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THE STUDY OF TAXONOMIC AFFINITY IN 7 SPECIES OF ASTERACEAE FAMILY BASED ON MORPHOLOGICAL CHARACTERS

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Abstract

Morphological characters are important characters in determining plant relationships. This study aims to analyze the phenetic relationship of the 7 member of Asteraceae family based on morphological characters. The study was conducted in May – July 2022. We used 7 species of Asteraceae including *Ageratum conyzoides* L., *Ageratum houstonianum* Mill, *Tithonia diversifolia* (Hemsl.) A.Gray., *Sonchus arvensis* L., *Erechtites valerianifolia* (Link ex Spreng.) DC., *Eupatorium odoratum* L., and *Tagetes erecta* L. The equipment used were cameras, plant description books, and NTSYS software for taxonomic affinity analysis were used in this study. The results of the Asteraceae dendogram analysis showed that 2 clusters were formed, the first cluster containing the species *Ageratum conyzoides* L., *Ageratum houstonianum* Mill, *Tagetes erecta* L., *Sonchus arvensis* L., and *Erechtites valerianifolia* (Link ex Spreng.) DC., while the second cluster consisted of *Tithonia diversifolia* (Hemsl.) and *Eupatorium odoratum* L. The closest similarity coefficient of 0.8 was in the genus *Ageratus* in the first cluster and *Tithonia diversifolia* (Hemsl.) and *Eupatorium odoratum* L., in the second cluster. Based on this, it can be concluded that the morphological characters that influence the clustering of 7 species Asteraceae in this study are flower type, flower color, leaf base, leaf venation, leaf margin, and leaf color.

Keywords: Asteraceae, morphology, taxonomic affinity

Introduction

The diversity of plants in Indonesia is among highest in the world [1]. There are various kinds of flowering plants that are diverse, reaching 25,000 species. One of family members of flowering plants is Asteraceae whose habitat is quite wide ranging from subpolar to tropical areas. Family Asteraceae is a family that has members of second largest species in kingdom Plantae [1]. Its appearance is mostly in form of herbs, rarely in the form of trees. *Dasyphyllum excelsum* species in Chile or *Vernonia arborea* in Malaysia have tree appearances [2]. Anatomically, Asteraceae has many laticifer cells and resin channels [3]. Pertiwi specify that members of Asteraceae family have compound flowers and various types with pollen characters dominated by tricolporate type [1]. This family is known to have flower heads formed by hundreds or thousands of tiny individual flowers, called pseudanthium.

Various benefits and uses of Asteraceae have been proven by many researchers in addition to its usefulness as an ornamental plant [4]. Susandarini's research found that Asteraceae family in Tawangmangu is widely used as medicinal plants such as *Ageratum conyziodes*, *Bidens pilosa*, *Cosmos caudatus*, *Emilia sonchifolia*, *Tithonia diversifolia*, and *Sonchus arvensis* [5]. *Lactuca sativa* as reported by Tamokou [6] has properties to inhibit microbes. Many species of Asteraceae members have been shown to have antioxidant activity [7] as evidenced in Rolnik's study which found promising antioxidant activity in extracts of *T. officinale*, *Sylibium marianum*, as well as *Artemisia absinthium* [2]. *Tagetes erecta* extract can even be used to kill *Aedes aegepty* larvae in Zulfikar's research [8]. In addition to medicinal benefits, apparently genus *Blume* in West Bengal is edible [9] and the species *Galinsoga parviflora* Cav and *Galinsoga quadriradiata* are also edible vegetables in the Wonosobo area, Indonesia [10].

The research related to taxonomy in this family has been carried out. Through morphological identification, researchers can identify characteristics of species. Identification continues the activity of clustering species in each taxon through analysis of relationships. Wortley describes the clustering of *Allittia, Castroviejoa, Lorandersonia, Pembertonia and Rhetinocarpha* which are members of Asteraceae based characteristics of pollen [11]. Hasanudin carried out phenetic analysis on Asteraceae where *Elephantopus scaber* and *Vernonia cinera* species had the closest relation as seen from the dissimilarity index of 0.28 [12]. Kalmuk stated that genus *Crepis* (member of Asteraceae) in Turkey could be grouped based achene micromorphology [13]. Not all species have been analyzed for phenetic relationships, so this study used species belonging to Asteraceae, consist of *Ageratum conyzoides* L., *Ageratum houstonianum*

Mill, *Tithonia diversifolia* (Hemsl.) A.Gray., *Sonchus arvensis* L., *Erechtites valerianifolia* (Link ex Spreng.) DC., *Eupatorium odoratum* L., and *Tagetes erecta* L.

