Morphological and agroecological study of Purwoceng Gunung (*Artemisia lactiflora* wall.) in areas slopes of mount Lawu

B Pujiasmanto¹, M T S Budiastruti¹, D Setyaningrum¹ and R T Taufani¹,²

¹ Department of Agrotechnology, Faculty of Agriculture, Universitas Sebelas Maret, Indonesia
² Doctoral Program of Agricultural Science, Faculty of Agriculture, Universitas Sebelas Maret, Indonesia

Corresponding author: bambang_p56@staff.uns.ac.id

Abstract. This study aims to determine the distribution pattern, morphological and agroecological characteristics of Purwoceng Gunung. The research location on the slopes of Mount Lawu, around the Grojogan Sewu, Tawangmangu sub-district. The sampling point was determined based on purposive random sampling through a pre-survey. Determination of sample plots and analysis of vegetation using the transect (line) method. The results showed that the stem shape was round and segmented, smooth surface and green, oval leaf shape with serrated edges, compound leaves, pointed leaf tip, blunt leaf base, green leaf color with a length of 4 cm and a width of ± 2 cm. The location of the flowers at the end of the stem and classified as compound interest, fibrous roots with yellowish white color. The distribution pattern of Purwoceng Gunung was uniform with low population density of 6 individuals per plot and an INP of 4.4. Habitat agroecological conditions with climate type C with the following soil chemistry: C organic 5.8%, organic matter 9.9%, N 0.27 %, P 16.04 %, K 0.27 %, pH NaF 9.02, pH H2O 6.1, CEC 26, 9 me 100 g-1, field capacity 43.9. The proportions of dust, clay and sand were 27.4%, 9.4% and 63.2% respectively.

1. Introduction

The use of medicinal plants is increasingly in demand by people as alternative medicine. This is because plants contain many antimicrobial chemicals that can potentially be antimicrobial agents [1]. In the health sector, the incidence and prevalence of non-communicable and communicable diseases have increased; most of these diseases do not have adequate treatment [2]. Indonesia, as a country with high biodiversity, where at least 80% of medicinal plant species in Southeast Asia can be found in Indonesia, as both native and introduced plants [3,4]. One of the medicinal plants is Purwoceng Gunung. Purwoceng Gunung (*Artemisia lactiflora* wall.) is of the genus *Artemisia*. Artemisia (*Asteraceae*) is a heterogeneous genus containing 200–400 species distributed mainly in the temperate zones of Asia, Europe, and North America. Asia has the most variety of species, with 174 in the former Soviet Union, 150 in China, 50 in Japan, and 35 in Iran. This genus is a rich source of biologically active compounds, namely terpenoids, sesquiterpenoids, flavonoids, and coumarins [5].

Purwoceng is commonly known in public. The roots have diuretic properties and are used as an aphrodisiac and tonic, due to the properties of this plant that can increase stamina. Some people also
often refer to it as Viagra of Java [6]; however, less is known about the wild plants of Purwoceng Gunung. The morphology of the Purwoceng Gunung plant is similar to that of Purwoceng in general, but the properties of this plant are relatively different. Purwoceng Gunung has medicinal properties that can be used to cure diseases. The use of this plant is as an anti-inflammatory drug, menstrual smoothing, and laxative urine [7]. There is very little research on the Purwoceng Gunung plant, so information about the ecology and existence of this plant is still limited. Careful planning is essential for genetic conservation of medicinal plant species of priority list in Indonesia. Purwoceng Gunung is a native plant with limited distribution. The research objectives were to determine the distribution pattern, morphological and agroecological performance of the Purwoceng Gunung plant.

2. Materials and methods
The study was conducted from February to March 2012 on the slopes of Mount Lawu, especially in the forest area of "Grojogan Sewu" Tawangmangu sub-district, Karanganyar Regency, Central Java. The research location was chosen based on environmental factors that were thought to be similar to the conditions for the growth of Purwoceng Gunung plants and focused on the slopes of Lawu as the natural habitat of these plants. The sample point was determined based on purposive random sampling through a pre-survey approach where the plant could be found. The method of determining sample plots and vegetation analysis used in this study was the transect method (line). On the transect line, an observation plot of 20×20 m was made and adjusted to the conditions in the field.

