Distribution and population density of the alang-alang gall midge, *Orseolia javanica* kieffer & van leeuwen-reijnvaan (Diptera: Cecidomyiidae)

P Hidayat*, I Aviansyah and B L Gumilang

Department of Plant Protection, Faculty of Agriculture, IPB University

*Email: phidayat@apps.ipb.ac.id

Abstract. Weeds is one of the remaining problems in the estate crops. Among the top ten noxious weeds is the cogongrass or alang-alang (*Imperata cylindrica*). The weed is easily dispersed, 60% of its biomass is under the ground and it is difficult to be controlled. Gall forming insect on alang-alang, *Orseolia javanica* (Diptera: Cecidomyiidae), is thought to have a potential as biocontrol agent. Gall midge-invested alang-alang will grow abnormal indicated by purplish colour, formed of tube-like leaves, and tapped on the end of the rod. A research was conducted to study the cogongrass gall midge distribution in West Java, Central Java, and Yogyakarta provinces as well as its population dynamic in Cianjur district. The distribution of cogongrass gall midge was found in the area with the altitudes of 331-1250 m above sea level. The highest population of the gall midge in Cianjur was 31 galls per m². There is a positive correlation between population dynamic of the gall midge in Cianjur and the rainfall intensity. The result of this study suggests that the gall formation density is relatively high despite high parasitization by hymenopteran was observed.

Keywords: cogongrass, estate crops, noxious weed, population dynamic

1. Introduction

Alang-alang or cogongrass, *Imperata cylindrica* (L.) Beauv. is an annual weeds that can breed generatively using seeds and vegetative using rhizomes [1]. Alang-alang is included in C4 plants which grow in areas with a rainfall range of 75-500 mm [2], and it is one of the most difficult weeds in the tropics and subtropics. Some common names of the weed in several regions, namely speargrass in West Africa, cogongrass in America [1], and alang-alang in Indonesia [3]. Alang-alang is spread over 500 million hectares worldwide [4]. Alang-alang in Southeast Asia reach 200 million ha [3] and several million ha in the southeastern United States [2]. It is estimated that the area of Alang-alang in Indonesia reaches 20-64.5 million ha [5]. The area of Alang-alang in West Java alone reaches 51 250 ha [6].

Some Alang-alang control techniques that have been used include the use of herbicides with active ingredients glyphosate [7], mechanics by pruning or pruning, and biologically. The majority of farmers control weeds using herbicides and pruning. Biological control of reeds has never been done. Natural enemies that have been reported to attack alang-alang are *Acrapex azumai* Sugi (Lepidoptera: Noctuidae) found in Japan [8] and the alang-alang gall midge *Orseolia javanica* Kieffer (Diptera: Cecidomyiidae) found
in Java, Indonesia [9]. The alang-alang gall midge is monophagous insect. In accordance with previous research conducted by Mangoendiharjo [9] in specific testing of hosts on several rice varieties and weed species, *O. javanica* attacks are only found in *I. cylindrica*.

Symptoms of alang-alang attacks are commonly found on the slopes of terraced rice fields which are dominated by weeds. Alang-alang that is infested by the gall midge have a reddish purple color, forming a pipe-like space, and at the end of the tapered stem [10]. Information on the distribution areas in the Provinces of West and Central Java reported by Mangoendihardjo [9] is less specific, because it only mentions location in general. In this study the location of the alang-alang gall midge distribution is shown to be more specific with clearer coordinate points. Population dynamic of alang-alang gall midge was recorded in Cianjur District precisely in Cibeureum Village, where most of the slope of rice field embankment is dominated by alang-alang. This study aims to determine the distribution of alang-alang gall midge in West Java, Central Java, and Yogyakarta Province as well as to find out the population dynamic in Cianjur district.

