

Types of Wild Plant of Asteraceae Family Potentially as Herbicide in Brawijaya University

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Abstract Asteraceae is one of the plant family that has the number of species reaches 30.000 species and spread all over the world including in the University of Brawijaya. The University is located on Veteran Street, Malang Town and has an area of 2.203.948 m². This research is important to know the species of Asteraceae family that have potential as herbicide in Brawijaya University Campus. The method used is roaming by conducting surveys directly in the field. The method used is roaming by conducting surveys directly in the field. The samples were then identified in the Laboratory of Plant Taxonomy. Further identification is made in the form of parallel keys. It was then determined that herbicide species were potential herbicides based on literature studies. Data analysis was done by using descriptive method. The results of this study found there are 13 species namely *Argeratum conyzoides*, *Galinsoga parviflora*, *Crassocephalum crepidioides*, *Calypocarpus vialis*, *Sonchus arvensis*, *Eclipta prostrata*, *Synedrella nodiflora*, *Tridax procumbens*, *Emilia sonchifolia*. Nine species have the potential to be herbicides. Four species including *Youngia japonica*, *Acmella paniculata*, *Vernonia cinerea* and *Senecio vulgaris*, do not yet have information about their potential as herbicides.

Keywords Asteraceae, Brawijaya University, Survey, Herbicides

1. Introduction

Asteraceae is one of the largest plant species in the world. Asteraceae is known as sunflower because this family member has flowers that are shaped like sunflowers. The benefits of Asteraceae are commonly used as traditional medicines for certain diseases or to heal wounds. Asteraceae is also consumed as fresh vegetables, animal feed, and ornamental plants, and can be used as hair fertilizers [34]. Besides being used as a traditional medicine, and also be used as a natural herbicide because some species have allelochemical content. [6] Fourteen families' poisonous plants for example Euphorbiaceae (eight species), Asteraceae (six species), Solanaceae (six species) etc.

Allelochemicals have toxic properties that can inhibit nutrient uptake and the growth of shoots and other plant roots [1]. The Asteraceae are invasive, usually containing allelochemistry so that they can inhibit the growth of other plants around them. The Asteraceae belong to plants that are very easy to grow, because pollination can occur easily through wind assistance. If the seeds are scattered and fall in

the appropriate area, the seeds will grow and develop. Therefore, the plants of the Asteraceae tribe are very easy to find, one of which is on the campus of Brawijaya University (UB).

Brawijaya University (UB) is one of the universities in Malang City and was established on January 5, 1963 [36]. Brawijaya University (UB) is located at Jl. Veteran Malang town and has an area of 2.203.948 m² [35]. Wild plants are found on the UB campus, especially from the Asteraceae tribe. Locations commonly found in wild plants are in the parking area, on the side of the main road and around the area of faculties. Many types of plants from the Asteraceae are found, some species may have potential as natural herbicides.

Therefore, this research is important to inventory the species of the Asteraceae family on the Universitas Brawijaya campus. Morphological description and form the key to the determination of each species and determine the plant species of the Asteraceae which has the potential as herbicides.

2. Materials and Methods

2.1. Time and Place

This research was conducted in December 2017-July 2018. Sampling was carried out at the University of Brawijaya campus. Data analysis was conducted at the Taxonomy

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Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang, East Java Indonesia.

2.2. Plant Sampling

Plant sampling is carried out with a direct survey on the campus of the University of Brawijaya which aims to inventory all types of Asteraceae that exist. When found in the Asteraceae plants, documentation is first done by taking photos using the camera, then marking the location with GPS. Plants are taken and collected, the part of the plant taken must include the roots, stems, leaves, flowers, fruits and seeds. The plants that have been taken are taken to the Laboratory of Plant Taxonomy for identification.

2.3. Plant Identification

Identification is done by observing the morphological structure of the plant species. Morphology observed in the form of roots, stems, leaves, flowers, seeds and fruit. Roots are observed in root systems. The stem is observed in the stem surface using a loup, the length of the stem and branch is measured by a meter or ruler, and the shape and type of the stem is observed. Leaves were observed in the abaxial and adaxial parts using loup. The length and width of the leaf is measured using a meter or ruler. Leaf edges, leaf bones, leaf shape, leaf base, apical leaves, leaf attachment, leaf arrangement, and inflorescence were also observed.

The organ of the flower was observed using a stereo microscope to see the size of the flower. Flower organ surgery is done by tweezers to determine the number of stamen, stamen arrangement, fusion stamen, number of pistils, number of styles, number of stigma, style, ovary position and fruit of the Asteraceae. Documentation was carried out using a camera, the description obtained was matched with the book Flora Of Java [4] to determine the name of a plant species and the book Plant Identification Terminology An Illustrated Glossary [19] to describe plant morphology, while also using various other plant identification books and official websites such as Plantlist.

2.4. Making Herbarium

The manufacture of herbarium is done after identification of each type of plant. Plants that have been collected must be in accordance with the paper size of the installation of a standard herbarium, 11½ x 16 ½ inches. If the plant is small, all parts of the plant are collected, while for large plants must include parts of plants that show growing habits [39]. The sample is wrapped with newspaper and then presses using sasak for oven or drying. The plants that have been finished pressed with sasak are then put in the oven at 55 °C for 2-3 days, after drying the sample is taken from the oven and starts mounting on the herbarium paper. Mounting is done using tape to attach plants to the herbarium paper. The plants that have been finished mounting are then labeled with a description of the plant, the location of the harvest, the date of collection, the collection number, the name of the

collector, and the name of the plant species. Herbarium is stored in the Herbarium Brawijaya University (MUBR) [7].

2.5. Literature Study

The literature study aims to find information about the potential of the Asteraceae family as a natural herbicide. Literature study is done by searching and reading various journals and scientific articles that discuss natural herbicides derived from the Asteraceae.

2.6. Creating Parallel Keys

The results of the identification that has been done, then made into a pair of statements (couplet). Each statement is made against each other. At the end of each statement given a number that will show the next direction, this step is carried out repeatedly until the final statement shows the name of the type [6].

2.7. Data Analysis

Data analysis is done by descriptive method. The results of the identification of each specimen that has been carried out are presented in the form of morphological descriptions. Morphological descriptions include the type of root, stem, leaf, flower, and fruit.

3. Results and Discussion

3.1. Character Description of Asteraceae on the University Campus

Brawijaya

Based on the results of the field survey, 13 namely Asteraceae families were found, consisting of *Ageratum conyzoides*, *Youngia japonica*, *Galinsoga parviflora*, *Calyptocarpus vialis*, *Sonchus arvensis*, *Crassocephalum crepidioides*, *Eclipta prostrata*, *Acmella paniculata*, *Synedrella nodiflora*, *Tridax procumbens*, *Emilia sonchifolia*, *Vernonia cinerea*, and *Senecio vulgaris*.

