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Agroecology and Uses of *Galinsoga parviflora* as Indigenous Vegetable in Highland of Kuningan, Banjarnegara and Wonosobo, Indonesia

Agroekologi dan Pemanfaatan Galinsoga parviflora sebagai Sayuran Indigenous di Dataran Tinggi Kuningan, Banjarnegara dan Wonosobo, Indonesia

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ABSTRACT

Gallant soldier (Galinsoga parviflora Cav.) is a cosmopolitan weed and is traditionally used as a vegetable in Java highland. The study aimed to evaluate agroecology and uses of G. parviflora as an indigenous vegetable in Java. Researches were conducted in Kuningan, Banjarnegara, and Wonosobo districts from June 2015 to July 2017. The distribution map was drawn from field tracks, interviews, and literature studies. Results revealed two Galinsoga species based on leaf and stem shape, i.e., G. parviflora and G. quadriradiata. Only G. parviflora was selected as a vegetable in Banjarnegara and Wonosobo, but not in Kuningan district. It ranked seventh among 13 traditional vegetables; young shoot with inflorescences was consumed after cooking or boiling, and sometimes used as a diuretic. Although it contributed low to household diet, however, its position on the social relationship among neighbors was important. The wide distribution range of Galinsoga in Java is potential as a new vegetable. It is important to study the nutrient content of this vegetable to improve utilization.

Keywords: Asteraceae, Dieng, gallant soldier, jukut saminggu, weed

ABSTRAK

Mondreng (Galinsoga parviflora Cav.) adalah gulma kosmopolitan dan secara tradisional digunakan sebagai sayuran di dataran tinggi Jawa. Penelitian bertujuan mengevaluasi agroekologi dan pemanfaatan G. parviflora sebagai sayuran indigenous di Jawa. Penelitian dilakukan di Kabupaten Kuningan, Banjarnegara, dan Wonosobo dari Juni 2015 hingga Juli 2017. Peta distribusi diambil dari penelusuran lapangan, wawancara, dan studi literatur. Hasil penelitian menunjukkan ada dua spesies Galinsoga berdasarkan daun dan batang, yaitu G. parviflora dan G. quadriradiata. G. parviflora merupakan sayuran di Kabupaten Banjarnegara dan Wonosobo, tetapi tidak di Kabupaten Kuningan. Galinsoga termasuk satu dari 13 jenis sayuran tradisional; pucuk muda dengan bunga dikonsumsi setelah dimasak atau direbus, dan kadang-kadang digunakan sebagai diuretik. Sayuran Galinsoga berkontribusi rendah terhadap rumah tangga, namun peranannya dalam hubungan sosial antar tetangga relatif penting. Perlu dilakukan studi kandungan nutrisi untuk meningkatkan pemanfaatannya.

Kata kunci: Asteraceae, Dieng, gulma, jukut saminggu, mondreng

INTRODUCTION

French soldier or gallant soldier (*Galinsoga parviflora* Cav.; 2n =16; Asteraceae) is a native plant to Peru (Canne, 1983; Rai and Tripathi, 1984; Damalas, 2008; Oh *et al*., 2010; Shin *et al*., 2012; Surywanshi and Yadava, 2015). In Indonesia, *Galinsoga parviflora* is called by several names such as *batakacut*, *bribil*, *jukut saminggu,* and *mondreng* (Setyawati *et al*., 2015). The genus comprises 14 species mainly found in Mexico, and Central and South America; except *G. parviflora* and *G. ciliata* (Raf.) Blake which has been naturalized worldwide (Shin *et al*., 2012). They are mostly found in high altitudes (Jang *et al*., 2014). *G. parviflora* is known as an invasive, sympatric, and cosmopolitan weed in agriculture fields (Rai and Tripathi, 1984; Oh *et al*., 2010; Shin *et al*., 2012; Surywanshi and Yadava, 2015).

