

Conference Paper

Anatomy and Morphological Study of Mentigi Gunung (*Vaccinium varingiaefolium* (Blume) Miq.) in Area of Mount Batok-Indonesia

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Abstract

Mentigi Gunung (*Vaccinium varingiaefolium* (Blume) Miq.), endemic plant of Java which dominates sub-alpine area of Mount Batok. This study aimed to characterize plant's anatomical and morphological structure for conservation purpose. Microscopic and macroscopic approaches used for organs observation. Morphological observation showed that this plant has a tap root, circular stem with lenticels on its surface. It has red young stem with a lot of trichomes, brown old stem, oval leaves with integer margins. Leaves have stone cells, cuticles, idioblasts. Young leaves are red and turn green. Flowers are purple with five sepals, five petals, 10 androecium and one syncarp gynoecium. Trichomes spread all over flower structures. The type of microspore is tetraeder. The gynoecium sits on the receptacle composed of five carpellum with inpherus ovulus. The fruits are green, globular, with trichomes and turn black when ripe. It has stone cells with purple cytoplasm and golden brown seeds. Vascular bundle is opened collateral type; the type is parasitic with kidney-shaped guard cells.

Keywords: Anatomy; morphology; mentigi gunung; *Vaccinium varingiaefolium* (Blume) Miq.

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1. Introduction

Indonesia has a plenty of endemic plants which spread out over the nation. One of them is *Vaccinium varingiaefolium* (Blume) Miq. belongs to Ericaceae family. The local name of this plant is *Mentigi* or *Manis Rejo*, in different region for example in the West Java this plant famous by the name of *Cantigi Ungu*. This endemic plant has a smiliarity with billberry (*V. myrtillus*) and blueberry (*V. corymbosum*). Even this mentigi is to be called "the billberry of Java". In Java, this plant grows well in the area closed to sulphur vents or volcano region [1], such as Mount Batok. Therefore, it dominates the sub-alpine area of Mount Batok and Bromo (above 1 800 m to 2 000 m) [1, 2]. There is a rare study of this plant. This study was aimed to determine about the anatomy and morphological structure of this plant for conservation purpose.

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2. Materials and Methods

Mentigi Gunung [*Vaccinium varingiaefolium* (Blume) Miq.] sample was collected from Mount Batok area. Observation of roots, stems, leaves, flowers, fruits, and seeds was done using microscopic and macroscopic approaches and reference based on Hidayat [3] and Tjitrosoepomo [4].

3. Result and Discussion

Morphological observation showed that this plant has a tap root, circular stem with lenticels on its surface. The stem is woody (lignosus). In mount Batok, this plant categorized as an erectus shrub. The microscopic and macroscopic approaches showed *Mentigi Gunung* (*V. varingiaefolium*) has a spesific character. In some area mount in Java this plant can be found as shrub and dwarves [5, 6] and dwarf or little tree in the area near caldera [5] or sulphur vent or open area, extremely stony and rather dry places and grow as tree in rich humus area. It will be smaller in area with wind exposed [2].

The plant has plagiotropic axes with spreading and decurved branches. This plant is fire resistant, its stem is sprouted and is holding on volcanic mountain which still explode [2]. This plant has spesific sweet odor, we suggest it came from nectarium and osmophore [3].

Young stem is red with a lot of trichomes (see Figure 5A) and old stem is brown (see Figure 2). It has opened collateral type vascular bundle. Red young stem has red anthosianin in epidermic layer, primary xylem and primary phloem, cambium intervacular, and parenchimatous cell with chromoplasts in pith (parenchimatous). Old stem has secondary growth. Anatomical of lateral root showed decreases cortex area and pith (parenchimatous) absent (see Figure 5).