Ageratum conyzoides L.

Sp. Pl. 839 (1753) Flora of Java. 10: 376 (1968)

Synonym:

Ageratum hirsutum Lam., in Poir., Encycl. Suppl. 1: 242 (1810).

Ageratum latifolium var. *latifolium*

Ageratum odoratum Vilm., Fl. Pl. Terre, ed. 2 : 42 (1866)

Terrestrial. Annual herbaceous with taproots. The stem is green-brown. Shape of the nodose rod. Stem surface has trichomes; length about 15-21 cm, diameter 0.13 to 0.21 cm. Shape of the leaf ovate, the base rounded. Leaf tip acute, including single leaves. The leaf bone reticulate, the edge of the leaf shaped like crenate. The attachment of petiole, leaves arranged opposite or facing each other. Surface of flower purple, inflorescence capitulum (Figures 1a and 1b). The crown is tubular and there are five indentations (Figure 1c). The number of stamen is five and arranged in included.

Stamen fusion coalescent, the stamen has a white color. Pistil and style number one and the forked stigma (Figure 1d); style macrostylous (style longer than pistil). Fruit achene. Ovary inferior.

Distribution and habitat: *Ageratum conyzoides* originates from Central America and the Caribbean, these plants have spread in several parts of the world [22]. This plant distributed in West Africa, Australia, Colombia, Costa Rica, Ecuador, Fiji, French Polynesia, Guam Islands, United States (Hawaii Islands), Tonga, Vanuatu, Palau, Mauritius, Nicaragua, Solomon Islands, Papua New Guinea, Samoa and Southeast Asia (including China, India, Philippines, Singapore, Thailand, Vietnam, Cambodia, Malaysia and Indonesia (Malang), Brazil and Korea. The habitat of *Argeratum conyzoides* is in grasslands, forests, waterways, and vacant land [21].

Specimen examined: dk's collection of 01 (MUBR) forest; 09 (MUBR).

Local name: Wedusan (East Java, Malang) and Babandotan (West Java).

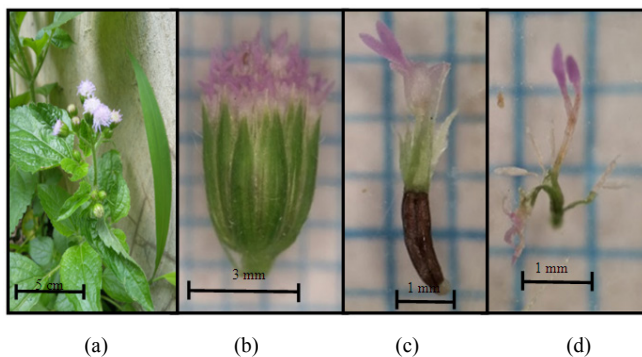


Figure 1. *Ageratum conyzoides* L. (a) Plant individuals; (b) the size of one flower hump; (c) tube flowers (d) pistil and stamen

***Youngia japonica* (L.) DC.**

Prodr 7: 194 (1838) Flora of Java. 107: 437 (1968)

Synonym:

Crepis taquetii (H.Lév. & Vaniot) H.Lév. Repert. Spec. Nov. Regni Veg. 11

Youngia japonica var. *genuina* Bab. & Stebbins. Carnegie Inst. Wash., Publ. 484: 1--106: 94 (1937)

Crepis japonica (L.) Benth. Fl. Hongk. 194 (1861)

Basionim:

Prenanthes japonica L. Mant. Pl. 1: 107 (1767)

Terrestrial. Herbaceous with taproot or mount roots. Stem scapiform form; length about 13-19 cm, green color, surface of stem has trichomes. Leaf lyrate, at the base attenuate, the apical leaf is obtuse. Single leaf, leaf bone pinni-palmate shape. Leaf edge runcinate, petiolate, arranged in rosette. Leaf length 4 - 6 cm, leaf width 1.4-3 cm, adaxial and abaxial parts are smooth, yellow flower (Figures 2a and 2b). Inflorescence panicle, flower stalk diameter 0.10 to 0.11 cm. Number of stamen five and arranged in included, stamen fusion is coalescent. Pistil and style number one and the forked stigma; style macrostylous (style longer than pistil). Fruit achene. Ovary inferior (Figure 2c and 2d).

Distribution and habitat: *Youngia japonica* (L.) DC. comes from China and also considered native to Korea and Japan. In addition, this plant is also spread in several tropical and subtropical regions that have warm temperatures, for example in the northern part of Argentina, the northern United States to the states of Pennsylvania and New York, southern South Africa to Christmas or southern Australia to New South Wales (28). This plant mostly found in vacant land, fields and on the roadside (25).

Specimen examined: dk's collection 10 (MUBR).

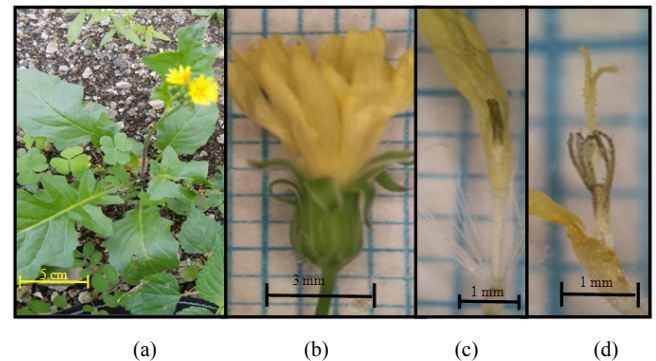


Figure 2. *Youngia japonica* (L.) DC (a) Plant individuals; (b) the size of one flower hump; (c) pansy flower (d) pistil and stamen

***Galinsoga parviflora* Cav.**

Icon. 3: 41 (1796) Flora of Java. 71: 414 (1968)

Synonym:

Galinsoga parviflora var. *adenophora* Thell. Allg. Bot. Z. Syst. 21

Vigolina acmella (Roth) Poir. Encycl. (Lamarck) 8: 613 (1808)

Terrestrial. Herbaceous with taproot. Stem dichotomous, light green color, rounded, stem length about 6-9 cm, the surface of the stem with trichome. Diameter about 0.2 - 0.23 cm. Leaf lanceolate, base aequilateral, apical acute. Single leaf, reticulate. The leaf edge serrate, the leaf attachment petiolate, arrangement opposite. The length of the leaves around 2- 4.5 cm, the width of the leaves about 1-3 cm. The adaxial and abaxial parts of the leaves with trichomes (Figure 3a). The flower white and the middle flower yellow (Figure 3b, 3c, and 3d). The length of the flower stalk 0.5-2 cm, the surface of the flower stalk trichome. Inflorescence corymb, there are five stamen arranged in included. Stamen fusion coalescent. Pistil and style number one and the forked stigma (Figure 3e); style macrostylous (style longer than pistil). Fruit achene. Ovary inferior.

