Cephaleuros solutus Karsten สาเหตุโรคใบจุดสาหร่ายของทุเรียน (*Durio zibethinus* Murray) ในประเทศไทย

Cephaleuros solutus Karsten, as a causal agent of durian (*Durio zibethinus* Murray) algal leaf spot disease in Thailand

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บทคัดย่อ: ทุเรียน (*Durio zibethinus* Murray) ไม้ผลที่นิยมเพาะปลูกในเขตเอเชียตะวันออกเฉียงใต้ ได้รับสมญานามว่าเป็นราชาของผลไม้ เนื่องจากผลมีขนาดใหญ่และหนามที่คล้ายมงกุฎ การที่ภาคใต้มีฝนตกชุก ปัญหาโรคทุเรียนที่สำคัญจึงมีมาก โรคหนึ่งที่พบคือโรคใบจุดสาหร่ายของทุเรียนหรือโรคสะเก็ดเขียวมีสาเหตุมาจากสาหร่ายในจีนัส *Cephaleuros* สาหร่ายกลุ่มนี้มีพืชอาศัยหลายชนิด อาการใบจุดสาหร่ายพบมากบริเวณใบของทุเรียน ลักษณะที่ใช้จำแนกชนิดของสาหร่ายเช่น อาการจุดสีส้มบนใบพืช โครงสร้างของสปอร์แรงจิโอฟอร์และสปอร์แรงเจียม จากลักษณะทางสัณฐานวิทยาสามารถจำแนกสาหร่ายสาเหตุโรคใบจุดของทุเรียนนี้คือ *Cephaleuros solutus* Karsten นับเป็นรายงานแรกที่พบบนทุเรียน
คำสำคัญ: ทุเรียน, ใบจุดสาหร่าย, สะเก็ดเขียว, *Cephaleuros*

ABSTRACT: Durian (*Durio zibethinus* Murray) is a fruit tree species cultivated in Southeast Asia. In Thailand, durian is considered as the 'King of Fruit' because of its large size and formidable thorn-covered husk-like crown. Because of long period of high rainfall in the south of Thailand, durian is facing with several diseases especially algal leaf spot. Algal leaf spot disease or green scurf of durian is caused by algae from genus *Cephaleuros*. The plant parasitic algae has a wide host range in tropical and subtropical plants. The symptoms from this genus commonly found on the leaves of durian. We identified the species of this causal agent based on morphological characters, dark-orange spots with sporangiophores on the leaf surfaces, head cell and sporangia. The results indicate that algal leaf spot of durian was identified as *Cephaleuros solutus* Karsten. This is the first report on *C. solutus* in durian.
Keywords: durian, algal leaf spot, green scurf, *Cephaleuros*

Introduction

Durian (*Durio zibethinus* Murray) is one of the popular fruit in Southeast Asian countries. It has been known as the "King of Fruit" in Thailand because of thorn-covered like crown and has a unique smell. This species belongs to family Malvaceae, it is an economical plant and mostly cultivated commercially for fruit production. Durian plantation is covered in several countries especially Thailand, Indonesia, Malaysia, Philippines and Myanmar (Brown, 1997). In Thailand, durian cultivated in the South is facing with a problem caused by diseases because of

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the long period of high rainfall and high humidity. One of the plant disease often found in durian is an algal leaf spot caused by algae initially identified in the genus *Cephaleuros* Kunze in Fries.

A plant parasitic alga, *Cephaleuros,* has been known as one of green algae invading several woody plants. The leaves affected by this algae show somewhat leathery on leaf surface, the spot color is burnt-orange to brown or rust colored (Nelson, 2008). This alga colonizes subcuticularly or intramatically on the leaf tissue, stems, and fruits of vascular plants. Filamentous was found on leaf surface, bearing the sporangiophores (Thomson and Wujek, 1997). *Cephaleuros* widely spread in tropical and subtropical region areas. The reports on this algae were recorded in Hawaii (Nelson, 2008; Rindi et al. 2005), Japan (Suto and Ohtani, 2009), Florida (Marlatt and Alfieri, 1981; Marlatt and Campbell, 1980), America (Brook, 2003), Africa (Rindi et al. 2006) and Panama (Rindi et al. 2008). There is no previous report about the specific species of algal disease in Thailand. The purpose of this study is to identify and characterize *Cephaleuros* species on *Durio zibethinus* Murray in Thailand.

