023): December Issue

Received: 03-12-2023	**Revised:** 05-12-2023	**Accepted:** 07-12-2023

ABSTRACT

This study investigated the morphological attributes of achenes among nine species within the Cardueae tribe of the Asteraceae family in Iraq. The specimen collection occurred between March 2021 and July 2022. Dissecting microscopy was used to document twelve morphological characteristics. Among the traits that were evaluated, it was found that achene size, symmetry, hilum location, the achene apex, and the existence or lack of the pappus were crucial diagnostic markers for identifying the species. The results demonstrate the significance of several achene traits, including color, size, and hilum, in recognizing and separating the studied species. Furthermore, the shape of the achene assisted in distinguishing *Notobasis syriaca* from the different species under investigation. The prognosis of the species was significantly influenced by the color and the outer and inner pappus lengths. The achene apex shape was crucial in dividing the studied species into two groups: denticulate and entire.

Keywords- Achenes, Pappus, Cardueae, Asteraceae, Iraq.

Key Findings: Findings show the morphological traits of the achene under investigation are very valuable in both a general and particular sense. Moreover, these properties serve as distinctive traits for the species under study when seen in combination with other morphological features, including form, pappus density, and color.

I. INTRODUCTION

The Cardueae tribe, belonging to the Asteraceae family, is made up of over 2300 species and 70 genera. These species are distributed across Europe, Asia, Australia, North and South America, and East and North Africa [1] [2]. The Cardueae tribe encompasses over 109 species, which accounts for approximately 3% of Turkey's flora diversity [3]. Within the Egyptian flora, the Cardueae tribe comprises approximately 91 taxa within the Asteraceae family [4]. The Cardueae tribe is a monophyletic group, and the species within this tribe, which belongs to the Asteraceae family, are commonly referred to as thistles [5].

The Cardueae, as described by Bentham, represent the largest tribe within the Asteraceae family in the ancient North Temperate zone [6]. Differences in the recognition of plant families can be attributed to variations in the morphology of seeds and fruits. In contrast to numerous vegetative and floral features, the phenotypic characteristics of the coats of seeds and fruits exhibit relatively limited variation and are less susceptible to environmental influences [7]. The achenes of the Asteraceae family hold significant taxonomic

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 43-48
https://doi.org/10.55544/jrasb.2.6.8

value in the classification and differentiation of numerous taxa, ranging from tribes to species. This is mostly attributed to their wide range of variation in terms of shape, size, pappus lengths, rib patterns, surface appearances, and other distinguishing traits [8]. [9]. The differentiation of genera within the Cardueae tribe has been shown to be most accurately achieved by the identification of achene features [10]. The Cardueae tribe can be effectively classified into four subtribes based on the distinctive features of their achenes. These traits allow for the differentiation of the Carlininae and Echinopsinae subtribes out of the closely associated Carduinea and Centaureinea subtribes [11]. In his seminal work, Dittrich (1970) made a notable distinction among the Cardueae taxa by examining the distinguishing features of the pappus and the apex region of the achene [10]. The achenes of the Cardueae tribe often lack hair or other surface structures and are accompanied by a noticeable pappus that may resemble scales or bristles, which is connected to the pericarpic wall [12]. There are around thirteen genera in the Cardueae tribe of Iraq [13]. The main aim of this study is to identify the morphological features of nine different species belonging to Cardueae tribe, notably those located in the northern and central regions of Iraq. Furthermore, its purpose is to function as a taxonomic tool for the utilization of taxonomists and other scholars specializing in botany. The current investigation enhances prior research conducted on various species belonging to the Cardueae tribe of Asteraceae. It achieves this by employing achene characteristics as diagnostic indicators to differentiate between taxa and address significant taxonomic challenges, particularly at the levels of genus and species.

II. MATERIALS AND METHODS

Achene of nine species from the tribe Cardueae were collected during fieldwork excursions in different regions of middle and northern Iraq. just as seen in Table 1. The period of time for collecting specimens was 2021–2022. After that, achenes were inspected using an Olympus dissecting microscope, and pictures were taken for each species. 20–25 achene specimens were examined. All of the samples were photographed using the built-in camera of the dissecting microscope. Furthermore, specimen photos are taken with Camera Lucida. The categorization of the features of achene in the species under study was conducted based on twelve criteria. The chosen features encompassed Achene dimensions such as length, width, shape, and color. Additionally, hilum color and dimension, as well as the achene apex size, color, and shape margin, were considered. Lastly, the color and both the inside and outside length of the pappus were also taken into account. Each plant specimen that was collected is accompanied by a label including essential information such as the scientific name, place, date of collection, type of soil, altitude, and any other pertinent characteristics. Several publications have been used in classifying plant specimens under study [3], [13], [14], and [15].