2. Materials and methods

Observation of the spread of alang-alang gall midge was carried out directly in several locations in Bogor, Cianjur, Klaten, Magelang, Salatiga, and Sleman districts. Observation of population density of alang-alang galls was carried out in Cugenang, Cianjur district, West Java Province. The geographical location of the village of Cibeureum is located at the coordinates of Lat: 6.7913889 Lng: 107.06875 with an altitude of 852 meters above sea level (m a.s.l.). The study was conducted from February to November 2016. Alang-alang with gall symptom was obtained from the field, while identification of parasitoids and data processing was carried out at the Insect Biosystematics Laboratory, Plant Protection Department, Faculty of Agriculture, IPB University.

Observation of the distribution of alang-alang galls was carried out directly in several regions in the provinces of West Java, Central Java, and Yogyakarta Special Region. The area of observation in West Java Province includes Bogor and Cianjur districts. The observation areas in Central Java Province included Magelang, Salatiga, and Klaten districts. The observation areas in the Special Region of Yogyakarta was carried out in Sleman district. Each district was chosen based on the height of the observation sites, from low to high altitude. The location of observations of the spread of alang-alang gall midges was carried out on the slopes of rice fields or open land dominated by weeds. One observation site consists of three points (1, 2, and 3) chosen randomly, each point consisting of four quadrants measuring 50 cm x 50 cm. The distance between quadrants is 4 m, the quadrant is used as an observation loop.

The parameters observed in each quadrant of the experiment were the number of healthy alang-alang and the number of alang-alang galls. Alang-alang gall consists of: no hole alang-alang gall which means that there are no insects coming out, alang-alang gall with a larger hole and there was an exuvium still attached indicated that gall midge emerged from the galls, and alang-alang gall with smaller holes indicated that parasitoid was emerged from the galls. The coordinates and height at each observation location are measured using a global positioning system (GPS).

3. Results and discussion

The area of the spread of alang-alang galls in West Java Province namely in Bogor and Cianjur districts, while the distribution of alang-alang galls in Central Java Province was in Magelang and Salatiga districts. Magelang district is a new reported location where alang-alang gall was discovered. Mangoendihardjo [7] added alang-alang gall was also found in other areas such as Pagilaran, Purwokerto, Salatiga, Sleman, Soropadan, Tegalgondo, Wonosobo, and Yogyakarta. Based on survey results there was no alang-alang gall found in Klaten and Sleman districts.

Alang-alang gall was found in Central Java and West Java Provinces are spread at an altitude of 331-1250 m a.s.l.. The distribution of alang-alang gall in Central Java Province found in Mungkid and Sawangan.
areas, Magelang district. The location of the alang-alang gall was found at 331 and 460 meters above sea level (m a.s.l.). In addition, alang-alang gall was also found in Kopeng and Argomulyo areas, Salatiga district, which were at the altitude of 691 and 1250 m a.s.l. (Figure 1). Alang-alang gall found in West Java Province was located in Cianjur District, namely in the areas of Gegbrong, Jambudipa, Cugenang, and Cibeureum. The locations were at the altitude of 460–854 m a.s.l., while in Bogor district alang-alang gall was only found in the Cisarua area at the altitude of 893 m a.s.l. (Figure 2).

Alang-alang gall found in the provinces of West Java and Central Java have almost similar environmental conditions, namely the environment around the area close to the mountain. This shows that the alang-alang gall have a preference for ambient temperature under relatively cool conditions and high humidity (79-84%). Based on the results of field surveys conducted, alang-alang gall was found at an altitude of 331-1250 meters above sea level.

![Map of alang-alang gall locations](attachment:map.png)

**Figure 1.** Sample locations for observing alang-alang gall flies; in Magelang and Salatiga Regencies, Central Java Province and Sleman District, Special Province of Yogyakarta.