3. Results and discussion
3.1. The morphology of Purwoceng Gunung plants
The morphology of the Purwoceng Gunung plant stem found in Tawangmangu with an age range of 5-6 months in natural habitats has a round and segmented shape; the surface is smooth and green, Oval-shaped leaves with jagged edges, belongs to the group of compound leaves where there are 3 strands of leaves in one petiole. The shape of the leaf is pointed at the tip, and the base is blunt. The color of the leaves is green with a length of about 4 cm and a width of ±2 cm. Flower morphology is classified as compound interest, located at the end of the stem, flower stalk length between 10–15 cm, green petals, star shape, diameter 0.5–1 mm, ivory white color. The plant has fibrous roots with yellowish-white color; height 65 cm, stem diameter 3–4 mm, number of primary branches 2–3, number of leaves 3 per petiole, root length 14 cm and number of root branches 17 (Figure 1).

Figure 1. Morphology of Purwoceng Gunung plants
3.2. Vegetation analysis of Purwoceng Gunung plants in their original habitat

Based on the data presented in Table 1, vegetation analysis was carried out in 5 plots with different locations. The results of the vegetation analysis for herbaceous plants in all sample plots showed that Purwoceng Gunung had lower average density than the other species. The number indicated by this species is only about 6; which means that this species presents in a very few numbers in the environment. In every plot observed, the presence of Purwoceng Gunung plants was almost non-existent, as in plots 3 and 4, which showed a zero value for this plant. Based on these findings, the existence of the Purwoceng Gunung plant needs attention so that it does not experience extinction.

The dominating species in this research location was Lentoran with a density value of 756; followed by Alshophila glauca, Scirpus sylvaticus, Hydrocotyle sibthorpioides, Kaempferia galangal, Eupatorium riparium, Ageratum conyzoides, Drymaria cordata, Duchesnea indica with the average density values of each. 290; 241; 89; 79; 67; 57; 27; 21. This density value is closely related to the importance of plants in the community. The importance of a species indicates the magnitude of the contribution of plant species in a community [8]. The development and changes in the importance of a plant species will show community dynamics [9].

| Table 1. Top ten herb vegetation density in the original habitat of Purwoceng Gunung |
|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Species             | K Square 1 (individual/m²) | K Square 2 (individual/m²) | K Square 3 (individual/m²) | K Square 4 (individual/m²) | K Square 5 (individual/m²) | Average |
|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Artemisia lactiflora| 25                 | 389                | 3140               | 216                | 37                 | 756                |
| Lentoran            | 0                  | 15                 | 0                  | 0                  | 0                  | 0                  |
| Alshophila glauca   | 279                | 140                | 187                | 197                | 664                | 290                |
| Scirpus sylvaticus  | 115                | 291                | 368                | 237                | 195                | 241                |
| Hydrocotyle sibthorpioides | 7 | 18                | 68                 | 203                | 150                | 89                 |
| Kaempferia galanga  | 131                | 12                 | 3                  | 0                  | 250                | 79                 |
| Eupatorium riparium | 176                | 36                 | 7                  | 47                 | 101                | 57                 |
| Ageratum conyzoides | 48                 | 37                 | 25                 | 74                 | 101                | 57                 |
| Drymaria cordata    | 0                  | 0                  | 69                 | 46                 | 21                 | 27                 |
| Duchesnea indica    | 0                  | 0                  | 6                  | 65                 | 0                  | 21                 |