Distribution and habitat: these plants come from North America and are widespread in Central America, South America, Europe, West Indies, Mexico, Australia, Africa and Asia, Indonesia (Malang), Pakistan country can be found in Balochistan, Hunza, Dir, Swat, Gilgit, Murree and Kashmir. In general, many grow in coastal areas, forests, river banks, wetlands, and on the outskirts of the city [3; 10, 11, 12].

Specimen examined: dk's collection 11 (MUBR).

Local name: Jakut Minggu (Sunda), Bribil (Central Java),

Bakatombaran (Madura).

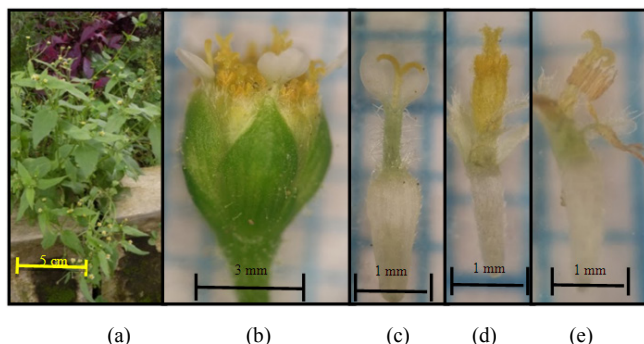


Figure 3. *Galinsoga parviflora* Cav (a) Plant individuals; (b) the size of one flower hump; (c) female flowers (flowers edge (d) tube flower (effeminate flower) (e) pistil and stamen

***Calyptocarpus vialis* Less.**

Syn. Gen. Compos. 221 (1832) Flora of Java. 63: 410 (1968)

Synonym:

Synedrella vialis (Less.) A.Gray. Proc. Amer. Acad. Arts xvii. 217 (1882)

Calyptocarpus blepharolepis B.L.Rob. Proc. Amer. Acad. Arts 47

Zexmenia hispidula Buckley. in Proc. Acad. Sc. Philad. 458 (1862)

Terrestrial. Herbaceous with a taproot. Stem creeping, the stem length around 1.7 - 2 cm, has many branches and longer than the stem. The stem diameter around 0.21 - 0.33 cm, surface purple, the bottom green, it has trichome. The leaves have deltoid shape, the base of the leaves truncate, single leaf, pinni-palmate, crenate, petiolate, arrangement opposite. Leaf length 2.6 - 4 cm, width 1.2 - 3.7 cm. The abaxial and adaxial parts of the leaf have trichomes. Yellow flower, inflorescence capitulum, capitate (Figures 4a and 4b). Edge flowers include female flowers with one pistil and two branched stigma, one ray (Figure 4c). The middle flower tubular, there are four corolla and stick together (Figure 4d). Stamen has a number of four, stamen fusion coalescent, the color of the stamen chocolate. In the gynacium section, there is one pistil and one style. Stigma branched; style macrostylous. Fruit achene. Ovary inferior (Figure 4e).

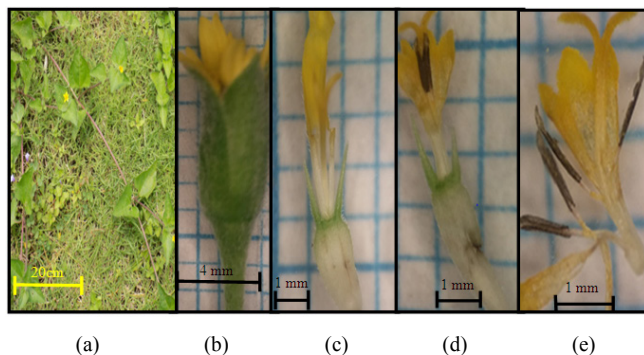


Figure 4. *Calyptocarpus vialis* Less. (a) Plant individuals; (b) the size of one flower hump; (c) female flower (edge flower (d) tube flower (effeminate flower) (e) pistil and stamen

Distribution and habitat: *Calyptocarpus vialis* Less. native to South America, Mexico and the West Indies (22). This plant is known as aggressive invasive plants in Karnataka, Mysuru, Bengaluru, Ballari, Dharwad, Hubballi, Vijayapura, Kalaburagi (South India). Usually these plants are found on the side of the road, grasslands, vacant land and forests. (24).

Specimen examined: dk's collection 12 (MUBR).

Local name: Legetan.

***Sonchus arvensis* L.**

Sp. Pl. 2:793 (1753) Flora of Java. 105: 434 (1968)

Synonym:

Sonchus glandulosus Schur. Enum. Pl. Transsilv. 371 (1866)

Sonchus repens Bubani. Fl. Pyren. (Bubani) ii. 110

Sonchus hantoniensis Sweet. Hort. Brit. (Sweet), ed. 2: 278 (1830)

Terrestrial. Herbaceous with a taproot. Shape of stem virgate, green color, the surface smooth with a vertical line along the stem surface. The length of the stem 1 - 120 cm, diameter 0.7 - 1 cm. Plants when they are young will form a rosette and the leaves will crumple below, then when they are older the stem will extend upwards and flowers will grow at the top. leaf lyrate, the base of the leaves that grow in the lower part are attenuate, while those that grow above or near the auriculate flower. Apical leaves rounded, single leaves, leaf bones reticulate; lacerate, attachment decurrent, the leaf arrangement rosette. Leaves 9 - 33 cm long, 2-9 cm wide, the abaxial and adaxial parts are smooth, the leaf green color. The flower yellow, inflorescence compound corymb, the surface of the receptacle and flower stalk has a trichome, the length of the flower stalk is 4-13 cm (Figure 5a and 5b). The number of stamen is five and arranged in included, stamen fusion coalescent. Pistil and style number one and the forked stigma, macrostylous (style longer than pistil) (Figure 5c and 5d). Fruit achene, Ovary inferior.