It has oval-shaped leaves with integer margin, its apex is gabled and its basis is unanimous. Young leaves are red with trichomes and the old ones are green (see Figure 2). The intervenium of leaf is like leather (coriaceus). It has pinnate venation (penninervis) and its vena like net. Phyllotaxis of this plant is spread (folia sparsa) and has leaves formula or divergences are $\frac{3}{8}$. The cross section of the leaves is dorsiventral type because mesophyll differentiation as palisade mesophyll and spongy mesophyll. The leaves have stone cells, cuticles on both sides, idioblasts. Stomata type is parasitic with kidney-shaped guard cells. Stomata belongs to base epidermic (abaxial layer) of leaf. Position of stomata according to epiderm layer is phanerophore (see Figure 4).

Flowers are purple inflorescence with 5 sepals, 5 petals, 10 androecium, and 1 syncarp gynoecium, trichomes are spread all over flower structures (see Figure 2). This is a complete flower or tetracyclic flower and hemafrodit. Flower is an epigyn structure (epigynus). The stamens are erectus. Its flower formula is:

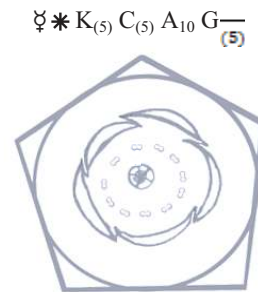


Figure 1: Flora diagrammatic.

The type of ovarium based on the position of ovulum and placenta is axillaris (see Figure 2I and 2J). The gynoecium sits on the receptacle composed of 5 carpellum with inpherus ovulus. Fruit is green, globular, with trichomes and turns black when its ripe. Fruits trichomes decrease when ripe. *V. varingiaefolium* fruits are closed fruit (*Fructus clausus*). The diameter of fruits is about 5 mm up to 15 mm. Longitudinal section of seeds shows if *V. varingiaefolium* has dicotyledon (see Figure 2N).

Then, anatomical observation showed the fruit has stone cells (see Figure 3G) with purple cytoplasm and golden brown seeds (see Figure 2J). This fruit also contains a unique sweet fragrance. The type of the microspore is tetraeder (see Figure 3E). The color of the corolla (petal) is purple with dark red in some area. In sepal, there is anthocyanin in some spot. In sepal and petals, epiderm layer is covered by cuticle in both sides of epidermic layer (adaxial and abaxial). It seems has an anthocyanin, the natural color leaves a stain in our hand if we try to touch it. Calyx is made of mesophil, vascular tissue, and adaxial and abaxial epiderm. According to the location of the androecium, the androecium sits to the basal area of the flower or it can be call as *Thalamiflorae*.

Some of the features in the *V. varingiaefolium* is found to have a lot of trichomes. Trichomes is a special structure from plants which live in the humid tension of region [7]. This condition based on the fact above is because of ecological condition, according to Unsworth [1, 8] said dried deposition rate depends on the concentration of SO₂ and H₂S, atmospheric turbulence and surface affinity. Wet deposition is controlled by precipitation, soil moisture as well as the air. Sulphur gas will be deposited into sulfuric acid and will fall to the ground as acid rain. In the soil, sulfuric acid will continue to