Note: K is plant density

Based on the results of the vegetation analysis for herbs in all plots, Artemisia lactiflora species had a very low significance index (IVI) (Table 2). It can be concluded that this plant does not have an important role in the community because the contribution given is tiny. In contrast, the highest important value index was shown by the Lentoran species with a value of 97.4 followed by other plants such as Scirpus sylvaticus, Alshophila glauca, Hydrocotyle sibthorpioides, Kaempferia galangal, Eupatorium riparium, Ageratum conyzoides, Drymaria cordata, Duchesnea indica with IVIs of respectively 34.6; 33; 14.8; 13.7; 12; 11.7; 6.8 and 5.2 (Table 2). Every plant is the product of the conditions in which the plant lives; which can be used as environmental indicators [10]. Based on these data, it can be concluded that Lentoran has an important role in this ecosystem so that this plant can also be used as a marker and as a bioindicator of the environment.

| Table 2. Herb vegetation in all plots in their natural habitat |
|---------------------|---------------------|---------------------|---------------------|---------------------|
| Species             | Family              | RD      | RF      | IVI      |
|---------------------|---------------------|---------------------|---------------------|---------------------|
| Artemisia lactiflora| Asteraceae          | 0.33    | 3.95    | 4.4      |
| Lentoran            | -                   | 44.84   | 5.26    | 97.4     |
| Alshophila glauca   | Cyatheceae          | 17.19   | 6.58    | 33       |
| Scirpus sylvaticus  | Cyperaceae          | 14.3    | 6.58    | 34.6     |
| Hydrocotyle sibthorpioides | Apiaceae | 5.29    | 6.58    | 14.8     |
| Kaempferia galanga  | Zingiberaceae       | 4.69    | 5.26    | 13.7     |
| Eupatorium riparium | Asteraceae          | 3.9     | 6.58    | 12       |
| Ageratum conyzoides | Asteraceae          | 3.38    | 6.58    | 11.7     |
| Drymaria cordata    | Caryophyllaceae     | 1.61    | 3.95    | 6.8      |
| Duchesnea indica    | Rosaceae            | 1.24    | 2.63    | 5.2      |

Note: K is plant density, RD is relative density, RF is relative frequency and IVP is Important Value Index
Based on the results of the vegetation analysis for trees, the highest important value index (IVI) was indicated by the calliandra (Calliandra haematocephala) with a value of 71.9 (Table 3). Based on these data, it can be concluded that for the area around the "Grojogan Sewu" forest, calliandra plants have an important role in the ecosystem. Ecologically, this plant is suitable for living in highland areas such as the "Grojogan Sewu" forest, which has an altitude of about 1,800 meters above the sea level. Calliandra plants generally grow naturally along riverbanks and can grow quickly in areas where the vegetation is disturbed, such as roadsides [11]. Calliandra plants require daily environmental temperatures between 22–28°C, maximum monthly environmental temperature growth tolerance between 24 and 30°C, and minimum between 18 and 22°C. Based on observations in the field, calliandra plants will thrive quickly and tightly in open land and low nutrients [12].

Table 3. Tree vegetation in the original habitat of Purwoceng Gunung

| Species                  | Family         | K Square 1 | K Square 2 | K Square 3 | K Square 4 | K Square 5 | RD (%) | RF (%) | IVI  |
|--------------------------|----------------|-----------|-----------|-----------|-----------|-----------|--------|--------|------|
| Pinus merkusii           | Pinaceae       | 6         | 0         | 6         | 0         | 4         | 6.99   | 12     | 67.4 |
| Ficus amplus             | Moraceae       | 1         | 0         | 0         | 0         | 5         | 2.62   | 8      | 12.6 |
| Trema amoineuse          | Ulmaceae       | 1         | 0         | 0         | 0         | 1         | 0.87   | 8      | 9.5  |
| Musa paradisiaca         | Musaceae       | 7         | 11        | 4         | 8         | 11        | 17.9   | 20     | 60.8 |
| Swietenia mahagoni       | Meliaceae      | 5         | 0         | 22        | 3         | 0         | 13.1   | 12     | 31.9 |
| Bauhinia tomentosa       | Caesalpiniaeae | 1         | 0         | 0         | 0         | 0         | 0.44   | 8      | 9.1  |
| Calliandra haematocephala| Fabaceae       | 44        | 33        | 0         | 10        | 40        | 55.46  | 16     | 71.9 |
| Trevesia sundica         | Araliaceae     | 0         | 1         | 1         | 0         | 0         | 0.87   | 8      | 16.7 |
| Toona sinensis           | Meliaceae      | 0         | 1         | 0         | 0         | 3         | 1.75   | 8      | 20.4 |