Table 1: The species and locations that are under study.

Taxa	Location	Elevation (m)
Silybum marianum L.	Kirkuk, Tikrit, Beji, Senyia,	108-150
Notobasis syriaca L.	Al-Rashad, Erbil, Hamrin,	102-204
Carthamus lanatus L.	Bekhal, Shaqlawa	397
Carthamus persicus Willd.	Al-Sharqat, Makhmour	394
Carthamus curdicus Hanelt	Alton-Kupri, Kirkuk, Shaqlawa	347-400
Carthamus tinctorius L.	Samara, Abo-Gharib, Al-Ameria	39-109
Carthamus oxyacantha M.Bieb.	Kirkuk, Senyia, Beji, Al-Alam	110-151
Carduus pyconocephalus L.	Hamrin, Beji, Erbil	110-1089
Carduus getulus Pomel.	Al-Sharqat, Tikrit, Al-Alam	108-153

III. RESULTS AND DISCUSSION

Results were shown in Tables 2 and 3 and Figures 1 and 2 for the quantitative and qualitative characteristics of the achenes of the species under study. Twelve characteristics were taken into consideration while characterizing and determining the differences between the nine species that were studied. Using the achene features to tell the difference between taxa and solving different taxonomic problems, mainly at the generic and specific levels, for a number of species in the Asteraceae tribe Cardueae [16] [17] [18].

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www.jrasb.com

ISSN: 2583-4053

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https://doi.org/10.55544/jrasb.2.6.8

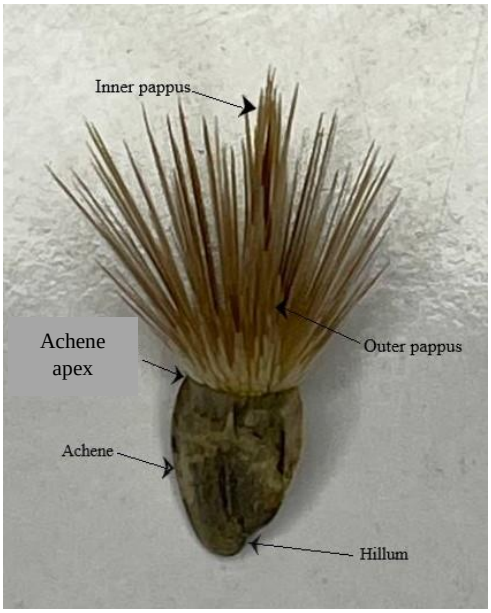

Figure 1: Illustrates a selection of the evaluated attributes of the achene.

Nine species of achenes from the Cardueae tribe were studied and looked into. The achene shape, indumentum, colors, presence or absence of beaks, hilum position, and pappus traits were all very different. These characteristics are listed below, in addition to their significance.

The achenes of the Cardueae species under study are illustrated. Each achene of the Cypsela type contains just a single fruit base that comes into contact with the seeds. The achene shell and seed covering are distinct from each other. Out of the eight species, only *Silybum marianum* was found to have achenes that exhibited dimorphic or trimorphic, while the remaining species had achenes that were monomorphic. Interestingly, our findings concur with those of [12], [19], and [20]. The achene shapes in Silybum marianum and *Carduus getulus* were oblong; in *Carthamus lanatus*, *Carthamus tinctorius*, *Carduus pyconocephalus*, and *Carthamus persicus*, the forms of achene in *Carthamus curdicus* and *Carthamus oxyacantha* were oblong; but the species *Notobasis syriaca* was distinguished by an ellipsoid shape (Table 1 and Fig. 2); these results are agreed with [21]. The achene morphology is more relevant at the species level and has significant taxonomic significance at the tribe level [19]. The achene length was between 4.2 and 6.6 mm on average. Among the species, *Carthamus oxyacantha* had the shortest average length of 4.2 mm, while *Carthamus curdicus* had the longest average length of about 5.7 mm. The other species had varying average lengths. Similarly, the achene width ranged between 1.7 and 4.4 mm on average. *Carduus pyconocephalus* was the smallest achene, evaluating 1.7 mm, whereas *Carthamus persicus* was the widest, observing 4.4 mm. The other species studied had varying average widths. Carthamus tinctorius displayed the largest achene size, whereas *Carduus pyconocephalus* demonstrated the smallest.

Table 2: presents the morphological characteristics of the achene in different species of the Cardueae tribe. (The measurements are given in millimeters).