The plant is non-toxic and is used as a fodder for cattle (Ali *et al*., 2017). The shoot including leaves, stem, and the flower is used as a traditional vegetable in Zimbabwe and South America (Chipurura *et al*., 2013; Maroyi, 2013;

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Patharaj and Kannan, 2019), anti-inflammatory and wound healing of dermatological diseases, eczemas, lichens and snakebites (Bazylco *et al*., 2015; Patharaj and Kannan, 2019). It is a good source of phenolic acids, which can be useful for the prevention of cardiovascular and other chronic diseases (Chipurura *et al*., 2013). *G. parviflora* is a good source of magnesium and protein (Odhav *et al*., 2007). According to Odhav *et al*. (2007), 100 g fresh mass contains 41.0 kcal, 89.0 g moisture, 4.0 g protein, 0.5 g fat, 1.2 g fiber, 1.7 g ash, 5.3 g carbohydrate, 17.8 mg calcium, 4.2 mg phosphorus, 4.0 mg potassium, 4.8 mg mangan, 0.3 mg cuprum, 1.5 mg zink, 74.9 mg magnesium, and 3.0 mg iron. Phytochemical evaluation by Patharaj and Kannan (2019) shows the plant extract contains an alkaloid, phenol, flavonoid, sterol, and terpenoids indicating great medicinal properties. In Indonesia, the *G. parviflora* exists in Sumatra and Java islands (Perdana *et al*., 2013; Surywanshi and Yadava, 2015). People in central Java use the shoot as a vegetable, however, the report was rare.

Studies on indigenous vegetables are mostly based on their association with limited community access to commercial vegetables, including the famine situation of middle-low income families (Leonti, 2012). The indigenous vegetables are commonly traded locally and they become an important part of food security, traditional medicine, nutrition, and source of income (Adhav *et al*., 2007; Andarwulan *et al*., 2012; Cruz-Garcia and Price, 2012; Leonti, 2012; Maroyi, 2013; Bazylco *et al*., 2015). Santosa *et al*. (2015) has indicated increasing consumer interest in non-pesticide vegetables and ethnic vegetables in West Java. The present study aimed to evaluate agroecology and uses of *Galinsoga parviflora* as an indigenous vegetable in Java.

MATERIALS AND METHODS

Study Sites

Fieldwork was carried out in Kuningan district around Mt. Ciremai of West Java, and Banjarnegara and Wonosobo districts around Mt. Dieng of Central Java (Figure 1) from June 2015 to July 2017. These districts were considered as potential gathering places of the Galinsoga species based on the preliminary evaluation. Mt Dieng area known as Dieng Plateau, is the center of vegetable production in Central Java, while Mt Ciremai in Kuningan is one of the centers of vegetable production in West Java. Ten villages were evaluated, i.e., Cisantana and Kuningan (Kuningan District), Sembungan and Garung-Menjer (Wonosobo District), and Binangun, Leksana, Kubang, Kepakisan, Pekasiran, and Surenan villages (Banjarnegara district) (Table 1). These villages represented the main center of vegetable production in each district.

Data Collection

Galinsoga specimen was evaluated according to Kabuce and Priede (2010). The specimen was considered as *Galinsoga parviflora* Cav group that had soft/rare or without hairs on the stem, leaves, or peduncle irrespective of single, double, or 3 toothed ray florets, and leaf margin less serrate or smooth. Otherwise, it was *Galinsoga quadriradiata* Ruiz & Pav group if the stem, leaves, and peduncle had coarse hairs, 4-5 white and 3 toothed ray florets, and serrate leaf margin.

In each village, Galinsoga was observed at different sites: 1) intensive-cultivated fields (farm and home garden); 2) least intensive-cultivated fields (under the canopy of perennial plants); 3) uncultivated fields (fallow lands, conservation lands, and pastures); 4) ruderal areas (roadsides, paths, and farm tracks); and 5) aquatic environments (ponds, gutter, streams, water reservoirs, and irrigation ditches near farmlands). In each site (when available), three to four plots (seized about 20 m x 20 m of each) were separated by about 0.1-0.5 km were visited.

