タイで見出されたヤマノイモ属植物に寄生する2種のサビキン

誌名	日本菌学会会報 = Transactions of the Mycological Society of Japan
ISSN	00290289
著者名	小野,義隆 Thiphaphorn,N. Thamthurasan,W. Unartngam,J. 岡根,泉
発行元	日本菌学会
巻/号	62巻1号
掲載ページ	p. 43-50
発行年月	2021年5月

日菌報 62: 43－50, 2021

N o t e

タイで見出されたヤマノイモ属植物に寄生する２種のサビキン

小野 義隆[1,4)*]・Naunnet THIPHAPHORN[2)]・Wanida THAMTHURASAN[3)]・Jintana UNARTNGAM[4)]・岡根 泉[5)]

1) 茨城大学教育学部, 〒 310-8512 茨城県水戸市文京
2) Plant Protection Research and Development Office, Department of Agriculture, Ministry of Agriculture and Cooperatives, Bangkok 10900, Thailand
3) Loei Horticultural Research Center, Horticulture Research Institute, Department of Agriculture, Ministry of Agriculture and Cooperatives, Phu Ruea, Loei 42160, Thailand
4) Department of Plant Pathology, Faculty of Agriculture at Kamphaeng Saen, Kasetsart University, Nakhon Pathom 73140, Thailand
5) 筑波大学生命環境系, 〒 305-8572 茨城県つくば市天王台

Two *Dioscorea* rust fungi found in Thailand

Yoshitaka ONO[1,4)*], Naunnet THIPHAPHORN[2)], Wanida THAMTHURASAN[3)], Jintana UNARTNGAM[4)], Izumi OKANE[5)]

1) College of Education, Ibaraki University, Mito, Ibaraki 310-8512, Japan
2) Plant Protection Research and Development Office, Department of Agriculture, Ministry of Agriculture and Cooperatives, Bangkok 10900, Thailand
3) Loei Horticultural Research Center, Horticulture Research Institute, Department of Agriculture, Ministry of Agriculture and Cooperatives, Phu Ruea, Loei 42160, Thailand
4) Department of Plant Pathology, Faculty of Agriculture at Kamphaeng Saen, Kasetsart University, Nakhon Pathom 73140, Thailand
5) Faculty of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Ibaraki, 305-8572, Japan

(Accepted for publication: February 17, 2021)

Goplana dioscoreae and *Phakopsora dioscoreae* were found in Thailand. *Goplana dioscoreae* occurs on *Dioscorea bulbifera* at Doi Suthep, Chaing Mai Prov., *D. wallichii* at Takua Pa, Phang Nga Prov., and unidentified *Dioscorea* plants at Doi Suthep, Chiang Mai Prov. and Thap Satae, Prachuap Khiri Khan Prov. *Phakopsora dioscoreae* occurs on *D.* aff. *alata*, *D. bulbifera*, and unidentified *Dioscorea* plants at Doi Suthep, Chiang Mai Prov. *Phakopsora dioscoreae* was known only from the type material collected in Myanmar in 1972.

(Japanese Journal of Mycology **62**: 43－50, 2021)

Key Words——Dioscoreaceae, *Goplana*, *Phakopsora*, Pucciniales, Southeast Asia

In Asia, Australasia, and islands of the South Pacific region, ten rust fungi, i.e., two *Goplana*, one *Hemileia*, one *Phakopsora*, two *Puccinia*, and four unconnected uredinial fungi, are recognized as distinct species parasitic on *Dioscorea* plants (Dioscoreaceae) (Saccardo and Sydow 1902; Sydow and Sydow 1924; Thaung 1974; Ono 1982; Ono and Hennen 1983; Hernández and Cline 2010; Judith and Rossman 2014). None of these rust species is reported in Thailand. Examination of rust collections in the past three decades and recent several years resulted in the discovery of *Goplana* and *Phakopsora* species in northern Province of Chiang Mai, southern Provinces of Phang Nga and Prachuap Khiri Khan. This paper reports hosts, geographic distribution, previously unnoticed morphological features, and a nomenclatural note of the two rust species.