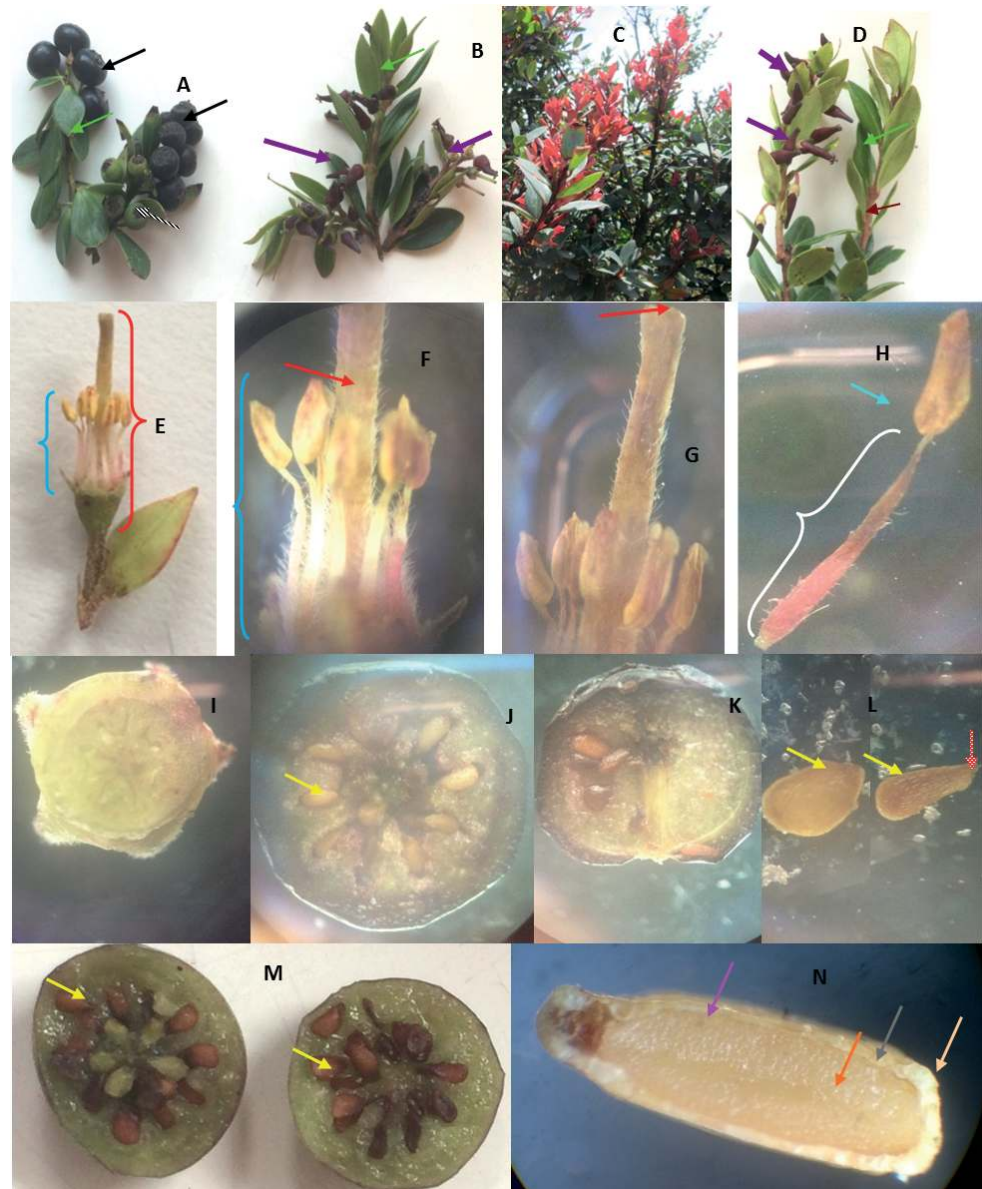


Figure 2: Morphology of *Mentigi Gunung* (*Vaccinium varingiaefolium* (Blume) Miq.), (F-L and N) stereo microscope;(A) Fruits and leaves, (B&D) inflorescence (Flowers), (C) red young leaves, (E-G) androecium and gynoecium, (H) Androecium, (I) Ovary, (J&M) Cross section of Fruit, (K) Longitudinal section of fruit, (L) seeds, (N) Longitudinal section of seed; color arrow; black:ripe fruits, black & white:young fruit, green:leaves, magenta:red young stem (Figure 4A), purple:flowers, red:pistillum (F:stylus and G:stigma), blue:stamen, cyan: Anthera,white:filamentum, yellow:seeds, orange:shoot apex, pink:cotyledon, grey:hypocotyl, peach:spermoderm, red&white:hilus.

ionized and develop into H^+ and SO_4^{2-} so that it will causing the soil to be more acid. Wet deposition mechanism is when SO_2 and H_2S in the soil lacking of sulphate, this condition will profitable for plants because sulphur is an element of essential nutrients, but in the exaggerated amount, it will become a toxic to the plant.