The highest alang-alang gall population is found at an altitude of 331 m a.s.l. in the Mungkid area of 34 galls per m², followed by a parasitoid population of 15 parasitoids per m². The lowest alang-alang gall population was found at an altitude of 893 meters above sea level in the Cisarua area of 0.3 gall per m² and no parasitoids were found. The population of alang-alang galls at several elevations was recorded to be fluctuating. Based on the observation, it showed that the highest alang-alang population is 31 gall per m².
with an attack rate of 14.4% (Table 1). The high alang-alang gall population in the field is directly proportional to the level of alang-alang gall midge attack. The lowest alang-alang population occurred on June 16, 2016 at 6 gall per m² with an attack rate of 4.8%. The population of alang-alang tends to decrease in the first three weeks of observation. The population of alang-alang has increased until the sixth week of observation and continues to decline until the last week of observation.

Rainfall at the time of observation, from April to June, experienced fluctuations. The highest rainfall occurs in March at 603.3 mm per month. The population of Alang-Alang Alang in that month was 26 ganj per m² (Table 3). Changes in the average rainfall that occurs every month causes the population of alang-alang flies to fluctuate too. The higher the rainfall, the higher the Imperata grass population. This is in accordance with Mangoendiharjo [7], the population of alang-alang gall will be optimal in areas with high humidity. The results obtained are also the same as Aviansyah's study, low rainfall causes a decline in the alang-alang gall population which occurs in May and June [11].

Alang-alang gall with large holes and small holes shows the population of alang-alang gall and parasitoids in the field (Figure 3). Based on the observations of an increase in the population of alang-alang gall midge in the field, it tends to be followed by an increase in parasitoids. Some parasitoids that can attack alang-alang algae flies are Aprostocetus sp. (Hymenoptera: Eulophidae), Platygaster orseoliae (Hymenoptera: Platygastridae), Propicroscytus mirificus Girault (Hymenoptera: Pteromalidae) [11].
Overholt et al [12] mentioned that he failed to get the adult gall midge emerged because all his samples were parasitized.

**Table 1.** Healthy alang-alang, alang-alang galls, and percentage of gall-infested alang-alang per m² in Cibeureum village.

| Observation dates  | Average number of Uninfested alang-alang | Alang-alang with gall | Total of alang-alang | Percentage of alang-alang galls (%) |
|--------------------|-------------------------------------------|-----------------------|----------------------|-------------------------------------|
| 31 Maret 2016      | 193.7                                     | 26.0                  | 219.7                | 11.8                                |
| 07 April 2016      | 200.0                                     | 19.0                  | 219.0                | 8.6                                 |
| 14 April 2016      | 202.7                                     | 9.6                   | 212.3                | 4.5                                 |
| 21 April 2016      | 188.0                                     | 12.0                  | 200.0                | 6.0                                 |
| 28 April 2016      | 210.0                                     | 21.0                  | 231.0                | 9.0                                 |
| 05 May 2016        | 183.3                                     | 31.0                  | 214.3                | 14.4                                |
| 12 May 2016        | 202.7                                     | 29.0                  | 231.7                | 12.5                                |
| 19 May 2016        | 174.6                                     | 26.7                  | 201.3                | 13.2                                |
| 26 May 2016        | 178.7                                     | 13.3                  | 192.0                | 6.9                                 |
| 02 June 2016       | 145.7                                     | 10.7                  | 168.3                | 6.3                                 |
| 09 June 2016       | 110.0                                     | 10.3                  | 120.3                | 8.5                                 |
| 16 June 2016       | 119.0                                     | 6.0                   | 125.0                | 4.8                                 |

Figure 4 shows the regression equation curve between the average monthly rainfall and the Imperata grassland population per m². The relationship of rainfall to Imperata grassland population shows that the higher the level of rainfall, the Imperata grass population in the field will also be higher. After a regression analysis test, changes in the average rainfall that occurs every month to the Alang-Alang population is positively correlated and results in a linear regression equation \( y = 2.604 + 0.041x \) and based on the ANOVA test at 5% level obtained R² value of 0.939, which means changes in the average rainfall that occurs every month affect the alang-alang population of 93.9%, the rest is influenced by other factors outside the model.
Figure 3. Alang-alang gall population per m² in Cugenang, Cianjur: (Δ-) Gall with no emerged insects, (□-) The gall with parasitoid emerged holes, (O-) The gall with midge emerged holes.