Taxa	Achene				Helium	
	Length	Width	Color	Shape	Length	Color
Silybum marianum	5.2 ± 1.8	2.5 ± 1.0	Brown	Oblong	0.7 ± 0.3	Black
Notobasis syriaca	5.1 ± 1.3	3.3 ± 1.5	Brown	Ellipsoid	0.4 ± 0.1	Dark brown
Carthamus lanatus	4.3 ± 0.9	3.8 ± 0.8	Creamy	Ovoid-Oblong	0.9 ± 0.5	Black
Carthamus persicus	5.6 ± 1.3	4.4 ± 1.2	Pale creamy	Ovoid-oblong	0.8 ± 0.4	Creamy
Carthamus curdicus	5.7 ± 1.4	3.9 ± 1.2	Dark brown	Ovoid	1.6 ± 0.7	brown
Carthamus tinctorius	6 ± 1.5	4 ± 0.9	Greyish brown	Ovoid-Oblong	1.3 ± 0.6	Grayish
Carthamus oxyacantha	4.2 ± 1.1	3.5 ± 1.0	creamy with Dark brown stripes	Ovoid	0.6 ± 0.3	Brown
Carduus pyconocephalus	4.5 ± 1.2	1.7 ± 0.7	Creamy	Ovoid-Oblong	1.2 ± 0.5	pale Brown
Carduus getulus	4.7 ± 1.3	2.6 ± 1.5	Creamy- Greyish	Oblong	1.0 ± 0.4	Creamy

The remaining species under investigation displayed a variety of sizes, ranging from medium to small (Table 1 and Fig. 2), in line with earlier research conducted on specific subsets within the Asteraceae family [22], [23], and [24].

Based on the details in Table 1 and Figure 2, it is possible to identify the *Carthamus oxyacantha* achene

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 43-48
https://doi.org/10.55544/jrasb.2.6.8

by its creamy color and dark brown stripes. Similarly, the achene of *Carduus getulus* is creamy-greyish, while *Carthamus persicus* has a pale creamy color. These characteristics distinguish them from the achene of other species, which vary in color dark brown, creamy and brown. This observation supports the claims made in the study [21] and [25].

Notobasis syriaca has the shortest hilum length and a distinctly dark brown hilum colors, distinguishing it from other species under investigation. The taxonomic significance of the hilum in species identification and classification is emphasized. The above information illustrates the taxonomic significance of the hilum and is in line with [22].

Regarding the taxonomic importance of the achene apex for identifying the species, the species being studied can be categorized into two groups: denticulate and entire. This categorization is based on the shape of the achene apex margin. The achene apex length varied between 0.11 and 0.75 mm, with an average length of 0.11 mm. while, *Carthamus oxyacantha* had the smallest achene apex, measuring 0.11 mm, while *Silybum marianum* showed the highest average length, measuring 0.75 mm. The species Silybum marianum has a yellowish achene apex, which sets it apart from the other species examined.

Table 3: Morphological attributes of Caredueae achene and pappus in various taxa (The measurements are given in millimeters).

Taxa	Achene apex			Puppus		
	Length	Shape of margin	Color	Length O. P.	Length I. P.	Color
Silybum marianum	0.75± 0.50	Denticulate	Yellowish	7.7± 2.2	12.0± 2.0	Bright white
Notobasis syriaca	0.13±0.05	Entire	Dark brown	7.0± 2.0	11.2±2.1	Yellowish white
Carthamus lanatus	0.65±0.30	Denticulate	Yellowish-dark brown	6.6± 1.0	12.7±2.3	Pale brown
Carthamus persicus	0.24±0.10	Denticulate	Brown	6.3± 1.5	11.4±2.0	Yellowish brown
Carthamus curdicus	0.46±0.10	Denticulate	Dark brown	4.5±1.0	11.0±2.0	Brown
Carthamus tinctorius	0.24±0.02	Denticulate	Greyish brown	4.0±2.0	9.6±1.9	Brown
Carthamus oxyacantha	0.11±0.01	Entire	Yellowish brown	5.5±1.0	-----	Brown
Carduus pyconocephalus	0.23±0.15	Entire	Pale brown	3.5±1.1	7.8±1.5	Yellow
Carduus getulus	0.23±0.05	Denticulate	Yellowish brown	6.5±0.9	12.0±2.2	Pale brown - white

- O. P. (Outer Puppus)
- I. P. (Inner Puppus)

These findings are consistent with previous investigations [22] and the significance of the achene apex in distinguishing and categorizing Centaurea species [26].