Transpiration is a loss of water in the form of water vapor from plant body through stomata, and also, it can flow through cuticles and lenticel [8, 9]. The characteristic

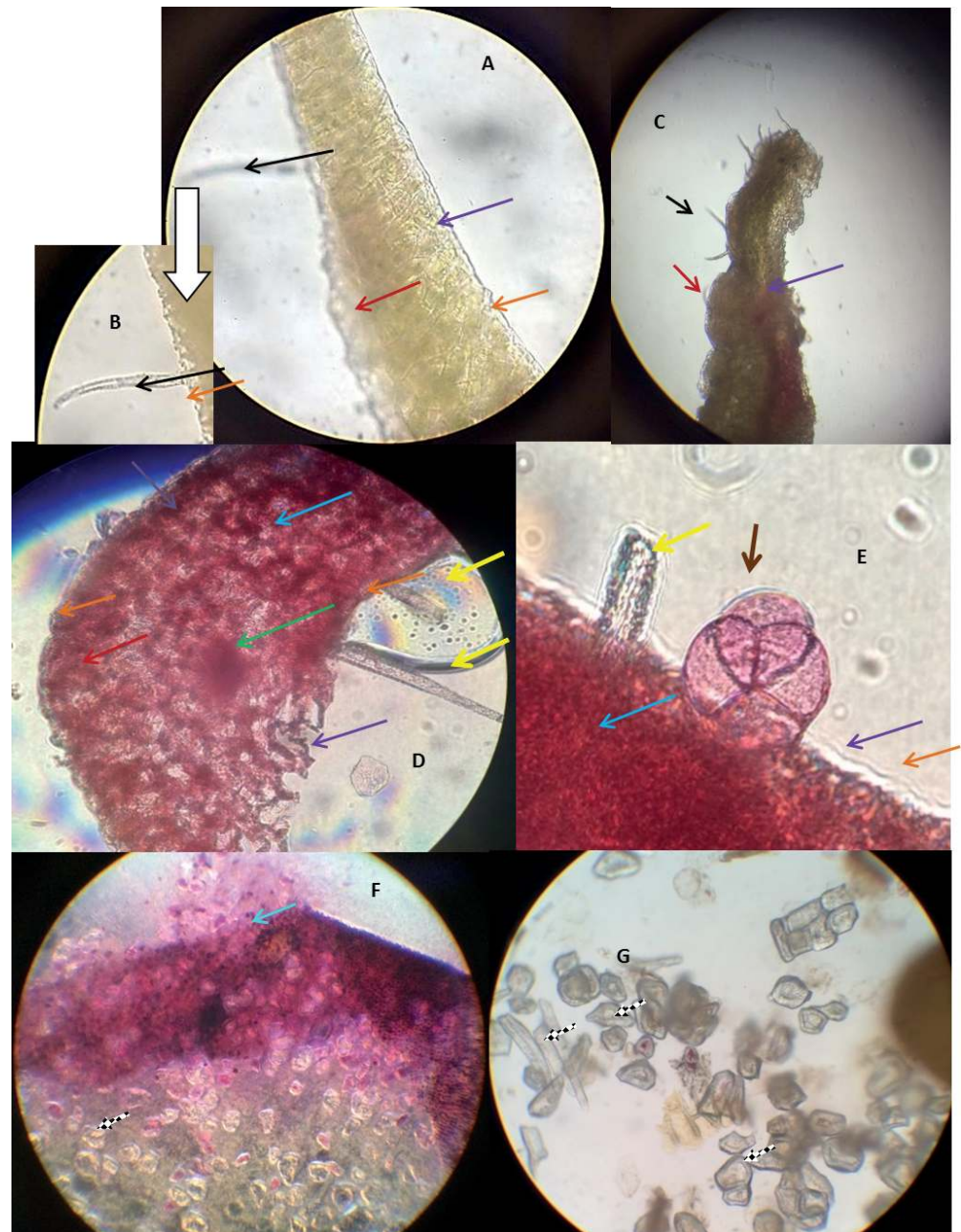


Figure 3: Anatomical of (A-D) flower and (F-G) fruit, (A-C) calyx, (D) corolla, (E) microspore tetraeder, (F) ripe fruit, (G) stone cell in fruit, arrow color; black:glandular trichomes, purple:adaxial epiderm, red:abaxial epiderm, orange:cuticles, chocolate:microspore tetraeder, blue:cell with anthocyanin,black & white:stone cell, yellow:non-glandular trichomes.

of the cuticle is an impermeable to water, and the transpiration that occurs in cuticles is relative very small [8, 10]. The presence of trichomes in *Vaccinium varingaefolium* caused by this ecological factor. It makes the plant producing a lot of trichomes. The plants use its trichomes to prevent the transpiration of water vapor from the body plant. Beside that, the exposure of sun is also one of the factors that control those feature.