Figure 4. Relationship between average monthly rainfall and population density of alang-alang galls.
4. Conclusion
Alang-alang ganjur flies are found in Bogor and Cianjur Regencies (West Java); Magelang and Salatiga (Central Java) are located at 331-1250 m a.s.l.. The average alang-alang population in Cianjur District from March to June 2016 is 17.8 galls per m2. The highest alang-alang population in Cianjur District was 31 galls per m2 with an average rainfall of 603.3 mm per month and the lowest was 6 galls per m2 with an average rainfall of 163.9 mm per month. The alang-alang population in Cianjur district showed positively correlated with rainfall. Further research needs to be done on the biology and effectiveness of alang-alang gall in the field to support the introduction to other areas as an environmentally friendly biological control.

References
[1] Brook R M 1989 Review of literature on Imperata cylindrica (L.) Raeuschel with particular reference to South East Asia. Int J Pest Manage. 35 12-25.
[2] Bryson C T and Carter R. 1993. Cogongrass, Alang-alang cylindrica, in the United States Weed Technol. 7 1005-9.
[3] Falvey J L 1981. Imperata cylindrica and animal production in South-East Asia: A review. J Exp Agricul. 15 52-6.
[4] Dozier H, Gaffney J E, Mcdonald K S, Johnson E R R L and Shilling D G 1998 Cogongrass in the United States: history, ecology, impacts, and management Weed Technol. 12 737-43.
[5] Suryatna E S and MacIntosh J L 1980 Food crops production and control of Imperata cylindrica (L.) Beauv on small farms Forestry Ecology and Management. 99 247-59.
[6] Garrity D P, Soekardi M, Noordwijk M V, Cruz R D L, Pathak P S, Gunasena H P M, So N V, Huijun G and Majid N M 1996 The Imperata grasslands of tropical Asia: area, distribution, and typology Agroforestry Systems 36 3-29.
[7] Miller J H 2003 Cogon Grass: Alang-alang Cylindrica (L.) (Palisot.Washington: Plant Conservation Alliance Alien Working Group)
[8] Takasu K, Yoshiyasu Y, Burrell A M, Klein P E, Racelis A, Goosby J A and Overholt W A 2014 Acrapex azumai Sugi (Lepidoptera: Noctuidae) as a possible biological control agent of the invasive weed Imperata cylindrica (L.) Beauv. (Poaceae) in the United States. Lepidoptera Sci. 65 30-5.
[9] Mangoendihardjo S 1980 Some notes on the natural enemies of alang-alang (Imperata cylindrica (L.) Beauv.) in Java Proceedings of BIOTROP Workshop on Alang-alang, ed B Soewardi (Bogor: Biotrop Seameo Regional Center for Tropical Biology) pp 47-55.
[10] Aviansyah I 2016 Populasi dan parasitoid lalat ganjur alang-alang Orseolia Javanica Kieffer & Vanleeuwen-Reijnvaan (Diptera: Cecidomyiidae) di Kabupaten Cianjur (Bogor : Bachelor thesis of IPB University)
[11] Buhl P N and Hidayat P 2016 A new species of Platygaster (Hymenoptera: Platygastridae) reared from Orseolia javanica (Diptera: Cecidomyiidae) on cogen grass, Imperata cylindrica (Poaceae) International Journal of Environmental Studies 73 1-7
[12] Overholt W A, Hidayat P, Ru B L, Takasu K, Goolsby J A, Racelis A, Burrell A M, Amalin D, Agum W, Njaku M, Pallangyo B, Klein P E and Cuda J P 2016 Potential biological control agents for management of cogongrass (Cyperales: Poaceae) in the southeastern USA Florida Entomologist 99 734-9.