In each village, at least 10 farmers were interviewed using open questions. The farmers were determined based on the field survey following the main road in the village of different hamlet. In each hamlet, 3-4 farmers working in the field were visited randomly and interviewed. The culture

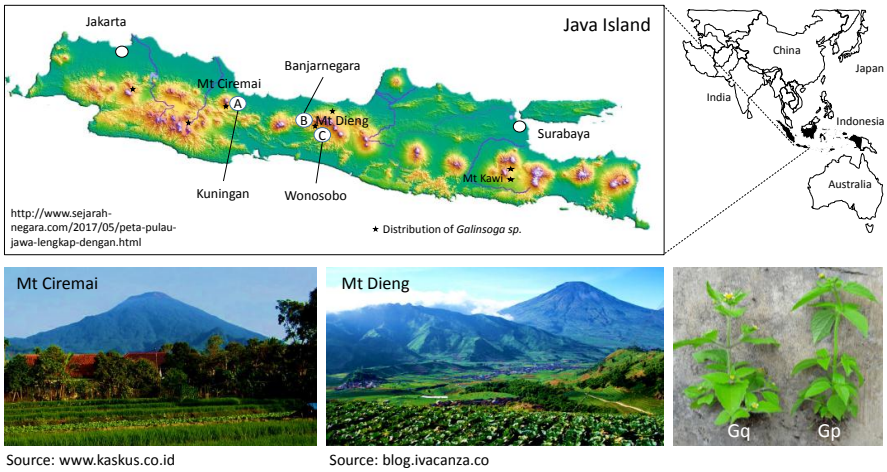

Figure 1. Study site of Kuningan (A), Banjarnegara (B), Wonosobo Districts (C) and *Galinsoga sp* distribution in Java. View around Mt. Ciremai and Mt. Dieng. Gq-*Galinsoga quadriradiata*, Gp-*Galinsoga parviflora*

Table 1. Description of the study site

District	Site	UTM coordinate	Temp. (°C)		Wet month[z]	Rainfall (mm)[y]	Altitude (m)[x]
			Min	Max			
Kuningan	CI	-6.94330, 108.43589	17-20	22-25	9	2,230	1,116
	KU	-6.98590, 108.47436	22-24	30-33	8	2,230	510
Banjarnegara	BI	-7.26296, 109.71419	18-22	25-29	8	2,157	1,025
	LE	-7.26924, 109.74151	18-22	25-29	8	2,157	1,026
	KB	-7.27289, 109.74591	18-22	25-29	8	2,157	1,002
	KP	-7.19728, 109.88588	8-10	17-19	8	2,650	1,944
	PK	-7.19020, 109.85278	8-10	17-19	8	2,650	1,901
	SU	-7.19720, 109.85672	8-10	17-19	8	2,650	1,774
Wonosobo	SE	-7.23683, 109.92387	8-10	17-19	8	2,650	2,160
	GA	-7.27229, 109.92103	18-20	25-27	10	4,088	1,240

Note: [z]Monthly precipitation > 100 mm, dry month <100 mm; [y]Estimated annual rainfall from closer weather station; [x]estimated by Mapfinder software; BI-Binangun, CI-Cisantana, GA-Garung Menjer, PK-Pekasiran, KB-Kubang, KU-Kuningan, LE-Leksana, KP-Kepakisan, SE-Sembungan, SU-Surenan village

technique was determined through an interview with farmers with farms seized 0.25 ha or larger. The production rate per hectare was estimated by converting the average yield of a 25-meter square plot into a land size of 10,000 m^2. The yield of a plot could be overestimated due to the variation in species of the main crop, and agriculture techniques including manure and mulch applications. Harvesting time was determined when the first terminal flower bloomed; harvesting followed farmer practice. The uses of harvested Galinsoga was rank altogether with other indigenous vegetables, i.e., selling to market, self-consumption, fulfill family nutrition, social function as a gift to other families, exchanged vegetables with other families, and others including as a feed. The method follows Santosa *et al*. (2003). Before the interview, we listed the thirteen most common traditional vegetables based on previous information from selected farmers.