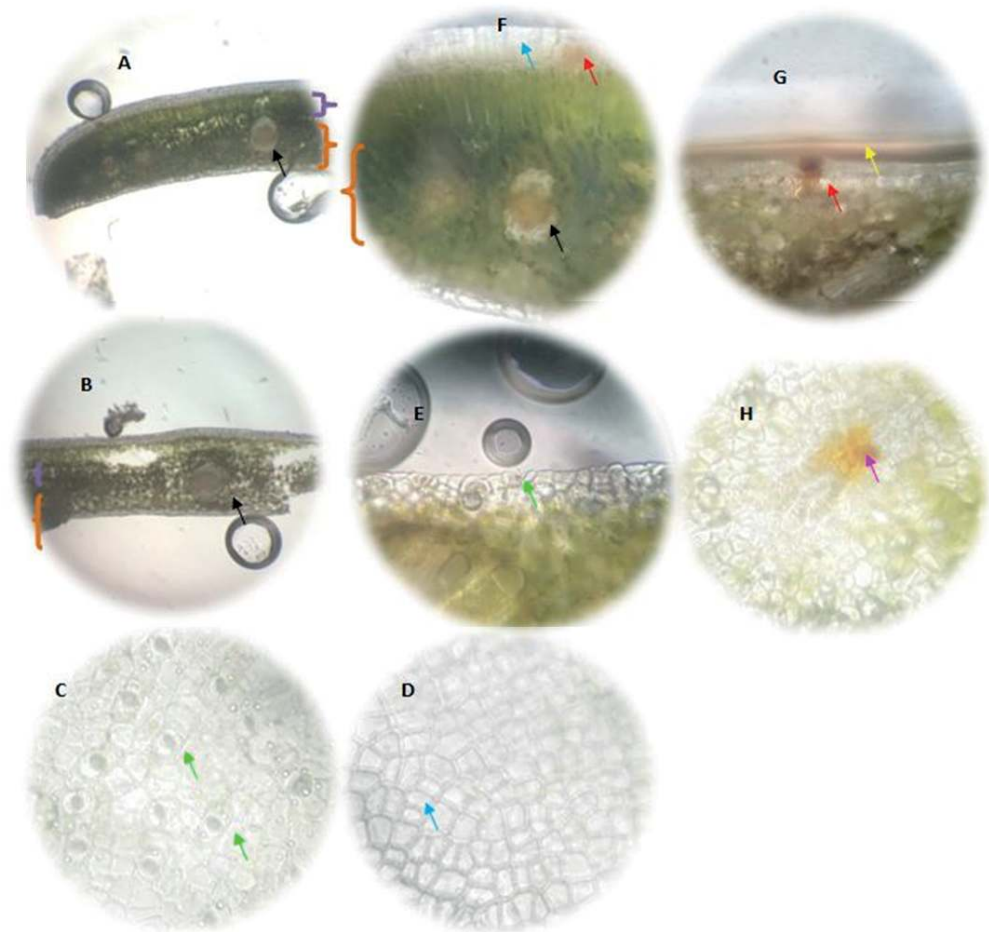


Figure 4: Anatomy of leaves *Vaccinium varingiaefolium* (Blume) Miq., (A, B, C and D) 10 × 10, (E, F, G, and H) 40 × 10; Color arrow; black: Vascular bundles, green:stomata of abaxial, red:idioblast, yellow:cuticles, purple:palisade mesophyll, orange:spongy mesophyll, blue:epiderm of adaxial, pink:stone cell, cyan: air cavity.

The exposure of the sun makes the environment even hotter and dried. This will affect the morphological structure of the roots. *V. varingiaefolium* has a tap root. As one of the Malesian *Ericaceae* according to the Heads [2] root particularly in crater fields and near solfataras, is very horizontal, and roots may attain large dimensions in such places. This is, of course, common to all plants growing on sterile, rocky, impervious or badly drained soils. Such roots also have a distinctly corky bark [2]. Based on that condition the root of *V. varingiaefolium* grows lengthwise according to its uses who absorb the water. The dried condition makes the root have to grow deeper into the soil.

This plants belongs to dicotyledons plants by several characters, specifically have an opened collateral bundles, have a pinnate venation, hermaphrodites, shrubby plants, and the veins of the leaves is similar to nets. Idioblasts from tannin can be found in *Craculaceae*, *Ericaceae*, *Fabaceae*, *Myrtaceae*, *Rosaceae*, and *Vitaceae* [7]. Dominant fragment in mentigi fruit is seed and stone cell [6].

