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**SHORT COMMUNICATION**

# INCIDENCE OF *Cochlochila bullita* STÅL (HETEROPTERA: TINGIDAE) PEST OF *Orthosiphon aristatus* PLANTING UNDER AGRIVOLTAIC FARMS CULTIVATION IN SELANGOR, MALAYSIA

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## ABSTRACT

An infestation of a lace bug, *Cochlochila bullita* (Heteroptera: Tingidae) on *Orthosiphon aristatus*, or commonly known as Cat's Whiskers Plant planted under Solar Photovoltaic (PV) was scientifically reported for the first time in Malaysia. Cat's Whiskers Plant have good potential of virtually untapped reservoir of bioactive chemical compounds with many potential applications in pharmaceuticals and agrochemicals. PV technology was promoted by Malaysia as an alternative energy mix with agri-based activities. In Serdang, this is the first incidence of lace bug under PV solar panels and becomes a potential risk of pests that would evolve under the agrivoltaic system especially during the monsoon season. Signs and symptoms of damaged on *O. aristatus* caused by this pest under PV array structure were investigated in this study. It is observed that lace bugs emerged due to the wet and humid conditions despite the dissipated heat during energy conversion. This lace bug causes severe damage to *O. aristatus* and has vivid potential as a serious pest.

**Keywords**: PV Solar; Tingidae; *Orthosiphon aristatus*; Pest; *Cochlochila bullita*

**ABSTRAK**

Serangan lace bug, *Cochlochila bullita* (Heteroptera: Tingidae) pada *Orthosiphon aristatus*, atau biasanya dikenali sebagai pokok Misai Kucing yang ditanam di bawah Solar Photovoltaic (PV) dilaporkan secara saintifik buat kali pertama di Malaysia. Pokok Misai Kucing mempunyai potensi yang baik bagi kandungan sebatian kimia bioaktif yang hampir belum diterokai dengan banyak potensi aplikasi dalam farmaseutikal dan agrokimia. Teknologi PV dipromosikan oleh Malaysia sebagai gunasama tenaga alternatif dengan aktiviti berasaskan pertanian. Di Serdang, ini adalah kejadian pertama lace bug di bawah panel PV solar dan menjadi potensi risiko perosak yang akan berkembang di bawah sistem agrivoltaic terutamanya semasa musim tengkujuh. Tanda-tanda dan gejala kerosakan pada *O. aristatus* yang disebabkan oleh perosak di bawah struktur PV solar telah diselidiki dalam kajian ini. Adalah diperhatikan bahawa lace bug muncul disebabkan oleh keadaan basah dan lembap walaupun haba terlesap semasa penukaran tenaga. Lace bug ini menyebabkan kerosakan teruk pada *O. aristatus* dan mempunyai potensi yang jelas sebagai perosak yang serius.


**Kata kunci**: Solar PV; Tingidae; *Orthosiphon aristatus*; Perosak; *Cochlochila bullita*

*Orthosiphon aristatus* is a medicinal herb in the family Lamiaceae, originating in southern China, the Indian Subcontinent, Southeast Asia and tropical Australia (Suddee et al. 2005). In Malaysia this plant is known as Misai Kucing, while in local Indonesian people named as Kumis Kucing (Tety & Novianti 2006). In the United States, *O. aristatus* commonly known as cat's whiskers or Java tea. It reaches a height of up to 200 cm upon maturity. The leaves contain flavones, saponins, a glycoside, an essential oil, and potassium (Mukesh et al. 2015). In Indonesia, Malaysia and Southeast Asia, this traditional herb was initially recorded as a treatment for diabetes, kidney stone and hypertension (Masuda et al. 1992; Matsubara et al. 1999; Ohashi et al. 2000; Shibuya 1999). Recent studies have demonstrated that rosmarinic acid isolated from *O. aristatus* possesses significant anti-inflammatory potential, primarily through the inhibition of NF-κB signalling and reduction of oxidative stress markers, suggesting its applicability in managing inflammation-induced metabolic and degenerative diseases (Mohmad Saberi & Chua 2023). Nowadays, these plants are believed to contain many nutrients and medicinal benefits, which has attracted the interest of farmers and investors to cultivate them as plantation crops.