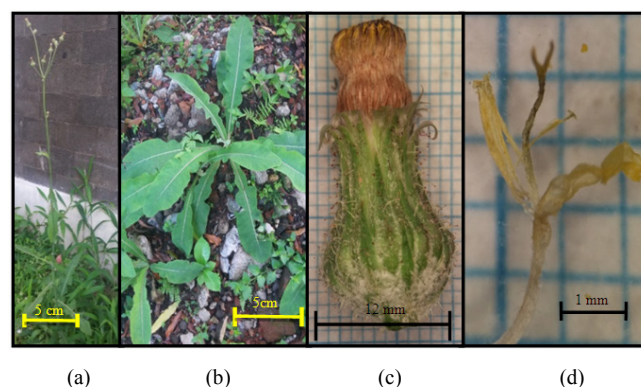


Figure 5. *Sonchus arvensis* L. (a) Plant individuals; (b) plants when in the form of rosettes; (c) size of one flower (d) pansy flower (e) pistil and stamen

Distribution and habitat: *Sonchus arvensis* L. originates from Europe and West Asia [20]. This plant can usually be found starting from humid to arid areas. For example, fields, waste disposal areas, forests, swamps, grasslands, roadsides, ditches, shores, rivers and lakes [5].

Specimen examined: dk's collection 13 (MUBR).

Local name: Tempuyung.

Crassocephalum crepidioides (Benth.) S. Moore.

J. Bot. 50: 211 (1912) Flora of Java. 89: 427 (1968)

Synonym:

Gynura polycephala Benth. Niger Fl. [W. J. Hooker]. 437 (1849)

Basionim:

Gynura crepidioides Benth. Niger Fl. 438 (1849)

Terrestrial. Herbaceous with a taproot. Stem quadrangulate, the color of the stem green, the stem length around 23 - 47 cm, diameter 0.71 - 5.56 cm, branch length 7 - 58 cm. The leaves are green, the leaf shape ovate, the base attenuate, the apical aristulate. Single leaf, biserrate. The leaf attachment petiolate, the leaf arrangement alternate. The adaxial and abaxial part smooth. Flowers have a red color, inflorescence compound corymb (Figures 6a and 6b). Tubular flowers with five corolla, five stamen, stamen arrangement included. The stamen fusion coalescent, red color. Pistils and styles number one, stigma two branched. style macrostylous. Fruit achene. Ovary inferior (Figures 6c, 6d).

Distribution and habitat: *Crassocephalum crepidioides* (Benth.) S. Moore is a native plant from Africa and currently has spread in Asia, including India, Indonesia, the Philippines and Thailand [15]. Usually grows in agricultural areas, roadside, residential areas, grasslands, river banks, and rocky areas [10, 11, 12].

Specimen examined: dk's collection 05 (MUBR), forest; 14 (MUBR).

Local name: Sintrong.

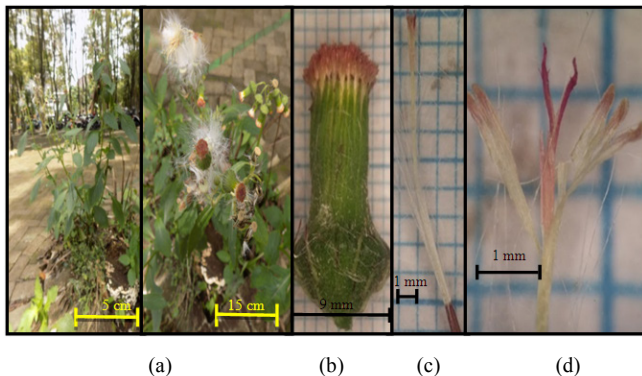


Figure 6. *Crassocephalum crepidioides* (Benth.) S. Moore (a) Plant individuals; (b) the size of one lumpy flower; (c) tube flowers (d) pistil and stamen

***Eclipta prostrata* (L.) L.**

Mant. Pl. Altera 286 (1771) Flora of Java. 51: 402 (1968)

Synonym:

Eclipta alba var. *longifolia* Bettfr. Fl. Argent. 2 (1899)

Eclipta alba (L.) Hassk.

Eclipta prostrata f. *aureoreticulata* Y.T.Chang. Wuyi Sci. J. 5: 235 (1985)

Eclipta patula Schrad. ex DC. Prodr. (DC.) 5: 491 (1836)

Basionim:

Verbesina prostrata L. Sp. Pl. 2: 902 (1753)

Terrestrial. Herbaceous with a taproot. Surface of stem green-brown color, dichotomous. Stem length 20-31 cm, branch length 3 - 32 cm. The stem surface has trichomes. The leaves are green, the shape of the leaves oblong-lanceolate, the base of the leaves attenuate, the apical leaves are acute. Single leaf (simple), leaf bone pinni-palmate, serrulate, attachment petiolate, leaf arrangement opposite. Leaf length 2.2 - 4.9 cm, width 0.8 - 1.1 cm. The abaxial and adaxial parts have trichomes. The flowers white, the amount of bractea 7 - 8, the type of flowering is compound corymb (Figures 7a and 7b). Edge flowers include female flowers and have white ray or ligule. Edge flowers stick to bractea (Figure 7c). Central flower has 4 white corollas, tubular corollas, including bisexual flowers. There are four stamen, fusion coalescent, light brown color. Pistil and style number each one, the forked stigma; style bifid. Fruit achene. Ovary inferior (Figure 7d).

Distribution and Habitat: *Eclipta prostrata* (L.) L. is a native plant from Asia, Indonesia (Malang), America and was introduced to Europe, Africa, Australia and the Pacific islands and spread throughout the world, in the tropics, subtropics and warmer regions. In general, these plants can be found on the banks of rivers, fields, and in vacant lands that have abundant water supply (15; 26).

Specimen examined: dk's collection 15 (MUBR).

Local name: Urang - aring.

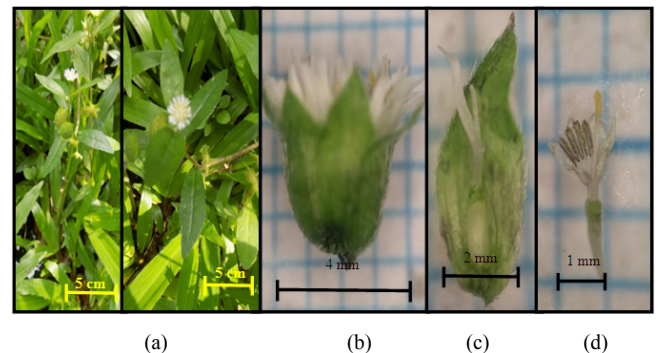


Figure 7. *Eclipta prostrata* (L.) L. (a) Plant individuals; (b) the size of one lumpy flower; (c) edge flowers (female flowers) (d) pistil and stamen (tube flowers)

***Acmella paniculata* (Wall. ex DC.) R.K.Jansen.**

Syst. Bot. Monogr. 8: 67 (1985) Flora of Java. 61: 409 (1968)

Synonym:

Spilanthes paniculata f. *bicolor* J.Kost. J. Kost. & Philipson, Blumea

6: 35 (1956)

Basionim:

Spilanthes paniculata Wall. ex DC. Prodr. 5 (1836)

Terrestrial. Herbaceous with a taproot. Surface of stem brown, the bottom green. the shape of the rod decumbent. The stem length around 15 - 32 cm. The leaves are dark green in adaxial, in the abaxial section they have a light green color. The shape of the leaf deltoid, the base truncate, apical acute. Single leaf (simple), the shape of the leaf bone

pinni-palmate, edge serrate, attachment petiolate, arrangement opposite. Fine adaxial and abaxial portion, leaf length 1.5 - 7 cm, width 1.9 - 5.1 cm. Bractea 10, inflorescence capitulum (Figures 8a and 8b). Edge flowers have orange rays or ligules, including female flowers (Figure 8c). Middle flower has five, corolla yellow, bisexual. The number of stamen 5, fusion coalescent, stamen color dark brown. Number of pistils and style one, stigma forked. Style bifid. Fruit achene. Ovary inferior (Figures 8d and 8e).