Materials and methods

The algal samples were collected from Pest Management field, Faculty of Natural Resources, Prince of Songkla University during 2013. Macroscopic features were measured under a stereo microscope, the samples were prepared by hand sectioning, thalli were peeled from leaf surface with razor blade and placed on glass slide with lactophenol to observe the morphology of the thallus and sporangiophores. Fresh thalli producing gametangia or sporangia were transferred with a drop of sterile water and placed onto a slide to observe the gametes and zoospore. The morphological characters were investigated under a light compound microscope.

Fillamentous cells selected from major filament in the thalli were measured by length and width. Gametangia and sporangia were examined directly when fresh fruiting body was founded. All morphological characters were identified based on the monograph by Thomson & Wujek (1997).

Results

The algal leaf spot disease was characterized based on morphological properties and identified as *Cephaleuros solutus* Karsten (1891). Description of this alga is in (**Figure 1)** and as following:

Thallus growing subcuticularly and subepidermally developed on the upper leaf surface. The shape was irregular in outline, composed of both open-branching filaments and pseudoparenchymatous ramuli or almost wholly filamentous or almost wholly ramulate. Thallus diameter was about 1-7 mm exhibiting some of other forms of growth, unicellular and multicellular setae of morphology. The filamentous cells were long or cylindrical until irregularly, with the size of 22-27.5 µm long and 15-25µm wide, length/width (L/W) ratio was about 1-1.8 (average ± SD, 1.26 ± 0.25), producing sterile hairs and setae that were developed to slender filament with 160-287 µm long and 5-10 µm wide (35.66 ± 9.46). The setae consisted of two up to four cells, pale brown and solitary.

Sporangiophores were solitary or in tuff with the size of 152-510 (±11.7) µm long and 7.5-15 µm wide, (31.13 ± 11.76), being cylindrical and erected from the filament, two to four cells, the terminal cell only becomes a head cell in normal development. Four lateral sporangiates bearing the sporangia and their sulfutory cells are produced on terminal head cells. Sporangia were spherical, in orange color and size of 20-27.5 µm long and 15-22.5 µm wide (1.21 ± 0.27). Gametangia were produced beneath the cuticle or epidermal cells of the upper leaf surface, enlarging in spherical or elliptical shape in size of 15-25 µm long and 10-15 µm wide (1.57 ± 0.26), in yellow to orange color, and solitary. Gametes could not be observed because thalli were not in the young stage. The zoospores are obbiconic to globose in size of 4.5-10 µm long and 2.5-7.5 µm wide (1.43 ± 0.42), with biflagellata.

The symptom lesion diameter was in the range of 3-10 mm. Although, no discoloration was observed around the thallus, the palisade cells were necrosis, being brown and red brown beneath the thallus. The algae caused necrosis and browning of leaf tissue on the upper leaf surface where the thallus developed.

Discussion and conclusion

From the six recognized genera in the Trentepohliales (*Cephaleuros* Kunze, *Stomatochroon* palm, *Phycopheltis* Millardet, *Physolinum* Printz, *Trentepohlia* Maritius, and *Printzina* Thomson and Wujek), Cephaleuros is the most severe among parasitic algae, which colonized in vascular plants. *Cephaleuros* has been considered as one of the diseases usually found in some plants in Thailand (Sanyong and Amarakul, 2001). There is no recent record and identification on specific *Cephaleuros* species in Thailand. Here, we present the first report on the species of *Cephaleuros*, which is *C. solutus* Karsten, found in durian from Thailand or elsewhere.

The symptom caused by *Cephaleuros* was collected in November 2013. Brown–orange lesions were found developed on the upper leaf surface and widely covered the leaf surface. This alga producing the symptoms was then identified as *C. solutus* Karsten with the color of thallus and other detailed measurements. The color varies from orange to dark brown, supposed to be caused by the growth cycle of the thallus. Start from the young thallus, the color will be orange, while during the maturation of sporangiophores the thallus color changed to become darker orange and then become dark brown when the thallus is on aging.