The morphological features of the pappus are valuable in taxonomy for establishing links among species. It has proven to be indicative of evolutionary relationships across species in the Cardueae tribe [27] and [28]. The important characteristics for distinguishing and categorizing the species under investigation were the colors and length of pappus, as well as the ability to differentiate between the lengths of the outer pappus and inner pappus. *Carthamus oxyacantha* stands out due to its distinctive feature of having a small number of pappus bristles, with only the outer pappus present. The current study looked at differences in the species that were studied in terms of whether they had an internal pappus or not, as well as differences in pappus traits that helped tell them apart. The identification of two types of achenes can be facilitated by the existence or lack of an inner pappus. This corresponds to the distinction between Achenes with an internal pappus and Achenes without one [20].

The findings indicate that the morphological characteristics of the achenes being studied have significant overall and particular advantages, as well as that their taxonomic significance is enhanced when analyzed alongside additional morphological attributes. The current identification key serves as an additional taxonomic research tool for classifying examined species and achene kinds.

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 43-48
https://doi.org/10.55544/jrasb.2.6.8

Figure 2: presents various achene shape, size, coloration, and pappus morphological: 1. *Carthamus lanatus* 2. *Silybum marianum* 3. *Notobasis syriaca* 4. *Carthamus oxyacantha* 5. *Carthamus curdicus* 6. *Carduus getulus* 7. *Carthamus persicus* 8. *Carduus pyconocephalus* 9. *Carthamus tinctorius*

IV. CONCLUSIONS

The present study examined the assessed characteristics of achenes from nine species within the tribe Cardueae. This study provides further evidence supporting the utilization of achene characteristics as reliable markers for taxonomic organization. The traits of achenes are important for characterizing the taxa studied at certain levels. However, understanding the significance of these qualities at an additional level needs additional studies. By using this work as a monograph along with other morphological traits, achene traits will become more taxonomically important, making it easier to identify species in the wild.

REFERENCES

[1] Anderberg A, Baldwin B, Bayer R, Breitwieser J, Jeffrey C, Dillon M, Eldenäs P, Funk V, Garcia-Jacas N, Hind D (2007). *Compositae: Compositae Adans., Fam. Pl. 2: 103 (1763), nom. alt. et cons. Asteraceae Martynov, Tekhno-Bot. Slovar: 55 (1820), nom. cons*. Springer.

[2] Shi Z, Raab-Straube E, von Greuter W, Martins L (2011). Cardueae. Pp. 42–194 in: Wu, Z. Y., Raven, P.H. & Hong, D. Y., eds., Flora of China Volume 20–21 (Asteraceae). Science Press (Beijing) & Missouri Botanical Garden Press (St. Louis).

[3] Davis PH (1975). flora of Turkey and the East Aegeen Island. Edinburg, Univ. press, Vol. 5: 814-841, 1975.

[4] Boulos L (2009). Flora of Egypt checklist, revised annotated edition. Al-Hadara Publishing, Cairo, 410.

[5] Bremer K, Anderberg AA (1994). Asteraceae: cladistics and classification. Timber press: Oregon. Pp113-146.

[6] Bentham G (1873a). Compositae In: G. Bentham & J. D. Hooker. Gen. Pl. 2: 163-533.

[7] ZORIĆ L, Merkulov L, LUKOVIĆ J, Boža P (2010). Comparative seed morphology of Trifolium L. species (Fabaceae). *Period. Biol.*, *112*(3), 263-272. https://hrcak.srce.hr/58277

[8] Ghimire B, Jeong MJ, Lee KM, Heo K, Lee CH, Suh GU (2016). Achene morphology of Saussurea species (Asteraceae, Cardueae) in Korea and its systematic implications. *Bot. J. Linn. Soc.*, *181*(4), 692-710. https://doi.org/10.1111/boj.12434

[9] Şirin E, Ertuğrul K, Uysal T (2017). Achene micromorphology of the genus Cyanus Mill. (Compositae) in Turkey and its taxonomic importance. *Phytotaxa*, *313*(1), 77-90. https://doi.org/10.11646/phytotaxa.313.1.5

[10] Dittrich M (1970). Morphologische and Anatomische Untersuchungen an fruchten der Carduinae (Compositae). I. Morphologischer Teil. Candollae 25: 45-67.

[11] Ozcan M, Akinci N (2019). Micromorpho-anatomical fruit characteristics and pappus features of representative Cardueae (Asteraceae) taxa: Their systematic significance. *Flora*, *256*, 16-35. https://doi.org/10.1016/j.flora.2019.04.009.