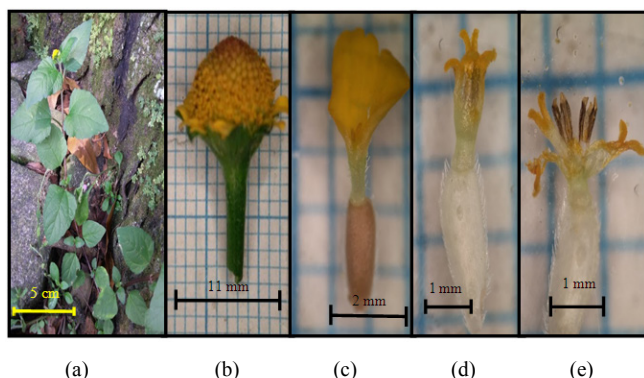


Figure 8. *Acmella paniculata* (Wall. Ex DC.) R.K.Jansen. (a) Plant individuals; (b) the size of one lumpy flower; (c) edge flowers (female flowers) (d) tube flowers (e) pistil and stamen (tube flowers)

Distribution and habitat: these plants come from Bangladesh, Brazil, China, Colombia, Ecuador; India (Andhra Pradesh, Assam, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Rajasthan, Tamil Nadu), Indonesia (Malang), Nepal, Papua New Guinea, Peru, Solomon Islands, Sri Lanka, Taiwan, Province of China, Thailand and Vietnam. This plant is often found in wetlands, pool edges, swamps, along the flow of water, in rice fields, and alongside roads [18].

Specimen examined: dk's collection 16 (MUBR.)

Local name: Jotang.

***Synedrella nodiflora* (L.) Gaertn.**

Fruct. Sem. Pl. 2: 456 (1791) Flora of Java. 64: 410 (1968)

Synonym:

Eclipta latifolia L.f. Suppl. Pl. 378 (1782)

Blainvillea latifolia (L.f.) DC. Contributions to the Botany of India (1834)

Wedelia cryptocephala Peter. Abh. Konigl. Ges. Wiss. Gottingen, Math.-Phys. Kl. ser. 2, xiii. 11. 94 (1928)

Basionim:

Verbesina nodiflora L. Cent. Pl. 1: 28(1755)

Terrestrial. Herbaceous with a taproot. Stem green color, the shape of the rod tetragonal. The stem surface has a trichome, stem length 14.8 - 21.8 cm, diameter 0.26 - 0.43 cm, branch length 6-15 cm. Leaves green, the leaf shape ovate, the base of the leaf cuneate, the apical leaf aristulate. Simple leaves, the shape of the leaf bone pinni-palmate, edge serrulate. The leaf attachment petiolate, the leaf arrangement opposite. Adaxial and abaxial leaves have trichomes, leaves length 2 - 5.5 cm, width 2.1 - 3 cm (Figure 9a). Flowers have seven bractea, two longer bractea (Figure 9b). Inflorescence verticillacter, capitate, the edge flower includes female

flowers that have a yellow ray or ligule (Figure 9c). The middle flower tubular, has five yellow corolla, including bisexual flowers. The number of stamen four, bisexual flowers, the arrangement of stamen included; stamen coalescent, dark brown. The number of pistils and style one, the forked stigma; style bifid. Fruit achene. Ovary inferior (Figure 9d and Figure 9e).

Distribution and habitat: these plants come from tropical America, and have spread in tropical regions and throughout the Southeast Asia region, Indonesia (Malang). In addition, it can be found on the plains of India, in Andaman and West Africa, in Bangladesh, Japan, Spain, China and England. This species grow almost in all habitats that have enough soil moisture [2].

Specimen examined: dk's collection 02 UB forest; 16 (MUBR).

Local name: Jotang, Gletang.

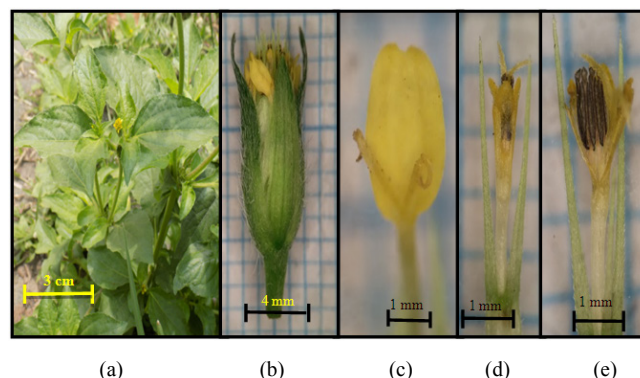


Figure 9. *Synedrella nodiflora* (L.) Gaertn. (a) Plant individuals; (b) the size of one lumpy flower; (c) edge flowers (female flowers) (d) tube flowers (e) pistil and stamen (tube flowers)

***Tridax procumbens* L.**

Sp. Pl. 2: 900 (1753) Flora of Java. 70: 414 (1968)

Synonym:

Balbisia canescens Rich. Syn. Pl. 2: 470 (1807)

Tridax procumbens var. *canescens* (Rich. ex Pers.) DC. Prodr. [A. P. de Candolle] 5: 679 (1836)

Balbisia elongata Willd. Sp. Pl., ed. 4 [Willdenow] 3(3): 2214 (1803)

Terrestrial. Herbaceous with a taproot. Stem green, procumbent; surface has a trichome, a stem length of about 9 - 11 cm, a diameter of 0.22 - 0.33 cm, branch length 11-23 cm. The leaves are green, obovate, base aequilateral, the apical leaf aristulate. Single leaf, the shape of the leaf bone, pinni-palmate, edge serrate. The leaf attachment petiolate, arrangement opposite. The adaxial and abaxial sections of the leaves have trichomes, lengths of 2.1 to 4.5 cm, width 0.9 to 3.4 cm (Figure 10a). Flower edges include females with white ray or ligule. Tubular middle flowers with five corollas yellow, bisexual flowers (Figures 10b, 10c, and 10d). Flowers grow terminal, inflorescence capitulum-capitate, there are five stamen in bisexual flowers and arranged exserted, fusion stamen coalescent, yellow stamen. In the gynecology section there one pistil and one style, two-stigmatized stigma; style macrostylous. Fruit achene.