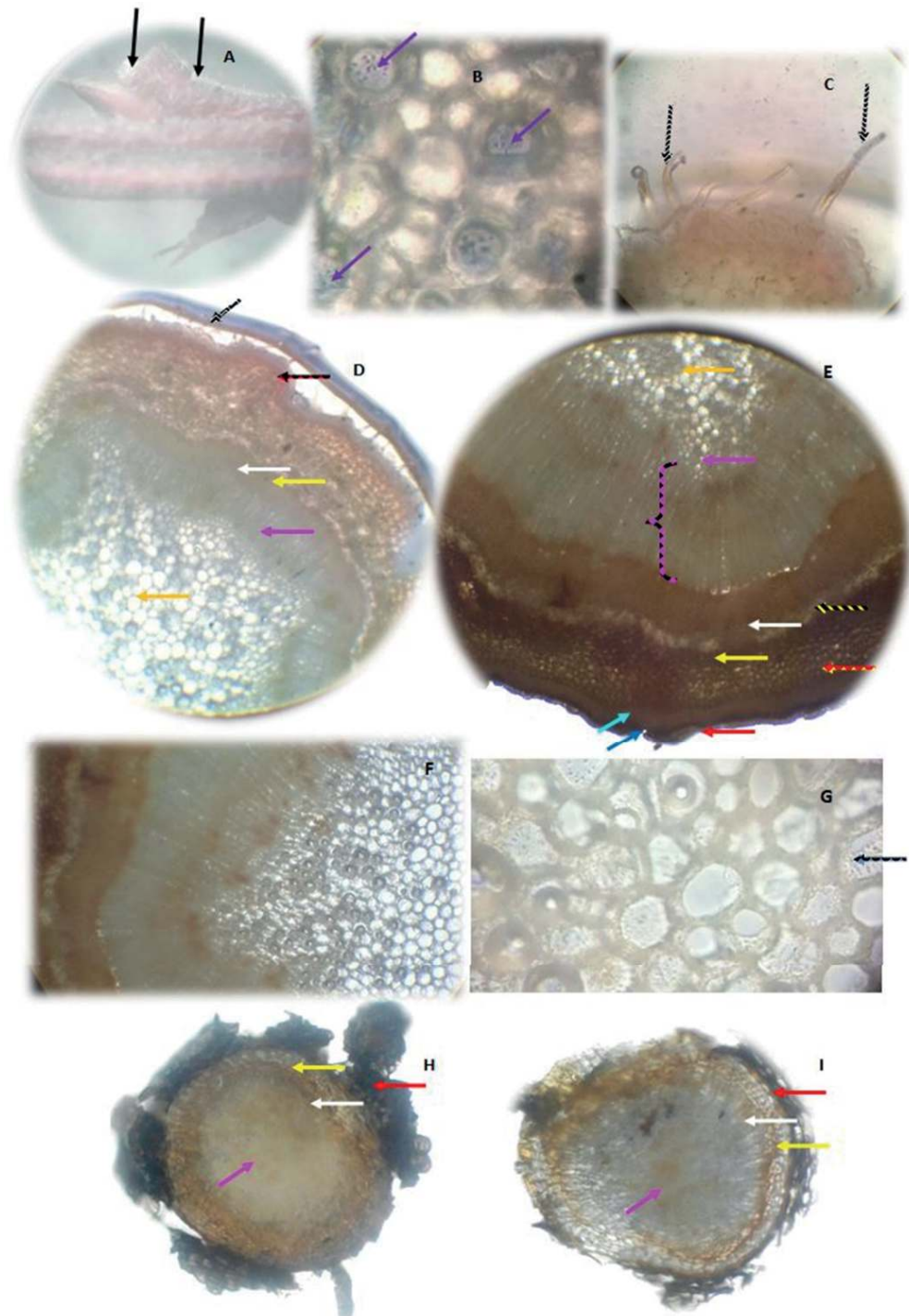


Figure 5: Anatomical structure of (A-D) young stem, (E-G) old stem and (H-I) lateral root, (A) stereo microscope of red young stem with trichomes, (B,C,G) 40 × 10, (D-F & H-I) 10 × 10, (B) empulur young stem, (G) empulur old stem with amilul color arrow:black:trichomes, black&white:glandular strichomes, purple: chromoplasts, orange:pith, red:epidermic, red&black:epidermic with red anthocyanin, blue:lenticel, cyan:periderm, white:cambium intervascular, yellow:primary phloem, pink:primary xylem, yellow&red:cortex, yellow&black:secondary phloem, pink&black:secondary xylem, black&blue:crystal.

Morphological and anatomical showed this plant rich with anthocyanin. This evidence with red color in young stem, young leaves, purple flower and black fruit. This



Figure 6: Variation of *V. varingiaefolium* Fruit's size, diameter 5 mm-12 mm.

anthocyanin exists in sepal (calyx) in few spot. First study chemical of anthocyanin showed *V. varingiaefolium* fruit has anthocyanin aglycon such as cyanidin, peonidin, delphinidin, petunidin and malvidin [6]. This anthocyanin aglycon similar with a compound of bilberry (*Vaccinium myrtillus* L.). Higher amounts of total phenolics (included anthocyanin) were detected in samples harvested from localities exposed to the sun than berries harvested in shadow [11]. Anthocyanins are responsible for the pink, red, blue, and purple color of plants [12]. The color is pH dependent; the color is red at $\text{pH} < 2$, changing to blue as pH increases and finally becoming colorless at high pH [12]. Fruits that harvest showed differences in size, in exposed sun region, fruit has longer diameter than in shadows area.

4. Conclusion

One of the dominant plants in Mount Batok is *Mentigi Gunung (Vaccinium varingiaefolium)* (Blume) Miq.) which is endemic *sub-alpine* plant in Java. This plant has specific characteristic such as trichomes that spread all over plant body and decrease in some old stem, ripe fruit and old leaves. This plant has trichomes, cuticles, lenticel, stomata which many more and smaller when this plant grow near sulphur vent or caldera, longer tap root, shrubby plant to adapted the dry condition. This plant has strong pigment such as anthocyanin, aglycone such as cyanidin, peonidin, delphinidin, petunidin and malvidin. This plant is dicotyl. The sweet fruit has dominant fragment such as stone cells and seeds.