Consumption rates were evaluated through an interview with 10-16 middle-up income consumers in each village. The respondent had a monthly income of 5 million rupiahs (about US$ 500) or more, considering they had an independent decision to consume the indigenous vegetable, unlike low-income consumers. The consumers also relatively well-educated (senior high school or higher), open-minded, and had a broad social relationship. The respondents included government officers (6.8%), businessmen (6.8%), merchants (8.5%), public service (7.7%), farmers (55.6%), and others (14.5%); and some consumers had more than one job. The consumer preference was asked on 13 traditional vegetables similar list to the farmer interview using simple method follows Santosa *et al*. (2003) and Kolli *et al*. (2016). In brief, respondents ranked the vegetables from 1 to 13, with 1 as the most preferable and 13 as the last. In case the respondent did not familiar with particular species, it was omitted from the calculation. Based on the average rank denoted by respondents in a village, then a new rank of the vegetables was developed representing the village preference.

In each district, a subdistrict market close to targeted villages was visited, and the availability of indigenous vegetables was recorded. In each market, 5-10 vegetable merchants were randomly interviewed. A vegetable was classified as marketable if a merchant at least traded it once a year.

RESULTS AND DISCUSSION

Uses

Galinsoga is locally called *anoni* (Kuningan), and *jangkung* and *ndosmen* (Banjarnegara and Wonosobo Districts). Two species were found in all sites, i.e., *G. quadriradiata* (hairy) and *G. parviflora* (smooth) (Figure 1). Only *G. parviflora* predominantly was consumed; the shoot was used as a vegetable in Banjarnegara and Wonosobo Districts but never been consumed in Kuningan District (Table 2). Farmers and consumers preferred species based on bright green leaf with soft/rare hair/ hairless and weak pungency referred to *G. parviflora*. They refused to harvest *G. quadriradiata* because of hairy leaves.

Among local vegetables, the consumer preference for Galinsoga ranked 6.5 (Table 2). It was likely that higher preference for Galinsoga consumption in Sembungan and Binangun villages due to the higher availability of the plant among the study sites. Conversely, in the lower altitude villages such as Leksana and Garung where the Galinsoga was less abundant, the Galinsoga only was consumed rarely depend on the availability.

In Pekalongan, a district nearby Banjarnegara, people boiled Galinsoga plant and drank the water as a tea for a diuretic. Similarly, people in Banjarnegara claimed Galinsoga tea had diuretic and refreshment effects. Freshness feeling after drink the tea of *G. parviflora* could relate to the antioxidants content, as stated by Odhav *et al*. (2007). Bazylco *et al*. (2015) determined caffeoylglucaric acids and

Table 2. Rank of indigenous vegetables by consumer preference in Kuningan, Banjarnegara, and Wonosobo districts

No	Vegetable (Family/Common/local name)	Kuningan		Banjarnegara					Wonosobo			Avg. rank[z]
		CI	KU	LE	KB	BI	KP	PK	SU	SE	GA	
1	*Carica papaya* Linn. (Caricaceae/papaya/ gandul)	7	7	5	9	4	3	4	5	7	6	5.7
2	*Centella asiatica* L. (Apiaceae/Indian pennywort/Pegagan)	9	8	9	13	11	-	-	-	11	12	10.4
3	*Cosmos caudatus* Kunth (Asteraceae/wild cosmos/Kenikir)	3	6	11	8	10	8	8	8	10	9	8.1
4	*Emilia sonchifolia* (L). DC ex Wight (Asteraceae /Red tasselflower/Lengko)	-	-	13	10	12	-	-	-	12	13	12
5	*Galinsoga parviflora* Cav (Asteraceae /Gallant soldier/Jangkung)	-	-	8	7	5	6	6	6	3	11	6.5
6	*Limnocharis flava* (L.) Buchenau (Limnocharitaceae/Velvet leaf/Genjer)	5	3	12	11	-	-	-	-	-	4	7
7	*Manihot esculenta* Crantz (Euphorbiaceae/ casava/kopral)	6	9	3	3	2	5	7	3	8	3	4.9
8	*Nasturtium officinale* R. Br (Brassicaceae/ Watercress/Kenci)	8	2	6	4	6	9	9	10	4	2	6
9	*Ocimum basilicum* L. (Lamiaceae/Basil/ kemangi)	2	1	10	12	7	10	10	9	9	10	8
10	*Sechium edule* (Jacq.) Sw. (Cucurbitaceae/ Chayote/Lung waluh)	1	4	1	2	3	1	1	1	1	1	1.6
11	*Solanum nigrum* Mill. (Solanaceae/ nightshade/Ranti kebo)[y]	4	5	2	1	1	2	2	2	2	5	2.6
12	*Xanthosoma sagittifolium* (L.) Schott. (Araceae/Elephant ear/Lumbu putih)	-	-	4	5	8	4	3	4	5	7	5
13	*Xanthosoma sagittifolium* (L.) Schott. (Araceae/Elephant ear/Lumbu ireng)	-	-	7	6	9	7	5	7	6	8	6.9