Planting the herb under Solar Photovoltaic (PV) Farms has open up a unique insight of a Nexus integration to both segments' energy generation and agriculture cultivation. The use of empty space under PV Solar as a place for planting, can provide a good return on yield. Othman et al. (2015) reported in terms of payback period and economics of scale, this idea has been proven of Return-on-Investment (ROI) for 1-acre AgroPV integrated solar farm with Net Present Value (NPV) of RM8,863.59. Exchange of agricultural land for commercial becomes a new challenge for land resources for food production. Dinesh & Pearce (2016) highlighted that the increasing population in urban area has created competition for land resource use in food production. Viswanathan et al. (2025) mentioned the potential of nanotechnology-based propagation strategies to accelerate large-scale cultivation of *O. aristatus*, a high-value medicinal herb, for both pharmaceutical and agrivoltaic farming systems. Therefore, photovoltaic project landscapes are transformed into a new transdisciplinary design of land used and extended to ecological performances and beneficial impacts on the surroundings.

Recent field research under PV-module shade found that the abundance of the beet leafhopper (*Circulifer tenellus*) was 21% higher in full-sun plots compared with plots beneath

PV modules, indicating that shading may reduce pest incidence in certain sap-feeding insects (Joukhadar et al. 2025). Insect pest attack by lace bug, *Cochlochila bullita* Stål (Heteroptera: Tingidae) on the *O. aristatus* was recorded in Malaysia in 2010 (Peng et al. 2014). Futhermore, Giliomee (2014) reported the lace bug, *C. bullita* was first recorded as a pest on rosemary (*Rosemarinus officinalis*) in South Africa. In India, *C. bullita* has been reported attacking *Ocimum kilmandscharicum* and *Ocimum sanctum* (Palaniswami & Pillai 1983) and *Ocimum basilicum* (Kumar et al. 2022), and in Thailand *C. bullita* is a major pest of *Ocimum basilicum* (Tigvattnanont 1989). In addition, Sajap & Peng (2010) reported, the damage caused by *C. bullita* was very serious damage particularly the dry season, but planting under Agrivoltaic farms cultivation pests emerged due to the wet and humid conditions (Othman et al. 2019). The pests damage the young leaves and shoots of the *O. aristatus* by piercing and sucking out the sap. This causes the leaves to become curling and drying, leaf dehiscence and decrease in inflorescence production (Mohanasundaram & Rao 1973; Palaniswami & Pillai 1983). Otherwise, Sajap & Peng (2010) observed that adult lace bugs usually feed on tender shoots of the herb causing them to wilt and eventually die.

The first occurrence of lace bug, *C. bullita*, was recorded in Malaysia planting under Agrivoltaic farms cultivation in 2018. Understanding of life history, host plant, damage and control method of *C. bullita* on *O. aristatus* was reported (Peng et al. 2014). Despite its common occurrence and wide distribution, *C. bullita* has not been recorded as a pest on *O. aristatus* planting in Agrivoltaic farms cultivation until recently. Preventive measures should be taken to prevent the spread of the lace bug, *C. bullita*. Plants should be monitored daily during the wet season for the presence of lace bugs. To control the lace bug, *C. bullita* attacks through the integrated pest management (IPM) concept with the use of cultural control, mechanical control, biological control and selective chemical pesticides. The damage it caused to *O. aristatus* in Agrivoltaic farms cultivation shows that it has the potential of also becoming a serious on these herbs in Malaysia. This study provides some insights of tropical field assessments of potential pests attacking *O. aristatus* herbal crops under PV array structure especially during the monsoon season.