Method

This research was conducted in May – July 2022. The species used were 7 species of Asteraceae members including *Ageratum conyzoides* L., *Ageratum houstonianum* Mill, *Tithonia diversifolia* (Hemsl.) A.Gray., *Sonchus arvensis* L., *Erechtites valerianifolia* (Link ex Spreng.) DC., *Eupatorium odoratum* L., and *Tagetes erecta* L., which grow in Demak and Semarang, Central Java. Observation tools used were camera, plant description book, and NTSYS software for phenetic relationship analysis. Morphological characters were observed in the leaves, stems, and flowers and then scored. A total of 14 morphological characters from leaf, stem, and flower organs were used as the basis for clustering including stem branching, stem surface, branch nature, leaf shape, leaf tip, leaf base, leaf venation, leaf margin, leaf color, leaf surface, flower type, flower color and presence of flower reproductive organs, completeness of floral ornaments (Table 1). The score results were analyzed using NTSys-PC version 2.02i software and clustering using UPGMA (Unweighted Pair Group Method with Arithmetic Mean). The final result is a dendrogram of Asteraceae taxonomic affinity based on morphological characters.

Results and Discussion

The 7 species used in this study are species that grow in Indonesia with habitats in rice fields and habitus in the form of shrubs and herbs. The habitus of these 7 species are shown in Figure 1. The dendogram (Figure 2) shows that the 7 species used are divided into 2 clusters. The first cluster consisted of *Ageratum conyzoides* L., *Ageratum houstonianum* Mill, *Tagetes erecta* L., *Sonchus arvensis* L., and *Erechtites valerianifolia* (Link ex Spreng.) DC., while the second cluster consisted of *Tithonia diversifolia* (Hemsl.) A.Gray., and *Eupatorium odoratum L.* The two clusters are separated at a coefficient of 0.32. *Ageratum conyzoides* L., and *Ageratum houstonianum* Mill., which are in the first cluster have a similarity coefficient of 0.8 indicating that the two species are the most closely related when compared to *Tagetes erecta* L. This is indicated by many similarities in morphological characters possessed by the genus *Ageratum* including stem branching, stem surface, branch nature, leaf shape, leaf tip, leaf base, leaf venation, leaf margin, leaf color, leaf surface, flower type, and the presence of reproductive organs. flowers, floral accessories. Only the color of the flowers distinguishes the two *Ageratum* species. *Sonchus arvensis* L., and *Erechtites valerianifolia* (Link ex Spreng.) DC., have a similarity coefficient of 0.46 which makes this group has a far taxonomic affinity compared to the other 5 species. Morphological characters in form of leaf venation, leaf color and direction of stem growth in *Sonchus arvensis* L., and *Erechtites valerianifolia* (Link ex Spreng.) DC., were same while other characters were different.

Tithonia diversifolia (Hemsl.) A.Gray., and *Eupatorium odoratum* L., were separated in the second cluster. The similarity coefficient for both is 0.8 as in the genus *Ageratum*. From the dendogram we can also observe that the character of flower type, flower color, leaf base, leaf venation, leaf margin, and leaf color contributed to the clustering of 7 species into 2 major groups. Indeed, morphological characters are one of the practical taxonomic sources to discriminate groups [14], trace taxonomic affinity of the species [15] and the approach to using morphology in taxonomic affinity is very important because it can cluster species in their taxon correctly [16]. A total of 67 species of Berkheya (family Asteraceae) were grouped into 14 groups based on the morphology of the achene [17].

Saussurea bogedaensis was detected to be closely related to S. involucrata and S. orgaadayi in terms of morphology and genetics. S. bogedaensis can be distinguished from the other two species through its morphological characters in the form of the phyllaries and the indumentum [18]. In the Petrosa genus, the morphological characters used, namely leaf length, petiole length, and the presence of ray florets prove that these characters are very influential in the grouping of the genus [15]. Meanwhile, 13 members of Asteraceae were divided into 2 clusters based on the characteristics of stem diameter, base of upper leaf blade, upper leaf width, type of leaf attachment, flower color, and achene shape according to research by Susandarini [19]. Guzel reported that Lactuca leucoclada is very close to Lactuca viminea and Lactuca orientalis based on the irregular character of the leaves and stems [20]. Based on these studies, morphological characters are still considered relevant for grouping species so that research related to taxonomic affinity needs to be continued in depth.