Note: K is plant density, RD is relative density, RF is relative frequency and IVP is Important Value Index

Based on the results of the vegetation analysis for grasses, the highest important value index (IVI) was shown by the Selaginella unisina with a value of 203, followed by other plants such as Aneilema malabarium, Cyperus rotundus with IVIs of 61.3 and 35.8, respectively (Table 4). Based on these data, it can be concluded that Selaginella unisina has an important role in this ecosystem.

Table 4. Grass vegetation in the original habitat of Purwoceng Gunung

| Species                  | Family         | K Petak 1 | K Petak 2 | K Petak 3 | K Petak 4 | K Petak 5 | FR (%) | KR (%) | INP  |
|--------------------------|----------------|-----------|-----------|-----------|-----------|-----------|--------|--------|------|
| Cyperus rotundus         | Cyperaceae     | 69        | 13        | 0         | 0         | 1         | 23.08  | 9.59   | 35.8 |
| Selaginella unisina      | Selaginellaceae| 47        | 9         | 21        | 58        | 531       | 38.46  | 76.99  | 203  |
| Aneilema malabarium      | Commelinaceae  | 20        | 33        | 23        | 29        | 11        | 38.46  | 13.41  | 61.3 |

Note: K is plant density, RD is relative density, RF is relative frequency and IVP is Important Value Index

Determination of the distribution pattern is by testing the Chi-squared 1d value; if the X^2 value is smaller than the X^2 table, it shows that the distribution of the population is random, and if it is more significant, it is uniform [13]. Based on observations, the distribution pattern for Purwoceng Gunung plants in their natural habitat is uniform (Table 5). This is strongly influenced by the level of presence of this species in each sample plot. The FR value of 3.95% indicates the level of existence of this species; the frequency here significantly affects the spread of a species. If the level of presence of a species in a community is higher, it shows a clustered distribution pattern in that place. In addition, the distribution pattern is also influenced by the density of the species because the closer the species is to a community, the more clustered the distribution pattern is. Based on the results of observations and calculations, the KR value obtained is 0.33%. From the FR and KR values obtained, it is found that the importance of both are relatively small so that they can be related to the distribution pattern, which results are uniform.

Table 5. Distribution pattern of Purwoceng Gunung plants in their original habitat

| Habitat               | RF (%) | KR (%) | Scatter Pattern |
|-----------------------|--------|--------|-----------------|
| Hutan “Grojogan Sewu” | 3.95   | 0.33   | uniform         |

Note: KR is relative density, FR is relative frequency and INP is Important Value Index
3.3. Agroecological conditions of Gunung Purwoceng plants in their natural habitat

Based on observations of the microclimate in the original habitat of the Purwoceng Gunung plant in Tawangmangu, it has an average soil temperature of 22.84°C, soil moisture ± 80%, air temperature 26.1 %, air humidity 62%, and light intensity 1,311.04 FC (Table 6). In theory, the temperature is always inversely proportional to moisture, for the Tawangmangu area with an altitude of around 1,200 m above the sea level has relatively low air temperature. The component of micro-chemistry with very high fluctuation is indicated by the component of light intensity (Table 6). The macro-climatic factor that plays a significant role in the sun's intensity is solar radiation [14]. If the radiation obtained is greater, the intensity received will also be more significant. The presence of clouds will absorb and reflect radiation and reduce the amount of solar intensity transmitted to plants. This what makes the level of light intensity highly fluctuated. In addition, at the research site, fog often occurs, which also affects the reception of sunlight.