The observations were carried out on young leaves planted under PV Solar conditions at Universiti Putra Malaysia (UPM), Serdang, Selangor at coordinates of 3˚00’29.6” N and 101˚43’20.6” E. The PV field arrangements comprise of CEEG PV modules with maximum generating capacity of 95W with *O. aristatus* cultivated directly under the modules and the circuit design of photovoltaic power with *O. aristatus* cultivated directly under the modules as shown in Figure 1. Infested leaves and stems (with or without flowers) of *O. aristatus* crop of maturity stage or after three months seedlings deposition under PV array were located randomly within four 12.32$m^2$ plots (consisted of 144 polybags) during wet season. The Malaysian climate consists of two distinct seasons, the dry season from February to July, and the wet season from August to January (Wan Nur Asiah et al. 2021). Infestation can be identified by observing adult lace bugs feeding on tender shoots, which causes the leaves and stems to wilt and ultimately leads to the death of the plant. The symptoms of infestation observed on the plants were photographed. A few samples were collected by hand, preserved in 70% ethanol, and taxonomically identified as the lace bug *C. bullita* using the keys described by Sajap and Peng (2010). Photographs were taken with a camera coupled to the Meiji techno RZ stereomicroscope.

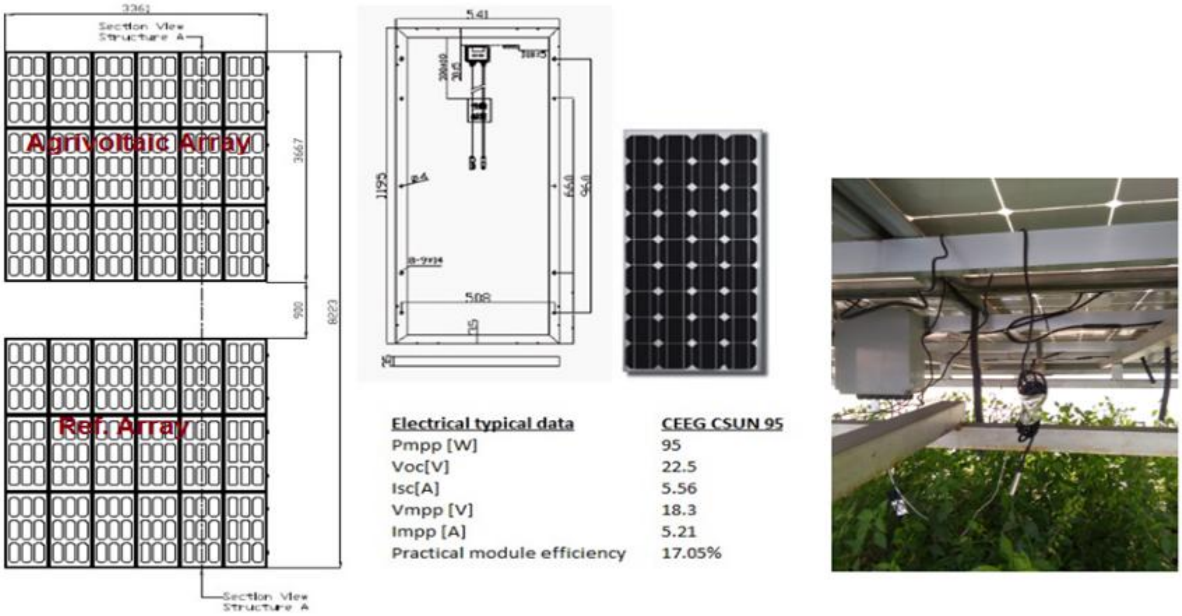


Figure 1. The circuit design of photovoltaic power with *O. aristatus* cultivated directly under the modules

The lace bug caused severe damaged on fresh leaves mainly during the monsoon season and consequently when planting under PV solar, the leaves starting curling and the rest of the plant will wilt in an accelerated manner. The adults of the *C. bullita* are dark-brown in body and wings (Figure 2). Peng et al. (2013) described the external male and female's genitalia, where the end of the female's abdomen with a V shape and U shape in male. *Cochlochila bullita* has a piercing-sucking mouthparts that has caused damage to the leaf by removing nitrogen-rich plant fluids (Sajap & Peng 2010). This result damaged leaves becoming heavily discoloured and upper leaves are burning and falling (Figure 3).