Ovary inferior (Figure 10e).

Distribution and habitat: these plants are native to tropical America and spread in tropical Africa, Asia, Indonesia (Malang) and Australia. *T. procumbens* is also widely distributed in India up to 2400 m above sea level (ASL). This plant can grow in almost all environments, but will adapt well to environments with coarse-textured soils in the tropics [33; 10, 11, 12].

Specimen examined: dk's collection 17 (MUBR.)

Local name: Gletang.

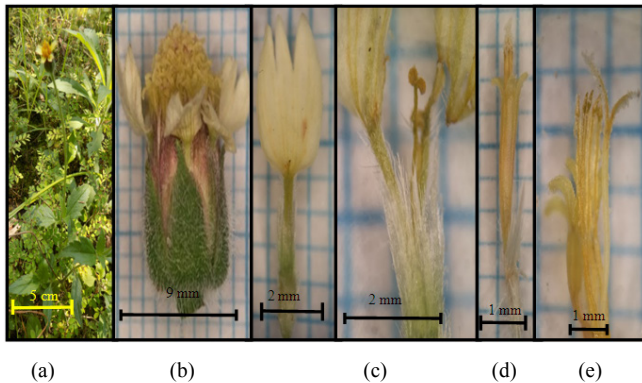


Figure 10. *Tridax procumbens* L. (a) Plant individuals; (b) the size of one lumpy flower; (c) edge flowers (female flowers); (d) tube flowers; (e) pistil and stamen (tube flowers)

***Emilia sonchifolia* (L.) DC. ex DC.**

Contr. Bot. India [Wight] 24 (1834) Flora of Java. 89: 427 (1968)

Synonym:

Emilia marivelensis Elmer. Leaf. Philipp. Bot. 1: 362 (1908)

Emilia sinica Miq. Journ. Bot. Neerl. i. 105 (1861)

Emilia javanica (Burm.f.) C.B.Rob. Philipp. J. Sci., C 3: 217 (1908)

Emilia rigidula DC. Prodr. 6:302

Senecio sonchifolius (L.) Moench. Suppl. Meth. (Moench) 231 (1802)

Gynura ecalyculata DC. Prodr. [A. P. de Candolle] 6: 298 (1838)

Basionim:

Cacalia sonchifolia Hort ex L. Sp. Pl. 2: 835 (1753)

Terrestrial. Herbaceous, taproot. Stem green color, virgate, length about 21 - 33.5 cm with a diameter of 0.24 - 0.37 cm and the stem surface has a trichome. Leaves green, the shape lyrate, base auriculate, apical acute. Single leaf, the shape of the bone reticulate, the shape of the leaf edge lacerate. The attachment of leaves decurrent and arranged rosette. The adaxial and abaxial sections of the leaves are smooth, leaves length 3.5 - 11.6 cm, leaf width 0.7 - 2 cm. Flower purple color, inflorescence corymb, the flower tubular with five corollas and includes bisexual (Figures 11a, 11b and 11c). Flowers have a number of five stamen arranged according to included, coalescent, stamen fusion white. Number of pistils and style one, stigma branched; style macrostylous. Fruit achene. Ovary inferior (Figure 11d).

Distribution and habitat: *Emilia sonchifolia* native to South and Central America. This type spread in tropical and subtropical regions, especially in parts of West Africa, Asia, Indonesia (Malang) and Oceania [41].

Specimen examined: dk's collection 04 UB forest; 18 (MUBR.)

Local name: Tempuh wiyang, Gathering wiyang (Java).

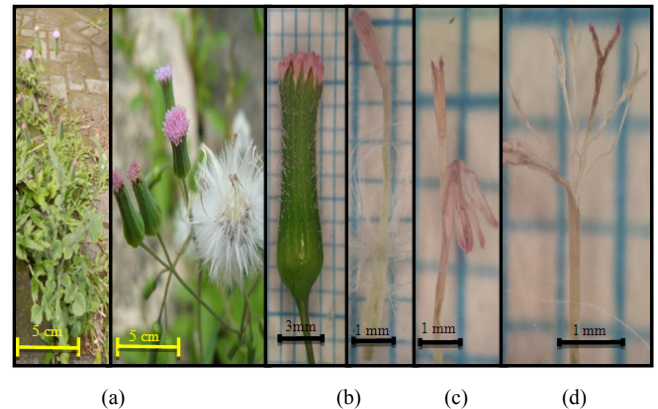


Figure 11. *Emilia sonchifolia* (L.) DC. (a) Plant individuals; (b) the size of one lumpy flower; (c) tube flowers; (d) pistil and stamen from tube flowers

***Vernonia cinerea* Less.**

Linnaea 4: 291 (1829) Flora of Java. 4: 371 (1968)

Synonym:

Cyanthillium cinereum (L.) H.Rob. Proc. Biol. Soc. Washington 103(1): 252 (1990)

Basionim:

Conyza cinerea L. Sp. Pl. 2: 862 (1753)

Terrestrial. Habitus herbaceous with taproot. Stem divergent, length 6 - 8 cm, diameter 0.22 - 0.34 cm; dark green, surface with trichome and there are vertical lines along the stem surface. The leaves are dark green, the leaf oblanceolate, the base of the leaf attenuate, the apical rounded. Single leaf (simple), the shape of leaf bone shaped pinni-palmate, leaf edge pinna-trilobate, leaf attachment petiolate, leaf arrangement dextrorse. Stem length 1.3 - 3 cm, width 0.5 - 0.9 cm. The abaxial and adaxial parts are smooth (Figure 12a). Flower purple color, inflorescence compound corymb, a tubular flower with five corollas which are attached to one another (Figures 12b and 12c). The color of the white stamen, the number of stamen five, arranged in included, stamen coalescent; pistil 1, stigma fork. Style 1 macrostylous. Fruit achene. Ovary's inferior (Figure 12d).

Distribution and habitat: *Vernonia cinerea* is native to Africa (eg. Benin, Cameroon, Nigeria, Gabon, Ghana, Kenya, Liberia, Madagascar), tropical and temperate Asia (eg China, Fujian, Bangladesh, Jiangxi, India, Japan, Indonesia (Malang), Malaysia) and Australia. This plant usually grows in areas that get enough sunlight, dry land, roadside, and cultivated land [24].

Specimen examined: dk's collection 19 (MUBR.)

Local name: Pidak bangkong (Java), Horsetail grass (Malay), Capeu tuhur (Sunda).