* Corresponding author: yoshitaka.ono.grapes@vc.ibaraki.ac.jp
Office phone & FAX: +81-29-228-8240

The herbarium specimens examined in this study have been deposited at the Herbarium of Systematic Mycology, the College of Education, Ibaraki University (IBAR). Individual specimens are listed under each species. Upper case letters, U and T, refer to uredinial and telial stages, respectively. Microscopic observations followed the method described by Unartngam et al. (2020). For observations of sorus structure, small pieces bearing sori were thin-sectioned under a binocular microscope. Spores and paraphyses were scraped from sori on herbarium specimens with a sharp-edged scalpel. The thin-sections, spores, and paraphyses were mounted in a drop of clear lactophenol solution on a microscope glass, covered with a cover slip, and warmed just before bubbling to expand them and expel air bubbles. For visualizing faint germ pores, urediniospores were placed in a drop of lactic acid on a slide glass and heated to boiling for a few seconds and mounted with a drop of lactophenol solution with 0.5% aniline blue (Ono et al. 2020). The slide preparations were immediately examined under Olympus BX 51 equipped with differential interference contrast (DIC) equipment and Olympus DP21 digital camera (Olympus, Tokyo, Japan). Paraphyses (n = 20/specimen) and spores (n = 20 /specimen) were measured with an Olympus DP 21 measurement software. For scanning electron microscopy (SEM), small sorus bearing pieces cut from dried herbarium specimens and scraped masses of spores were placed on conductive double adhesive tape on an aluminum specimen holder. The preparation was coated with platinum-palladium to 25 nm thickness using a Hitachi E-1030 ion sputter (Hitachi, Tokyo, Japan). These samples were observed with a Hitachi S-4200 SEM (Hitachi, Tokyo, Japan) operating at 15 kV.

Goplana dioscoreae (Berk. & Broome) Cummins, Mycologia 27: 607. 1935. Figs. 1, 2

Basionym: *Aecidium dioscoreae* Berk. & Broome, J. Linn. Soc., Bot. 14: 95. (1873) [1875].

On *Dioscorea bulbifera* L., Chiang Mai Prov., Chiang Mai, Doi Suthep-Pui National Park, Doi Suthep, ca. 860 m asl, 18° 48'N, 98° 55'E, 26 Dec 2002. Y. Ono, M. Imazu and J. Engkhaninum (U, IBAR9109); on *D. wallichii* Hook., f., Phang Nga Prov., Takua Pa Distr., north of the junction of the Routes 4 and 401, roadside of the Route 4, 8° 51'42"N, 98° 22 ' 31 "E, 30 Nov 1985 . M. Kakishima, Y. Ono and P. Lohsomboon (U & T, IBAR4086); on *Dioscorea* sp., Chiang Mai Prov., Chiang Mai, Doi Suthep-Pui National Park, Doi Suthep, on a trail near National Park Accommodation area, ca. 18° 48'N, 98° 55'E, 1100 − 1200 m asl, 16 Feb 2015. Y. Ono, C. Ayawong and P. Janruang (U, IBAR10689); 28 Nov 2018 . I. Okane, J. Unartngam, C. Ayawong and Y. Ono (U & T, IBAR11435; U & T, IBAR11437); between accommodation site and Sai Yoi Waterfall, ca. 18° 48 'N, 98° 55 'E, 10 Nov 2019 . I. Okane, C. Ayawong, J. Unartngam and Y. Ono (U & T, IBAR11542; U, IBAR11549); between Sai Yoi Waterfall and Montha Tan Waterfall, ca. 18° 48 'N, 98° 55 'E, 10 Nov 2019 . I. Okane, C. Ayawong, J. Unartngam and Y. Ono (U & T, IBAR 11553); Prachuap Khiri Khan Prov., Thap Satae Distr., Huai Yang Waterfall National Park, 11° 37'N, 99° 36'E, 3 Dec 1985. M. Kakishima, Y. Ono and P. Lohsomboon (U & T, IBAR10806).

Only uredinia and telia are known for this fungus. Individual uredinia occur mostly on the adaxial leaf surface (Fig. 1A), frequently on petioles, stems and fruits (Fig. 1 B). They are minute, deep seated in the host tissues, covered by thin-walled peridium (Fig. 1C), dome-shaped, dark brown or blackish, and becoming erumpent by irregular central aperture. In the previous reports (Ono 1982; Ono and Hennen 1983), the presence of thin-walled peridium is not recognized in the uredinia because it soon collapses as the sori mature. The sori are often densely grouped and coalesce each other (Fig. 1 A, B), and becoming powdery and orange-yellow. Urediniospores are produced on a short pedicel, usually appearing almost sessile, subglobose, obovoid, broadly ellipsoid or obovoid-ellipsoid, often angular, and (14 −) 17 − 28 (− 31) × 13 − 20 (− 23) μm in size (Fig. D). The wall is colorless, 1 − 1.5 μm thick, and ornamented with apically round or truncate cones, except for basal smooth surface near the hilum (Fig. 1E, F). The urediniospore surface structure, which was not previously observed by scanning electron microscopy, appears one of morphological features characteristic to this fungus. Germ pores are hardly observable, (6 −) 8 − 10 (− 12) and scattered (Fig. 1G). Basidiosori (telia) occur on the abaxial leaf surface. They are minute, subepidermal in origin, aparaphysate, becoming erumpent, pulvinate, waxy when dry and gelatinous when wet, light brown, light chestnut-brown or blackish brown (Fig. 2A). Probasidia (thin-walled teliospores, germinating upon maturity) are sessile, cylindric, arising from a basal basidiogenous cell, and 40 − 65 × 6 − 11 μm in size (Fig. 2B). The wall is colorless, thin, and smooth. Trans-