| Square | Soil temperature (°C) | Soil humidity (%) | Air temperature (°C) | Air humidity (%) | Light intensity (FC) |
|--------|-----------------------|-------------------|----------------------|-----------------|---------------------|
| 1      | 22.91                 | 74.48             | 25.56                | 62.93           | 970.74              |
| 2      | 23.61                 | 75.00             | 26.11                | 57.15           | 2,160.78            |
| 3      | 22.61                 | 78.30             | 25.44                | 66.48           | 784.04              |
| 4      | 22.87                 | 80.89             | 27.46                | 59.41           | 1,625.56            |
| 5      | 22.22                 | 76.30             | 25.67                | 63.81           | 1,014.11            |
| Average| 22.84                 | 76.99             | 26.1                 | 62              | 1,311.04            |

Note: data is based on measurements in each observation plot and is carried out 9 times a month

The soil analyzed from the original Purwoceng Gunung habitat in the Grojogan Sewu forest area belongs to the Andisol soil order (Table 7). Andisols are generally black and contain a lot of amorphous material [15]. Andisols have several important properties. Clay has a permanent low charge and a high pH-dependent charge. Aluminium poisoning is rare. Andisols can fix phosphate and have high water binding ability. The percentage of carbon tends to be relatively higher than other mineral soils [16]. Andisol soils are formed from volcanic materials with high organic matter and high cation exchange capacity [17].

| Parameter                | 1     | 2     | 3     | 4     | 5     | Average |
|--------------------------|-------|-------|-------|-------|-------|---------|
| C (%)                    | 5.77 st | 6.23 st | 6.39 st | 5.49 st | 5.06 st | 5.78 st |
| Organic material (%)     | 9.94 st | 10.75 st | 11.02 st | 9.47 st | 8.73 st | 9.98 st |
| N (%)                    | 0.26 s  | 0.27 s  | 0.27 s  | 0.31 s  | 0.25 s  | 0.27 s  |
| P (Bray)                 | 16.64 st | 14.73 t | 15.53 t | 17.65 st | 15.63 t | 16.04 st |
| K                        | 0.29 r  | 0.27 r  | 0.26 r  | 0.26 r  | 0.29 r  | 0.27 r  |
| Cation Exchange Capacity | 26.08 t | 26.72 t | 28.48 t | 27.04 t | 26.6 t  | 26.98 t |
| pH H₂O                   | 6.03 am | 6.1 am  | 6.07 am | 6.14 am | 6.14 am | 6.1 am  |
| pH NaF                   | 9.15    | 9.19    | 9.1     | 8.75    | 8.95    | 9.02    |
| Field capacity           | 42.24   | 43.62   | 44.08   | 43.35   | 46.15   | 43.9    |
| Dust                     | 23.81   | 35.60   | 21.25   | 22.82   | 33.55   | 27.4    |
| Clay                     | 11.26   | 9.83    | 10.52   | 7.11    | 8.12    | 9.4     |
| Sand                     | 64.93   | 54.57   | 68.24   | 70.07   | 58.35   | 63.2    |

Notes: st: very high, t: high, s: medium, r: low, sr: very low, sm: very sour, m: sour, am: slightly acidic, n: neutral, aa: slightly alkaline, a: alkaline

4. Conclusion

The morphology of the Purwoceng Gunung plant stem aged 5–6 months were round shaped and segments; the surface is green and smooth. Leaves are oval with serrated edges, including compound leaves. The shape of the leaf is pointed at the tip, and the base is blunt. Compound flowers located at the
end of the stem, flower stalk length 10–15 cm, green petals, star shape, diameter 0.5–1 mm. Fibrous roots with yellowish-white colour. Height 65 cm, stem diameter 3–4 mm, number of primary branches 2–3, number of leaves 3 per petiole, root length 14 cm and number of root branches 17. The distribution pattern of Purwoceng Gunung in its natural habitat is uniform, with a low population density of approx. Six individuals per plot and IVI.

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