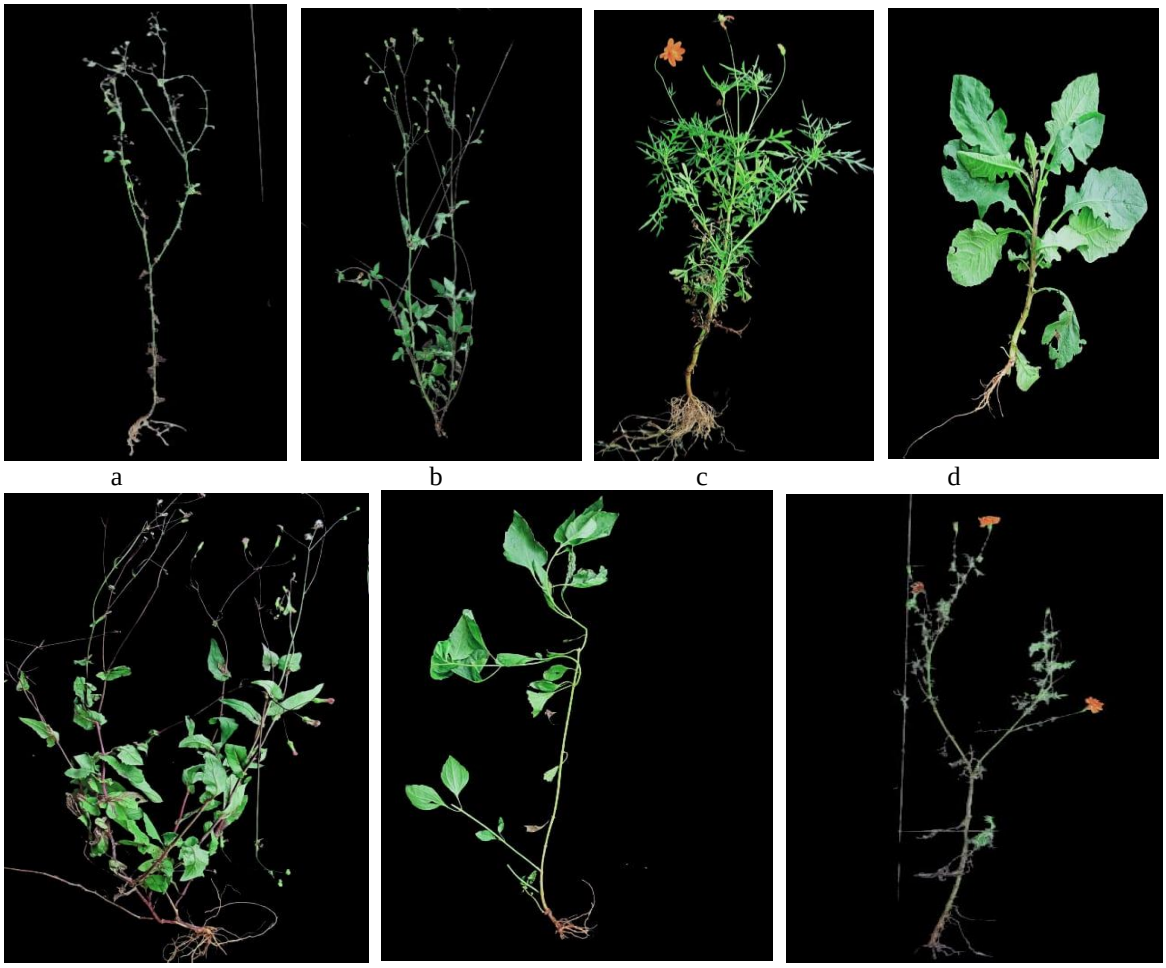
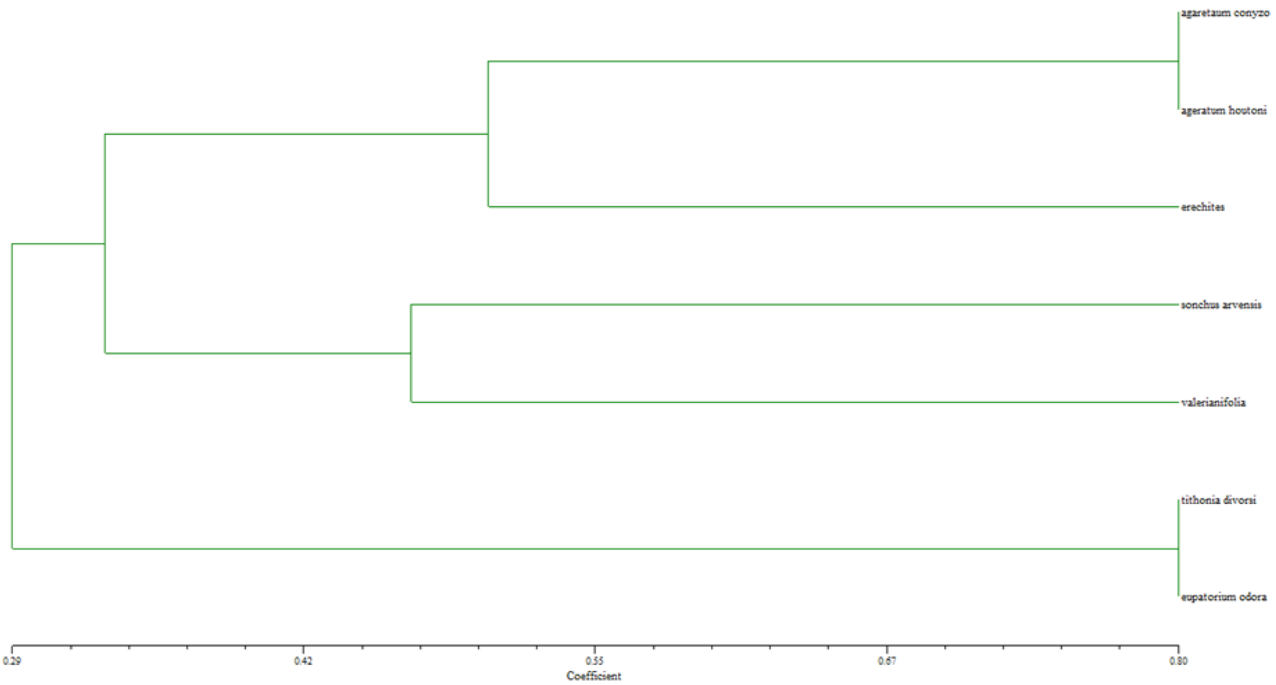