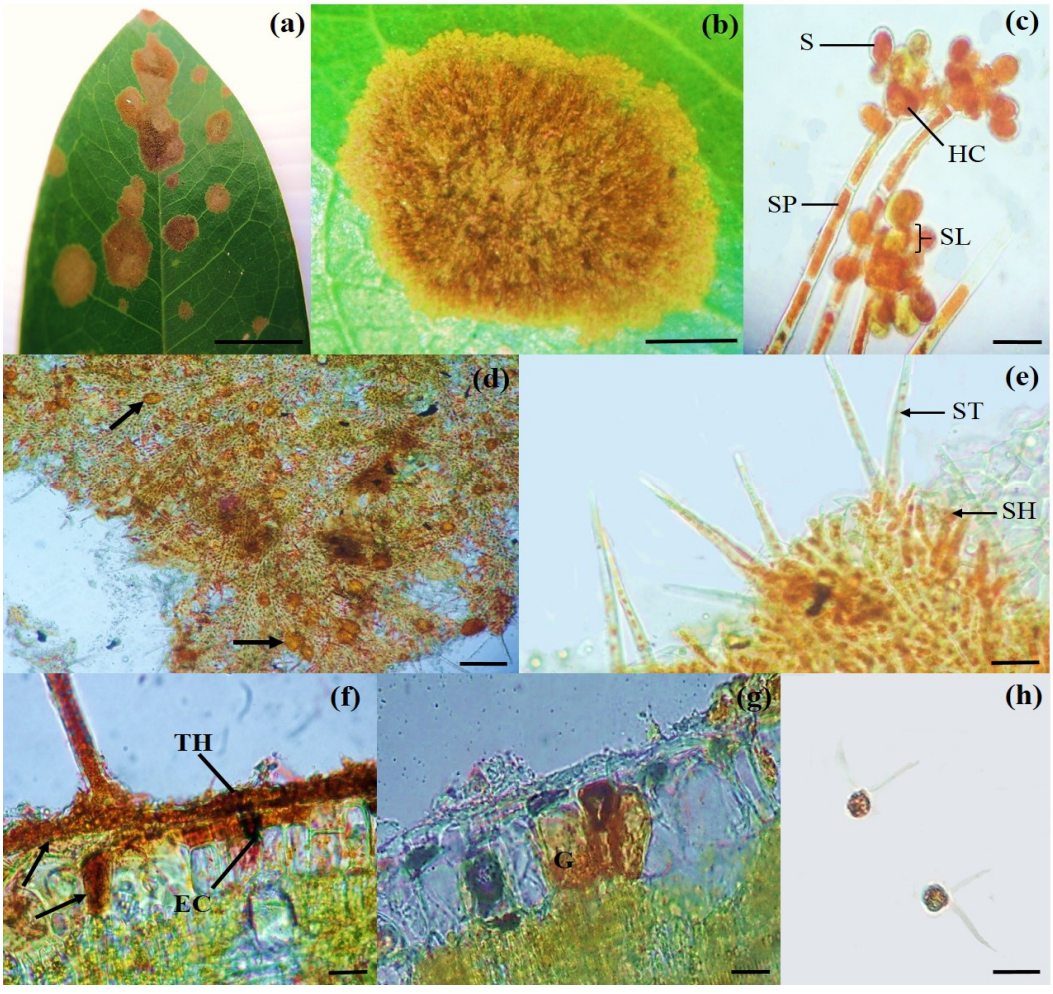

Figure 1 **(a)** Algal leaf spot caused by *Cephaleuros solutus* Karsten on the leaf of *Durio zibethinus* Murray (Bar = 1 cm), **(b)** macrocopic feature of open ramulose thalli on the leaf (Bar = 1 mm), **(c)** sporangiophores (SP) with the head cell (HC) bearing sporangia lateral (SL) and the sporangia (S) on the top (Bar = 50µm), **(d)** surface view of thallus with the bulbous cell (arrow) growth on the base of sporangiophores (Bar = 100µm) , **(e)** zoom view of fillamentous cell with the sterille hair (SH) and setae (ST), **(f)** transverse section on multi layer thallus (TH) causing necrosis on epidermal cell (EC) showing development of fillamentous growing subcuticular and intramatrical (arrows), **(g)** transverse section showing immature gametes (G) are formed bellow the epidermal cell, **(h)** zoospores with biflagellata. (Bar = 50µm).

Sporangiophores grow subcuticularly on the upper leaf surface, and the head cells terminally borne from sporangiophores with four sporangiates lateral bearing the sporangia. The fresh and mature sporangia then will directly release the zoospores when placed into a water drop. It is likely that only the fresh and young thallus that produces sporangia can release the zoospores, based on our several trials that just the young thallus with high productivity of sporangia could release the zoospores.

The disease caused by *C. solutus* Karsten reported in this study was firstly characterized on durian (*Durio zibethinus*). However, *Cephaleuros* species have been also recorded in some horticulture plants such as guava and avocado (Marlatt and Alfieri, 1981, Nelson, 2008). The disease in guava also showed the infection on fruits, this becomes a problem impacting on product quality. Several interesting pathological problems are still unexplained regarding to this plant parasitic algae. The infection, host range, and susceptibility of the host to the *Cephaleuros* species are needed to be further verified.

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