Figure 2. Planting of *Orthosiphon aristatus* under Agrivoltaic Farms Cultivation

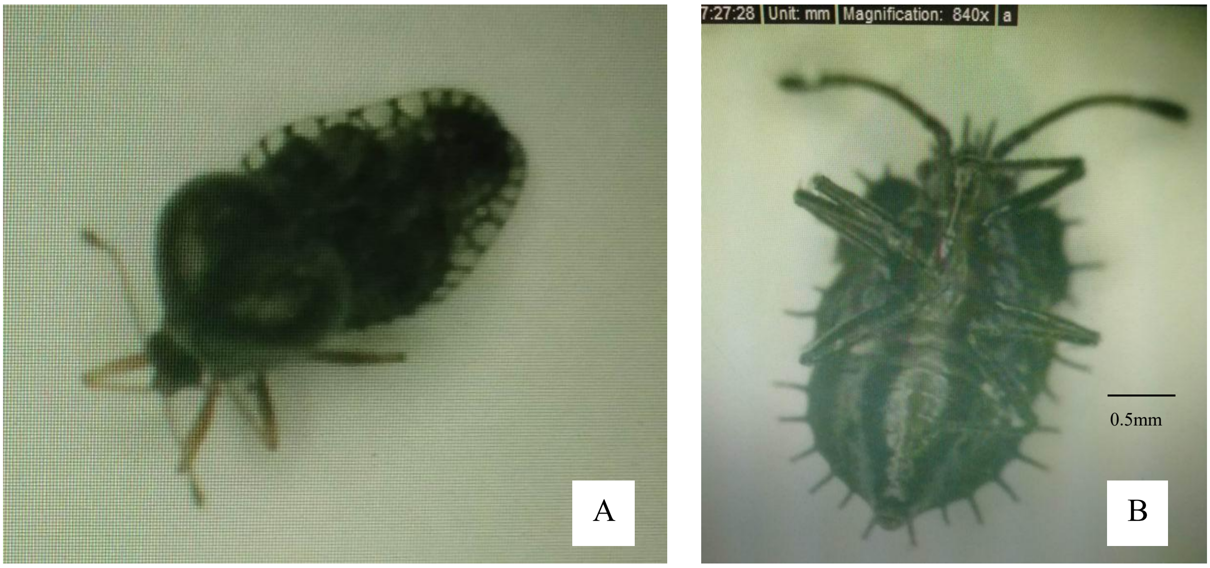

Figure 3. Adult Lace bug, *Cochlochila bullita* Stal.; Dorsal view (A) and ventral view (B)

Observation and monitoring are very important in controlling the presence of pests. Several types of controls can be implemented to control pests, including biological controls (Koo et al. 2007) cultural control, mechanical control (Sajap & Peng 2010), and chemical control (Klingeman et al. 2000; Reeves 2006). In this study, insecticide with active ingredients of the type chlorpyrifos have been used to control the *C. bullita* population. Two times spraying were performed in the morning and evening to control insect populations and observations of new shoots were observed. After two weeks, new shoots sprouted in opposite pairs, smooth in green, tapered at the ends and serrated leaves (Figure 4). Peng et al. (2014) reported on the understanding of life history, host plant, damage and control method of *C. bullita* on *O. aristatus*.


Figure 4. Gregarious feeding on leaves by lace bug *Cochlochila bullita* on *O. aristatus*.

The cultivation of *O. aristatus* in Agrivoltaic cultivation has not previously been attacked by *C. bullita*. Since the symptoms of this attack were recorded, the plants should be monitored weekly during the dry season and daily during the wet season for the presence of lace bugs. The infestation by the lace bug in the herb planting area planted under solar PV is an event that can be avoided if early monitoring can be implemented. Basic concepts in pest control such as observation, sampling, assessment and identification of pests, before making a decision on the control method is very important to determine the success of a crop and get optimal profit. In addition, Sajap & Peng (2010) reported that lace bug attacks can trigger a wave of more dangerous damage to herbaceous plants if no control is done. Otherwise, Peng et al. 2014 suggested the possible control method against this pest namely cultural control, mechanical control, biological control and chemical control. Knowledge on the ecology, and behaviour of *C. bullita* should be studied to prevent future invasion of pests.