Note: [z]High rank less preferable; [y]People uses fruits in Kuningan and shoot in Banjarnegara and Wonosobo districts; '-'not available in the market, not familiar or not for consumption. BI-Binangun, CI-Cisantana, GA-Garung, PK-Pekasiran, KB-Kubang, KU-Kuningan, LE-Leksana, KP-Kepakisan, SE-Sembungan, SU-Surenan village

flavonoids such as patulitrin, quercimeritrin, quercitagetrin, phenolic acids-caffeic and chlorogenic acids; and Dudek *et al*. (2016) determined the caffeoyl-altraric acid derivatives from Galinsoga leaves.

Many farmers refused to harvest Galinsoga and other indigenous vegetables in their farms because it had a low market value, high cost of collection, and the amount was a little. Therefore, farmers mostly used indigenous vegetables for self-consumption (Table 3). However, it was not aimed to fulfill family nutrition. In Leksana and Kubang villages, some farmers utilized the Galinsoga shoot altogether with *Emilia sonchifolia* as a feed of rabbit, guinea pig (locally called *marmut*), and goat; like in Uganda (Mwesigwa *et al*., 2015) where Galinsoga is utilized as a feed of chicken.

Trading and Consumption

Galinsoga shoot was available in the local market irregularly. Most vegetable merchants replied that they were able to provide it by request five days in advance, except the merchants in Kuningan market who did not recognize the Galinsoga as a vegetable. A merchant in a market of Karangkobar subdistrict sold 5 to 7 kg Galinsoga shoot in a day by request in advance. She bonded 40 to 50 shoots into a bunch of about 0.4 to 0.5 kg (called *unting*) fetch Rp 500-1,000 (equal to US$ 0.05-0.10). Vegetable price was unlikely to be a constrain for respondents in Banjarnegara and Wonosobo districts. The price was considered low as compare to pak choi vegetable, Rp 1500-2000 (equal to US$ 0.15-0.2) for one bunch.

A family with 2-3 members prepared two bunches or more for one serving. Before cooking, the shoots were cleaned by removing the old stem and mature flowers, leaving about 35 to 50% edible portion based on the weight of a bunch available in the market. Consumers avoided old shoot or full blooming florets because tasted pungent, irrespective of the hairy level.

Some families in Leksana village bought an extra amount and shared it with neighbors or relatives. Sharing food is a common practice among neighbors in mountainous

Table 3. Farmer's reason to harvest *Galinsoga parviflora* and other indigenous vegetables in Banjarnegara, Kuningan, and Wonosobo districts

No	Vegetables[Z]	Sell to market	Self-consumed	Fulfill family nutrition	Social function (gift)	Exchanged with other families	Other[Y]
1	*C. papaya*	4	1	3	2	5	6
2	*C. asiatica*	3	2	6	4	5	1
3	*C. caudatus*[X]	6	1	3	5	4	2
4	*E. sonchifolia*	6	3	5	4	2	1
5	*G. parviflora*	5	1	6	2	3	4
6	*L. flava*[X]	2	1	5	3	4	6
7	*M. esculenta*	2	1	4	3	5	6
8	*N. officinale*	1	4	5	2	3	6
9	*O. basilicum*	2	3	4	6	5	1
10	*S. edule*	1	2	3	4	5	6
11	*S. nigrum*[T]	2	1	5	3	4	-
12	*X. sagittifolium*- Lumbu	2	1	6	4	5	3
13	*X. sagittifolium*- Lumbu ireng[V]	2	1	3	6	5	4
	Average	2.9	1.7	4.5	3.7	4.2	3.8