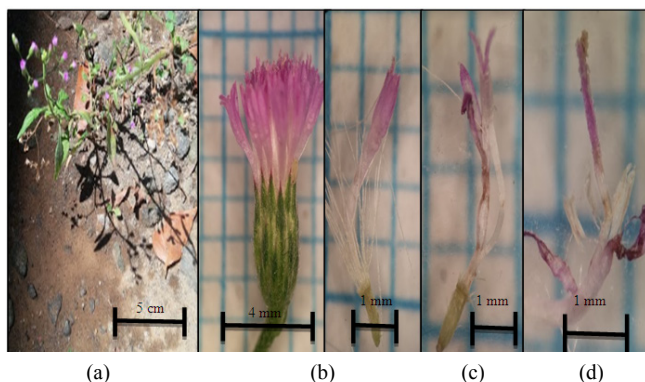


Figure 12. *Vernonia cinerea* Less (a) Plant individual; (b) the size of one lumpy flower; (c) tube flowers (d) pistil and stamen from tube flowers

***Senecio vulgaris* L.**

Sp. Pl. 2:867 (1753) Flora of Java. 88: 426 (1968)

Synonym:

Senecio vulgaris subvar. *Vulgaris*

Senecio vulgaris-humilis Batt. & Trab. Fl. Alger. Tunis. 187.

Basionim:

Senecio vulgaris L. Sp. Pl. 2: 867 (1753)

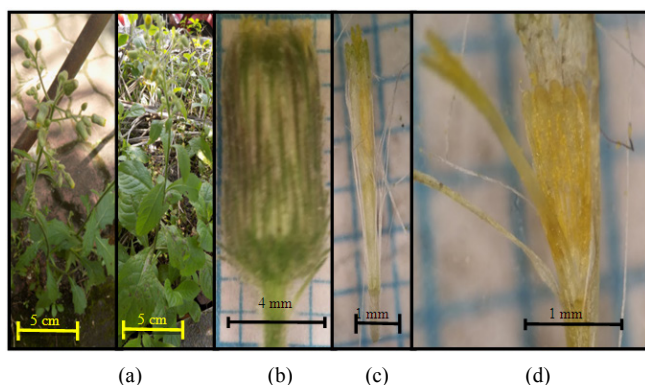


Figure 13. *Senecio vulgaris* L. (a) Plant individuals; (b) the size of one lumpy flower; (c) tube flowers (d) pistil and stamen from tube flowers

Terrestrial. Herbaceous with a taproot. The color of the stem green. The surface of the stem covered with white trichomes, not branched, stem length 39 - 41 cm. Leaves green, the leaf shape lyrate, the base attenuate, if the leaves are aristulate. The leaves include a single leaf, the shape of the leaf bone is reticulate, the leaf edge lacerate. The attachment of leaves petiolate and arranged cauline. The leaves 3 - 10 cm long, 0.5 - 3.9 cm wide, adaxial covered with temporary trichomes, while the abaxial portion smooth (Figure 13a) Edge flowers include female flowers that have yellow ray or ligule. Middle flower includes bisexual flowers in the shape of a tube with five yellow corollas. Flowers have bracteole, flowers grow axillary. Inflorescence panicle, capitate (Figures 13b and 13c). The number of stamen five, bisexual and arranged in included, stamen fused with the form of coalescent, yellow stamen. The number of pistil and style one with two branched stigma, macrostylous. Fruit achene. Ovary inferior (Figure 13d).

Distribution and habitat: *Senecio vulgaris* is a native Eurasian plant and is spread across mainland Europe, Scandinavia, the British Isles and Asia, Indonesia (Malang). These plants usually grow in areas of agriculture and on urban land [29].

Specimen examined: dk's collection 20 (MUBR.)

3.2. Key to Determination

The key to determination is based on the characteristics of each plant that has been found on the campus of Brawijaya University. The following are identified characters:

- | | |
|--|-----------------------------|
| 1a. Leaf deltoid. Flower ligula absent, inflorescence capitulum | <i>Ageratum conyzoides</i> |
| 1b. Leaf deltoid. Flowers with ligule, inflorescence capitulum | 2 |
| 2a. Thick stem, smooth stem surface | 3 |
| 2b. Small stem, rough stem surface | <i>Calytocarpus vialis</i> |
| 3a. Leaf thick dark green, the surface slippery | <i>Acmella paniculata</i> |
| 3b. Leaf light green, arrangement rosette | 4 |
| 4a. Leaf attachment petiolate, the apical obtuse | <i>Youngia japonica</i> |
| 4b. Leaf attachment decurrent, virgate, the apical lyrate | 5 |
| 5a. Flower yellow, leaf length 9 - 33 cm | <i>Sonchus arvensis</i> |
| 5b. Flower purple, leaves are smooth | 6 |
| 6a. Leaf in base attenuate, leaf pinni-palmate | 7 |
| 6b. Leaf auriculate, reticulate, leaf decurrent | <i>Emilia sonchifolia</i> |
| 7a. The leaf arrangement dextrorse, the abaxial and adaxial part of the leaf smoot | <i>Vernonia cinerea</i> |
| 7b. The leaf arrangement opposite, the abaxial and adaxial part of the leaves have trichomes | 8 |
| 8a. The number of stamen 4, the style bifid | <i>Eclipta prostrata</i> |
| 8b. The number of stamen 5, the style macrostylous | 9 |
| 9a. Apical leaves acute, leaf lanceolate | <i>Galinsoga parviflora</i> |
| 9b. Apical leaves aristulate, leaf attenuate | 10 |

10a Flower tube yellow. The stem trichomes	11
10b Flower tube brownish-red. Stem surface smooth	<i>Crassocephalum crepidioides</i>
11a. Leaf base cauline. Flower capitates	<i>Senecio vulgaris</i>
11b. Leaf base pinnate-palmate, leaf arrangement opposite	12
12a Stem tetragonal, leaf ovate, inflorescence verticillaster	<i>Synedrella nodiflora</i>
12b. Stem procumbens, leaf elliptic, inflorescence capitulum	<i>Tridax procumbens</i>

The key to this determination is a practical key that can be used in the field, especially at the UB campus. The guidelines used in making the key to this determination are based on the guidelines contained in the Flora of Java [4].

3.3. Potential of Herbicides of Some Asteraceae Tribes at Universitas Brawijaya (UB) Campus

The Asteraceae have a lot of potential, one of which has a herbicide. There are nine types of Asteraceae plants found on environment UB campus that have potential as herbicides. These plants include *Argeratum conyzoides*, *Galinsoga parviflora*, *Crassocephalum crepidioides*, *Calyptocarpus vialis*, *Sonchus arvensis*, *Eclipta prostrata*, *Synedrella nodiflora*, *Tridax procumbens*, and *Emilia sonchifolia*.