It was observed that *C. bullita* is a severe pest for *O. aristatus* that feeds particularly on tender parts of the plant. The feeding of the nymphs and adults causes injury on leaf and stunted growth of the plant. However, since spraying has been done, the potential for the insects to spread and cause more damage is low. The new shoots recovery after spraying insecticide (Figure 5). Therefore, the importance of biology and the life cycle of pests is studied so that integrated pest control can be implemented. Thus, this report may serve as a foundation for more extensive research regarding the pest management of *Orthosiphon aristatus* to maximize herb production in Malaysia.


Figure 5. Recovery on new shoots after spraying insecticide

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## AUTHORS DECLARATION

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The authors declare no conflict of interest.

**Ethics Declarations**
This research does not include any ethical issues.

**Data Availability Statement**
The manuscript has no associated data

**Authors' Contributions**
Syari Jamian (SJ) and Siti Izera Ismail (SII) originated this research and executed experiments; SJ, SII and Mohammad Effendy Ya'acob (MEY) involved in data collection; SJ wrote the paper while SII and MEY provided the necessary corrections. The manuscript has been read and approved by all authors.

**REFERENCES**

Dinesh, H. & Pearce, J.M. 2016. The potential of agrivoltaic systems. *Renewable and Sustainable Energy Reviews* 54: 299-308.

Giliomee, J.H. 2014. First record of the lace bug *Cochlochila bullita* (Hemiptera: Tingidae) as a pest of rosemary in South Africa. *African Entomology* 22(3): 670-672.

Joukhadar, I, Estrada, M., Velasco-Cruz, C., Coon D., Lavrova, O., Thompson, M., Guzman, I. & Walker, S. 2025. Impact of Agrivoltaic shade on beet curly top virus and yield in chile pepper (*Capsicum annuum*). *Hortscience* 60(6): 841–851.

Klingeman, W.E., Buntin, G.D., van Iersel, M.W. & Braman, S.K. 2000. Whole-plant gas exchange, not individual-leaf measurements, accurately assesses azalea response to insecticides. *Crop Protection* 19: 407-415.

Koo, C.D., Lee, S.K. & Kim, S.H. 2007 Characteristics of an entomopathogenic fungus infecting *Corythucha ciliate* Hemiptera: Tingidae. *Journal of Korean Forestry Society* 96(1): 58-64.

Kumar, M., Rai, D., Kanth, N., Kumar, A. & Rai, C.P. 2022. Seasonal incidence, natural enemies, damage intensity and management of lace bug, *Cochlochila bullita* on sweet basil. *Journal of Entomological Research* 46(suppl): 988-992.

Masuda, T., Masuda, K., Shiragami, S., Jitoe, A. & Nakatani, N. 1992. Orthosiphol A and B, novel diterpenoid inhibitors of TPA (12-O-tetradecanoylphorbol-13-acetate)-induced inflammation, from *Orthosiphon stamineus*. *Tetrahedron* 48: 6787-6792.

Matsubara, T., Bohgaki, T., Watarai, M., Suzuki, H., Ohashi, K. & Shibuya, H. 1999. Antihypertensive actions of methylripariochromene A from *Orthosiphon aristatus*, an Indonesian traditional medicinal plant. *Biological & Pharmaceutical Bulletin* 22: 1083-1088.

Mohanasundaram, M. & Rao, P.V.S. 1973. A note on *Cochlochila bullita* Horvath (Tingidae: Heteroptera) as part of *Coleus parviflorus*, a tuber crop in Tamilnaidu. *Indian Journal of Entomology* 35: 346.

Mohmad Saberi, S.E. & Chua, L.S. 2023. Potential of rosmarinic acid from *Orthosiphon aristatus* extract for inflammatory induced diseases and its mechanisms of action. *Life Sciences* 333: 122170.

Mukesh, K., Singh, B., Gidwani, B., Gupta, A., Dhongade, H., Kashyap, P. & Tripathi D.K. 2015. A review of the medicinal plants of Genus *Orthosiphon* (Lamiaceae). *International Journal of Biological Chemistry* 9(6): 318-331.