Note: [Z]Pooled of 117 farmers: 1 = first rank and 6 = lowest rank; [Y]including feed and medicine; [X]only available in Kuningan district, less available in other districts; [V]consumed by some respondents in Karangkobar subdistrict, but only available in Kalibening subdistrict market; [T]fruit in Kuningan district, and shoot in Banjarnegara and Wonosobo districts

Banjarnegara and Wonosobo districts as part of social relationships. Half of the respondents consumed Galinsoga monthly, followed by every six months (Table 4). Galinsoga was mostly consumed as a traditional salad (80%) followed by soup (20%). As a traditional salad, the shoot was initially boiled for about 5-10 minutes and the water was discharged to remove pesticide residue. It was consumed as *urap* (mixed with shredded coconut and paste of candlenut, garlic, onion, chili, coconut sugar, and salt) or simply with chili paste (*sambal*). The Galinsoga soup was prepared with leaves of cassava, nightshade, and pak choi. It was stir-fried with herb paste made of galanga, garlic, salt, fried onion and served when it still hot.

Economic Value and Agroecology

Galinsoga was an important weed in the vegetable fields of leek, cabbage, carrot, chilly, tomato, and pak choi

Table 4. Frequency on galinsoga intake among respondents upon availability in the market

District	Village name	Preference for consumption (percentage)[Z]				Total respondents
		Weekly	Monthly	6-monthly	Annually	
Kuningan	Cisantana	-	-	-	-Y	10
	Kuningan	-	-	-	-Y	12
Banjarnegara	Binangun	2 (17)	7 (58)	3 (25)	-	12
	Leksana	1 (6)	12 (75)	3 (19)	-	16
	Kubang	-	8 (80)	2 (20)	-	10
	Kepakisan	1 (8)	6 (50)	3 (25)	2 (17)	12
	Pekasiran	-	7 (54)	6 (46)	-	13
	Surenan	-	3 (27)	6 (55)	2 (18)	11
Wonosobo	Sembungan	-	6 (60)	4 (40)	-	10
	Garung	-	5 (46)	5 (46)	1 (8)	11
	Average (%)	3.8	56.3	34.5	5.4	

Note: [Z]Consumed as salad, pecel, soup, or mixed with other vegetables; [Y]most respondents want to try to consume

fields such as in Kepakisan and Pekasiran villages (Table 5). In Garung village, some farmers maintained Galinsoga in the home garden as a vegetable, although it was claimed as a weed in home gardens of banana in Leksana village. The Galinsoga existed under the canopy of *terong mener* (*Solanum betaceum* Cav.) and papaya (*Carica papaya*) fields in Sembungan, Pekasiran, and Kepakisan villages, therefore, the Galinsoga became dominant weeds in the Dieng area, irrespective of crops. According to Setyawati *et al*. (2015), *G. parviflora* predominantly grows in the open area and disturbed ground.

Many farmers in Kepakisan, Pekasiran, and Surenan villages claimed Galinsoga as an indicator plant of fertile soil, and help to control soil erosion. According to Guo *et al*. (2008) leachate of *G. parviflora* could accelerate germination and seedling growth of *Brassica pekinensis*, although aqueous leaf extract at rate 80 g L^{-1} inhibits the seeds germination and seedling growth of *Raphanus sativus*, *Brassica chinensis*, and *Lactuca sativa* var romana. Some farmers maintained the Galinsoga as an insect trap crop in the farm of carrot, leek, maize, cabbage, and other Brassicaceae families. According to Yuliadhi *et al*. (2013), the Galinsoga flower provides a nest site for *Diadegma semiclausum*, a parasite of *Plutella xylostella* in the cabbage field. In Malang, Ilmiyah (2015) identified *G. parviflora* as a host plant for *Menochilus sexmaculatus*, a predator of *Aphis brassicae* dan *Myzus persicae* in cabbage.