Figure 1. (a) Asteraceae morphology. A. *Ageratum conyzoides* L. (b) *Ageratum houstonianum* Mill (c) *Tithonia diversifolia* (Hemsl.)A.Gray. (d) *Sonchus arvensis* L. (e) *Erechtites valerianifolia* (Link ex Spreng.) DC., (f) *Eupatorium odoratum* L. (g) *Tagetes erecta* L.



Gambar 2. (a) Asteraceae Dendogram

Table 1. Morphological character of asteraceae family

No	Character	Species						
		A	**B**	**C**	**D**	**E**	**F**	**G**
1.	Flower type	Compound	Compound	Compound	Does not bloom	Compound	Does not bloom	Compound
2.	Flower color	White	Purple	Yellow	Does not bloom	White	Does not bloom	Yellow
3.	Branching of the stem	Dichotomous	Dichotomous	Dichotomous	Monopodial	Dichotomous	Dichotomous	Dichotomous
4.	Leaf shape	Ovoid	Ovoid	Inverted ovoid	Spathulatus	Elongated	Ovoid	Inverted ovoid
5.	Leaf Tips	Tapering	Pointed	Pointed	Blunt	Tapering	Tapering	Pointed
6.	Leaf Base	Grooved	Grooved	Pointed	Tapering	Grooved	Blunt	Pointed
7.	Leaf Venation	Pinnate	Pinnate	Palminervis	Pinnate	Pinnate	Pinnate	Palminervis
8.	Leaf Margin	Serratus	Serratus	Flat	Repandus	Serratus	Serratus	Flat
9.	Leaf Color	Dark green	Light green	Dark green	Dark green	Dark green	Light green	Light green
10.	Leaf Surface	Hairy	Hairy	No hair	Hairy	No hair	No hair	No hair
11.	Stem Surface	Hairy	Hairy	Hairy	Hairy	Soft	Hairy	Hairy
12.	The presence of reproductive organs in flowers	Only 1 reproductive organ in flower	Only 1 reproductive organ in flower	2 reproductive organs in flower	Does not bloom	Only 1 reproductive organ in flower	Does not bloom	2 reproductive organs in flower
13.	Completeness of flower jewelry	Complete	Complete	Complete	Does not bloom	Incomplete	Does not bloom	Complete
14.	The nature of the branches	Virga singularis	Virga singularis	Virgula	Virga	Virgula	Virgula	Virgula

Note: A: Ageratum conyzoides L.; B: Ageratum houstonianum Mill; C: Tithonia diversifolia (Hemsl.)A.Gray; D: Sonchus arvensis L.; E: Erechtites valerianifolia (Link ex Spreng) DC.; F: Eupatorium odoratum L.; & G: Tagetes erecta L.

Conclusion

The closest phenetic relationship is in the species *Ageratum conyzoides* L., with *Ageratum houstonianum* Mill and *Tithonia diversifolia* (Hemsl.) A.Gray., with *Eupatorium odoratum* L. The similarity coefficient is the same, namely 0.8. Meanwhile, *Sonchus arvensis* L., and *Erechtites valerianifolia* (Link ex Spreng.) DC., have a similarity coefficient of 0.46 which indicates that the phenetic relationship is quite far. We recommend that further research in the Asteraceae family be expanded by using more species and adding morphological characters to extend studies in this family.

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