Ohashi, K., Bohgaki, T., Matsubara, T. & Shibuya, H. 2000. Indonesian medicinal plants. XXIII. Chemical structures of two new migrated pimarane-type diterpenes, neoorthosiphols A and B and suppressive effects on rat thoracic aorta of chemical constituents isolated from the leaves of *Orthosiphon aristatus* (Lamiaceae). *Chemical & Pharmaceutical Bulletin* 48: 433-435.

Othman, N.F., Ya'acob, M.E., Abdul-Rahim, A.S., Othman, M.S., Radzi, M.A.M., Hizam, H. & Jaafar, H.Z.E. 2015. Embracing new agriculture commodity through integration of Java Tea as high Value Herbal crops in solar PV farms. *Journal of Cleaner Production* 91: 71-77.

Othman, N.F., Jamian, S., Su, A.S.M. & Ya'acob, M.E. 2019. Tropical field assessment on pests for Misai Kucing cultivation under agrivoltaics farming system. *AIP Conference Proceedings* 2129(1): 020002.

Palaniswami, M.S. & Pillai, K.S. 1983. Biology of *Cochlochila bullita* S., a pest on Chinese potato. *Journal of Root Crops* 9: 59-62.

Peng, T.L., Sajap, A.S., Jeen, L.H., Lee, S.H. & Lum, W.C. 2013. Morphological re-description of *Cochlochila bullita* (Stal) (Heteroptera: Tingidae), a potential pest of *Orthosiphon aristatus* BlumeMiq. (Limiales: Limiaceae) in Malaysia. *Pakistan Journal of Biological Sciences* 16(23): 1786-1790.

Peng, T.L., Sajap, A.S., Jeen, L.H., Lee, S.H. & Lum, W.C. 2014. Occurrence of *Cochlochila bullita* Stål in Malaysia. *Serangga* 19(2): 67-76.

Reeves, W. 2006. Azalea Lace Bug – Control. Gardening In Georgia. http://www.walterreeves.com/insects-and-animals/azalealacebug-control/ [19 July 2013].

Sajap, A.S. & Peng, T.L. 2010. The lace bug *Cochlochila bullita* (Stål) (Heteroptera: Tingidae), an important pest of *Orthosiphon aristatus* Bentham (Laminales: Lamiaceae) in Malaysia. *Insecta Mundi* 0136: 1-5.

Shibuya, H. 1999. Chemical structures of two new isopimarane- type diterpenes, Orthosiphonones A and B and a new benzochromene, orthochroinene A from the leaves of *Orthosiphon aristatus* (Lamiaceae). *Chemical & Pharmaceutical Bulletin* 47: 695-698.

Suddee, S., Paton, A.J. & Parnell, J.A.N. 2005. Taxonomic Revision of the tribe *Ocimeae dumort* (Lamiaceae) in continental South East Asia III. Ociminae. *Kew Bulletin* 60: 3-75.

Tety, H. & Novianti, A. 2006. *Kumis Kucing: Serial Tanaman Obat*. Indonesia: Badan Pengawas Obat dan Makanan, Direktorat Obat Asli Indonesia.

Tigvattnanont, S. 1989 Studies on the bionomics and local distribution of some lace bugs in Thailand: I. *Monanthia globulifera* (Heteroptera: Tingidae). *Khon Kaen Agriculture Journal* 18: 200-212.

Viswanathan, D., Ranjani, S. & Hemalatha, S. 2025. Effect of carbon nanoparticles in enhancing the vegetative propagation of *Orthosiphon aristatus. Discover Sustainability* 6(45): 1-13.

Wan Nur Asiah Wan Mohd Adnan, Syari Jamian, Nur Azura Adam, Mohamad Shukri Tan Shilan, Siti Asma Samsudin & Chong Leong Puan. 2021. Foraging activities of stingless bees: *Geniotrigona thoracica* and *Heterotrigona itama* (Apidae: Meliponini) in relation to wet and dry seasons in Selangor, Malaysia. *Serangga* 26(4): 152-160.