Argeratum conyzoides L. can be used as a natural herbicide to control weeds in rice fields. A total of 2.0 t ha⁻¹ of *Ageratum conyzoides* leaf powder applied for two days can reduce 75% growth of rice weeds. In addition, there are also reported three phenolic compounds identified in leaves, stems and roots. These phenolic compounds are gallic acid, caumalic acid, protocatechuic acid [42]. Another benefit of *Ageratum conyzoides* is usually used as traditional medicine, in Central Africa this plant is used to treat pneumonia, wounds, burns [25].

Leaf extract from *Galinsoga parviflora* has the ability to inhibit germination and shoot growth from rice, soybeans, and corn although the inhibition percentage is only about 3.4%. The effect of leaf extract from *Galinsoga parviflora* is more effective in inhibiting root growth, with an inhibition percentage of > 20% [8]. Based on this, *Galinsoga parviflora* has the potential as a herbicide.

Calyptocarpus vialis Less. have allelopathic properties that can be used as natural herbicides. It is proven that extracts from the roots, stems and leaves of *Calyptocarpus vialis* were able to inhibit seed germination from *Bidens pilosa* and *Synedrella nodiflora*. The higher extract concentrations (4%, 6%, 8%, 10% and 12%) will provide a stronger inhibitory effect, even there are only one or two seeds (total of 10 seeds) that have radicles (would be roots) and the size is very short [32].

The compound content found in *Calyptocarpus vialis* Less. in the form of phenols, tannins, saponins, glycosides, steroids, terpenoids, and coumarin [22].

Sonchus arvensis L. has allelopathic properties that can inhibit the growth of other plants, this has been proven in studies using corn kernels. The results of this study indicate that extracts from the plant part of *Sonchus arvensis* L. (leaves and stems) can inhibit the growth of corn kernels. Based on the analysis, leaf extract contains four kinds of

phenolic compounds namely quercetin, hydrogenic acid, ferulic acid and coumaric acid, while the stem extract contains two phenolics namely quercetin and vanillic acid [5], because of the allelopathic activity of these plants it can be concluded that *Sonchus arvensis* L. has the potential as a herbicide.

Crassocephalum crepidioides (Benth.) S.More. have allelopathic activity, this is evidenced by studies using leaf extract of *Crassocephalum crepidioides* (Benth.) S.More. The results showed that leaf extract with a concentration of 25 0.25 gmL⁻¹ can inhibit the growth of *Amaranthus retroflexus* L., *Echinochloa crusgalli* (L.) Beauv. and *Digitaria sanguinalis* (L.) Scop [39]. So it can be concluded that this plant has the potential as a herbicide.

Extracts from *Eclipta prostrata* (L.) L. have potential as herbicides. This was evidenced in studies using *Amaranthus spinosus* L., *Cassia tora* L. and *Cassia sophera* L. which were given leaf extract from *Eclipta prostrata* (L.) L. The results showed a growth inhibition on the three test plants [17] According to [30] regarding the allelopathic activity of *Eclipta prostrata* (L.) L. shown in the research carried out on Medical *Melilotus alba*, with the provision of leaf extract, stem and root of *Eclipta prostrata* (L.) L. The result is germination from Medicinal *Melilotus*. inhibited even the radicles or prospective roots are also stunted by growth.

Synedrella nodiflora contains flavonoids, alkaloids, glycosides, steroids, tannins, saponins, phytosterols and triterpenoids. [2]. Some of the compounds contained are groups of allelochemical groups that have allelopathic properties. Leaf extract from *Synedrella nodiflora* (L.) Gaertn., can inhibit germination and seed growth from tomato plants. This is evident when tomato seeds are given extract from the leaves of *Synedrella nodiflora* (L.) Gaertn. Seeds that have germination of about 35% of the total whole with a given solution concentration of 20%. Based on this, *Synedrella nodiflora* (L.) Gaertn. has the potential as an herbicide [16].

Tridax procumbens L. has allelopathic properties that can be used as a herbicide. Plants experiment (*Vigna radiata* L., *Dolichos biflorus* L. and *Vigna unguiculata* L.) given leaf extract from *Tridax procumbens* L. experienced germination inhibition, the higher the extract concentration (25%, 50% and 75%) given the percentage of germination getting smaller. In addition, inhibition also occurs in the shoots and root length, even at a concentration of 75% of the leaf extract can reduce the root length of about 3.4 cm and shoot length of 4 cm when compared with the control [33], so it can be concluded that *Tridax procumbens* has the potential as a herbicide.

Seeds (*Zea mays*, *Citrullus vulgaris*, *Abelmoschus esculentus*, *Vigna unguiculata*, *Glycine soja*, and *Arachis hypogaea*) given leaf extract from *Emilia sonchifolia* showed germination inhibition, even if the extract concentration was increased (0.2, 0.4 and 12 Mg ha⁻¹) almost all the percentage of seed germination decreased [38]. The results of phytochemical screening showed that the leaves of *Emilia sonchifolia* contained tannins, triterpenoids, saponins, anthraquinones, flavonoids and alkaloids, where several of these compounds were included in the allelochemical group [13]. Based on these results *Emilia sonchifolia* has the potential as a herbicides.

4. Conclusions

Asteraceae has 13 the potential as a natural herbicide, namely *Argeratum conyzoides*, *Galinsoga parviflora*, *Crassocephalum crepidioides*, *Calyptocarpus vialis*, *Sonchus arvensis*, *Eclipta prostrata*, *Synedrella nodiflora*, *Tridax procumbens*, and *Emilia sonchifolia*. Four types have not been revealed about allelopathic activity which can be used as an herbicide.

Distinctive character from *Argeratum conyzoides*, flowers do not have ligula, the type of inflorescence is the capitulum. *Galinsoga parviflora*, an acute apical leaf, forms of laceolate leaves. *Crassocephalum crepidioides*, flower tube in brownish red color. *Calyptocarpus vialis* have small stems, rough stem surfaces. *Sonchus arvensis* has the color of yellow flowers, leaves length 9 - 33 cm. *Tridax procumbens*, the shape of the stem is procumbent. *Emilia sonchifolia*, leaf base is auriculate, leaf attachment is decurrent. *Youngia japonica*, apical leaf is obtuse, yellow flower has ligule. *Eclipta prostrata*, the number of stamen is 4, the style is bifid. *Acmella paniculata*, leaf color is thick dark green, slippery leaf surface. *Synedrella nodiflora*, the shape of the stem is tetragonal. *Vernonia cinerea*, leaf arrangement is dextrorse. *Senecio vulgaris*, leaf arrangement is cauline.

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