According to farmers, growing Galinsoga was simple. It abundant in fertile, high organic matter and well-drained soil with pH 4.8 to 6.0, however, it also available in less fertile soils. Undisturbed plants able to complete three times a life cycle a year; a life cycle required about three months. During a life cycle, the Galinsoga continuously showered seeds assisted by wind because the seed has pappus. According to Damalas (2008), the plant completes a life cycle within 45-50 days and produces regrowth from stem cutting. In Binangun village, the seedling started to grow in the early rainy season (September); and leaves were harvested around the end of September to November. In Leksana and Kubang villages, seedling available year-round in the field with supplement irrigation. According to Kastanja (2015), *G. parviflora* becomes a dominant weed within 18 days after soil plowing. According to Ivany and Sweet (1973), the seed germinates within 10 days at a rate of 99.3 to 100% under sunshine and 90% in the dark. Therefore, to express its fast coverage after soil plowing, people in Garut district, West Java calls Galinsoga as *jukut saminggu* (a-week-grass). In Banjarnegara and Wonosobo districts, a mature plant produced 200 to 400 florets, and each floret contained 24 to 50 seeds. Thus, a single plant approximately produced 4,800 to 20,000 seeds in a growing season.

Nevertheless, variability in Galinsoga infestation was found in the field according to microclimate (Table 6). Seedling mostly absent in fallow fields, except in Sembungan, Kepakisan, and Pekasiran villages. On the other hand, the seedling was abundant in intensive and semi-intensive fields, including around the aquatic body in Cisantana, Sembungan, and Kuningan villages that might facilitate seed dispersal into lower altitudes in those villages. Interestingly, many leek fields were free of Galinsoga seedling in Cisantana village-Kuningan. Unfortunately, vegetation analysis was not conducted at the present study therefore factor determined seedling availability among

Table 5. Presence of Galinsoga seedlings at different main crop in each study site

Crop name	Presence of Galinsoga seedling									
	Kuningan			Banjarnegara					Wonosobo	
	CI	KU	LE	KB	BI	KP	PK	SU	SE	GA
Banana	na	na	+	na	-	na	na	na	na	+
Beans*	-	-	+	+	+	+	+	+	+	+
Cabbage	+	na	+	+	+	+	+	+	+	+
Carrot	+	na	na	na	na	+	+	+	+	-
Cassava	-	+	+	-	+	na	na	na	na	-
Chilli pepper	-	+	+	+	+	na	+	+	na	-
Chinese cabbage	+	na	+	+	+	+	+	+	+	-
Leek	+	+	+	+	+	+	+	+	+	+
Maize	+	-	+	+	+	na	na	na	na	+
Pak choi	+	-	-	+	+	+	+	+	+	-
Potato	+	na	na	na	na	+	+	+	+	na
Sweet potato	+	+	+	+	-	na	na	na	na	-
Tomato	+	-	-	+	+	-	+	+	+	-

Note: na-no crop during study; '-' = absent, '+' = present; * including *kacang kapri* (*Pisum sativum* L.) and *kacang babi* (*Vicia faba* L). BI-Binangun, CI-Cisantana, GA-Garung, PK-Pekasiran, KB-Kubang, KU-Kuningan, LE-Leksana, KP-Kepakisan, SE-Sembungan, SU-Surenan village

Table 6. Presence of *Galinsoga parviflora* in the different microclimate in Kuningan, Banjarnegara, and Wonosobo Districts, Indonesia

Microclimate	Kuningan			Banjarnegara					Wonosobo	
	CI	KU	LE	KB	BI	KP	PK	SU	SE	GA
Intensive field	+++	+	++	+++	++	+++	+++	+++	+++	+
Less intensive	++	-	-	-	+	++	++	++	+++	-
Fallow lands	-	-	-	-	-	+	+	-	+	-
Ruderal sites	++	+	-	-	-	+	+	+	++	-
Aquatic side	++	+	-	++	-	+	+	-	+++	-