[12] Jana BK, Mukherjee SK (2012). Carpological studies of some members of the tribe Lactuceae (Asteraceae). *J. Interacad.*, *16*(2), 188-195.

[13] Ghazanfer SA, Edmondson JR, Nicolas Hind DJ (2019). Flora of Iraq Compositae. Vol. 6, Ministry of Agriculture Repuplic Iraq by Royal Botanic Garden, KEW 111-158.

ISSN: 2583-4053

Volume-2 Issue-6 || December 2023 || PP. 43-48

https://doi.org/10.55544/jrasb.2.6.8

[14] Post GE (1933). *Flora of Syria, Palestine and Sinai: a handbook of the flowering plants and ferns, native and naturalized from the Taurus to Ras Muhammad and from the Mediterranean Sea to the Syrian desert; illustrated with many drawings*. American Press.

[15] AL-Rawi A (1964). Wild plants of Iraq with their Distribution. Tech. Bull. 14, Dir., Gen. of Agr. Res. Proj. Ministry of Agriculture Government Press. pp. 323.

[16] Bona M (2014). Achene characteristics of Turkish Centaurea (Asteraceae) and their systematic application. *Bangl. J. Bot.*, *43*(2), 163-168.

[17] Behjou AM, Sonboli A, Riahi H, Osaloo SK (2016). Achene micromorphology in Tanacetum (Asteraceae-Anthemideae) and its taxonomic and phylogenetic implications. *Flora-Morphology, Distribution, Funct. Ecol. Plants*, *222*, 37-51. https://doi.org/10.1016/j.flora.2016.03.012.

[18] Candan F, Uysal T, Tugay O, Bozkurt M, ERTUĞRUL K, Demirelma H (2016). The examinations of achene ultrastructural features of section Acrolophus (Centaurea, Asteraceae) via scanning electron microscopy. *Turk. J. Bot.*, *40*(2), 147-163. https://doi.org/10.3906/bot-1503-51

[19] Jana BK, Mukherjee SK (2014). Inter-tribal variations of fruit structure among four tribes of the family Compositae. *Indian J. Appl. Pure Biol.*, *29*(2), 291-301.

[20] Shamso E, Hosni H, Ahmed D, Shaltout K (2021). Achene characteristics of some taxa of Asteraceae from the Northwestern Mediterranean coast of Egypt. *Egypt. J. Bot.*, *61*(1), 1-31. https://doi.org/10.21608/ejbo.2021.50068.1583

[21] Boj˘nanský V, Fargašová A (2007). Atlas of seeds and fruits of Central and East-European flora: the Carpathian Mountains region. Springer Science & Business Media.

[22] Shabestari ES, Attar F, Riahi H, Sheidai M (2013). Seed morphology of the Centaurea species (Asteraceae) in Iran. *Phytol. Balcan*, *19*, 209-214.

[23] Bona M (2015). Systematic implications of achene characteristics in genera Centaurea l., Cyanus mill., Psephellus cass. and Rhaponticoides vaill. (Asteraceae). *Bangl. J. Plant Taxon*, *22*(2), 125.

[24] Rakizadeh S, Attar F, Sotoodeh A (2019). Taxonomic significance of achene morphology in the genus Centaurea L. (Asteraceae). *Nova*, *3*, 1398. https://nbr.khu.ac.ir; Kharazmi University Press; DOI: 10.29252/nbr.6.3.352

[25] Hacıoğlu BT, Arslan Y, Subaşı I, Katar D, Bülbül AS, Çeter T (2012). Achene morphology of Turkish Carthamus species. *Aust J Crop Sci*, *6*(8), 1260-1264. https://search.informit.org/doi/10.3316/informit.732060416531510

[26] Adwan A, Al-Mashhadani AN, Abas R (2020). Taxonomical features of achene of some species of Centaurea L. (Asteraceae) in Middle and North Iraq. *Eur Asian J. Biosci*., *14*(2).

[27] Stille JS, Stuessy TF, Dickoré WB, Jaeger M, Gemeinholzer B, Wissemann V (2016). Comparative pappus micromorphology of edelweiss (Leontopodium, Gnaphalieae, Asteraceae) with implications for taxonomy, ecology and evolution. *Bot. J. Linn. Soc.*, *182*(3), 612-636. https://doi.org/10.1111/boj.12472

[28] Das D, Jana BK, Mukherjee SK (2018). Cypselar morphology of twenty-three species of the family Compositae. In: *Plant Syst. Biotechnol.*: Challenges and Opportunities", H. K. Chourasia and D. P. Mishra (Eds.), Today & Tomorrow's Printers and Publishers, New Delhi - 110 002, India. pp. 255-274.