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References

- [1] NC. Devi, S. Aminah, and H. Taufikurahman, "Ecological aspects of *vaccinium varingiaefolium* growing in a stressed volcanic environment," in *Presented in Botany Conference*, pp. 34-35, Bandung, ITB, 2001.
- [2] M. Heads, "Ericaceae in Malesia: vicariance biogeography, terrane tectonics and ecology," *Telopea*, vol. 10, no. 1, pp. 311-449, 2003.
- [3] B. Hidayat Estiti, *Anatomy tumbuhan berbiji [Anatomy of seed plant]*, ITB Press, Bandung, 1997, 4253 in Bahasa Indonesia.
- [4] Gembong. Tjitrosoepomo, "Morfologi tumbuhan: cetakan ke-17 [Plant Morphology]," *Yogyakarta: UGM Press*, pp. 4-251, 2007, in Bahasa Indonesia.
- [5] A. Sadili, R. Kartawinata, A. Kartonegoro, H. Soedjito, and A. Sumadijaya, "Floristic composition and structure of subalpine summit habitats on MT. Gede-Pangrango Complex, Cibodas Biosphere Reserve," in *Sumadijaya A. Floristic composition and structure of subalpine summit habitats on MT. Gede-Pangrango Complex*, vol. 12, pp. 391-404, Indonesia. Reinwardtia, West Java, 2008.
- [6] ER. Sakdiyah and RA. Kodir, Studi awal kandungan antosianin pada buah cantigi ungu (*Vaccinium varingiaefolium* (BL.) MIQ.) yang berpotensi sebagai suplemen antioksidan Preliminary studies on the anthocyanin content Cantigi purple fruit (*Vaccinium varingiaefolium* (BL.) Miq.) Potential as an antioxidant supplement. Prosiding SnaPP 2012: Sains, Teknologi dan Kesehatan 2012; 3: 95-100 in Bahasa Indonesia.
- [7] E. Susetyoadi Kartini, M. Saptasari, and Sulisetijono., "Anatomi tumbuhan [Plant anatomy]," in *Anatomi tumbuhan [Plant anatomy]*, p. 41, UM Press, Malang, 2005, in Bahasa Indonesia.
- [8] SA. Suryani and D. Ratnawati, "Stomate response and transpiration rate of *Vaccinium varingiaefolium* (Bl.) Miq. leaf according to leaf development levels and distance ranges from sulphur gases source Sikidang cauldron Dieng Plateau," *Yogyakarta: MIPA UNY*, pp. 1-12, 2003.
- [9] D. Sastramiharja and A. Siregar, "Fisiologi Tumbuhan [Plant physiology]," in *Fisiologi Tumbuhan [Plant physiology]*, p. 34, Departemen Pendidikan dan Kebudayaan, Jakarta, 1996, in Bahasa Indonesia.
- [10] W. Prawiranata, S. Harran, and P. Tjondronegoro, "Dasar-dasar fisiologi tumbuhan," *jilid 1 [Basic of plant physiology, vol. volume 1]*, p. 138, 1991, in Bahasa Indonesia.

- [11] M. Jovančević, J. Balijagić, N. Menkovič et al., "Analysis of phenolic compounds in wild populations of bilberry (*Vaccinium myrtillus* L.) from montenegro," *Journal of Medicinal Plants Research*, vol. 5, no. 6, pp. 910–914, 2011.
- [12] W. Chu, S. Cheung, R. Lau, and I. Benzie, "Bilberry (*Vaccinium myrtillus* L.)," in *Herbal Medicine*, vol. 20115386 of *Oxidative Stress and Disease*, pp. 55–71, CRC Press, , 2011.