Note: BI-Binangun, CI-Cisantana, GA-Garung, PK-Pekasiran, KB-Kubang, KU-Kuningan, LE-Leksana, KP-Kepakisan, SE-Sembungan, SU-Surenan village; '-' not available, + denotes 1 to 10 seedlings, ++ denotes 11 to 50 seedlings, +++ denotes > 50 seedlings of average three plots sized 5 m x 5 m

microclimate still unresolved. It was noted that at the gutter of vegetable fields in Cisantana village present weeds of *Artimisia sp* and *Eupatorium sp*. It has been reported that seed germination is sensitive to allelopathy produced by *Artemisia dubia* (das Mallik *et al*., 2014) and *Eupatorium riparium* Regel (Rai and Tripathi, 1984) that may explain the absence of Galinsoga in fallow fields.

Future Challenge

In the intensive vegetable fields, cropping 3-4 times a year was common in the study sites. In previous cropping time, goat manures at a rate of 20-30 ton ha^{-1} was applied in Banjarnegara and Wonosobo districts, and amounted to 15-20 ton ha^{-1} in Kuningan district. Since farmers feed goats with flowering Galinsoga plants like in Binangun village, therefore, seeds bank was speculated high in goat manure leading to high seedlings growth after the application of the goat manure.

Recently, manure from chicken production had been adopted by approximately 90% of the vegetable production area in Banjarnegara and Wonosobo districts due to cheap and high availability than that of the goat manure. As a result, in the farms with regular application of chicken manure, Galinsoga seedling was nearly absent. Wichrowska and Jaskulski (2014) noted Galinsoga population decreases by 50% when manure was replaced by straw and mineral fertilization.

The application of plastic mulch covered about 60% of the field of study sites of Dieng. The mulch was installed to reduce weeding costs, soil erosion, and control rot disease. Kastanja (2015) stated that Galinsoga seeds undergo dormant under plastic mulch. In potato and cabbage fields of Kubang village, the average number of Galinsoga seedlings per square meter decreased from 56-2,550 in bare land to 0-38 seedlings in mulched-fields caused a yield reduction of Galinsoga from approximately 400-1,150 kg ha^{-1} to 20-50 kg ha^{-1}, respectively. Nevertheless, in potato fields in Kepakisan village farmers still able to collect Galinsoga shoots in mulched-field two months after the harvest of potato around July-August. Santosa *et al*. (2009) show that Galinsoga of both seedling and seed bank is absent in the tea plantation at altitude 480-1200 m above sea level. It is probable that under continuous shading like in the tea plantation, the Galinsoga lost the viability.

The present study demonstrated that Galinsoga is still important for vegetables in the mountainous area in Banjarnegara and Wonosobo Districts, although changes in the vegetable production technology might threaten its availability. Galinsoga is prospective as a future vegetable considering its wide distribution in Indonesia such as Java (Yuliadhi *et al*., 2013; Azalia *et al*., 2015; Ilmiyah, 2015), Tobelo-Maluku (Kastanja, 2015), Sumatera (Permana *et al*., 2013), and Bali (Yuliandhi *et al*., 2013; Sutomo, 2019). It was found at the cabbage field in Sembalun around Mt. Rinjani in Lombok during visitation in January 2017. The distribution of Galinsoga in Java is presented in Figure 1. The study also noted that lack of cooking skill determined the popularity of the consumption in Kuningan and young families in Wonosobo district. Therefore, promoting food sharing could be an important strategy to maintain the cooking skill of Galinsoga like in Banjarnegara communities.

CONCLUSION

G. parviflora was a common weed in the vegetable fields, and it was traditionally used as an indigenous vegetable in Banjarnegara and Wonosobo districts. It was harvested for self-consumption and sometimes traded locally. Increasing pesticide application in the farm, application of mulch, and chicken manure affected Galinsoga availability and consumption rate. In the future, it is important to study the culture technique and its nutrient content to improve utilization as an indigenous vegetable and medicinal plant in Indonesia.

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