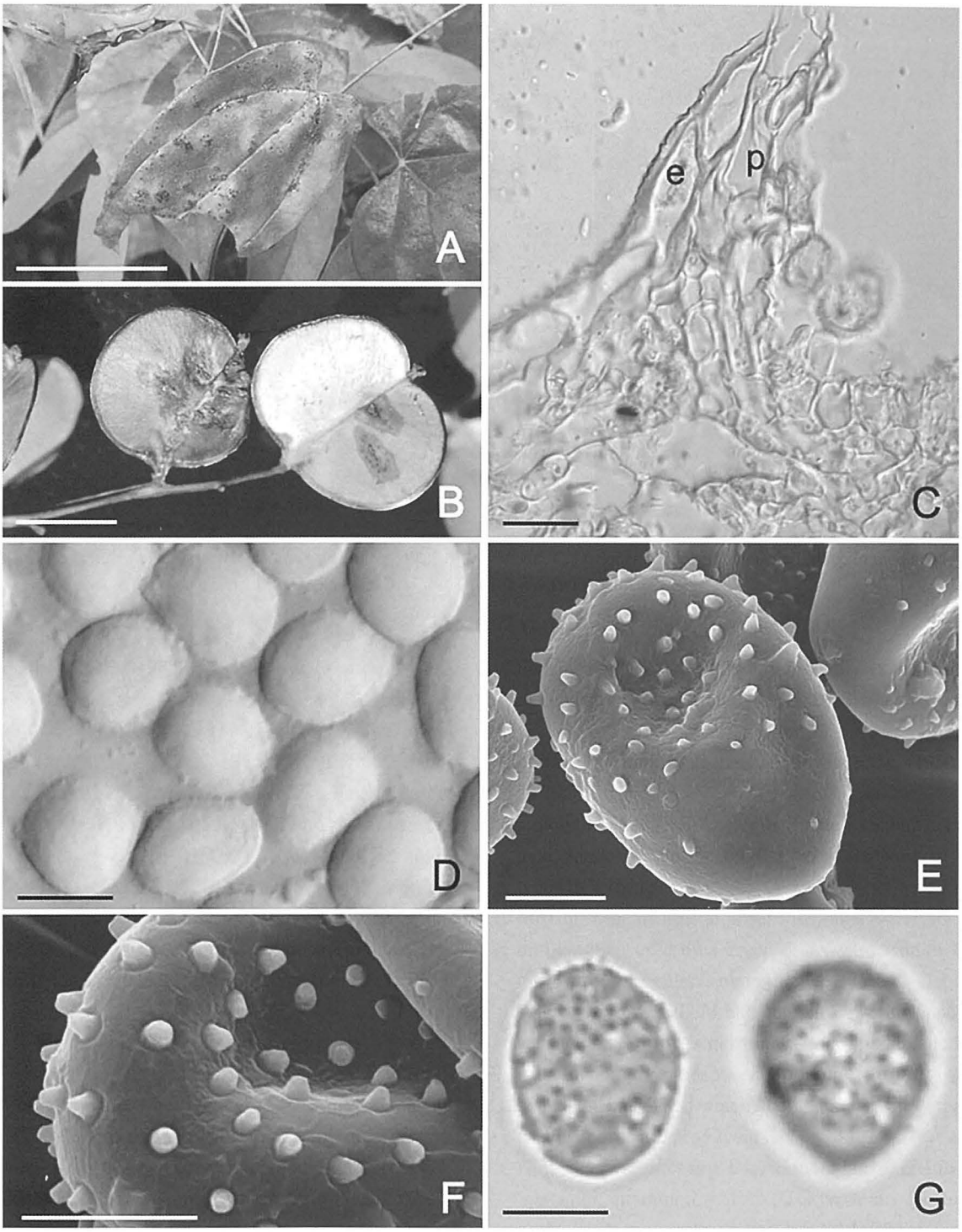

Fig. 1. *Goplana dioscoreae* (A, C, D: IBAR11435; B, E–G: IBAR10689). A. Uredinia produced on the adaxial leaf surface of unidentified *Dioscorea* plant. B. Uredinia produced on fruits of unidentified *Dioscorea* plant. C. A cross section of uredinium, showing subepidermal, peridiate sorus. e: host epidermis. p: fungal peridium. D. Urediniospores focused on horizontal plane. E. Surface structure of urediniospore (SEM). Small cones with round or truncate apex are distributed more or less evenly, except for the smooth surface near the basal hilum. F. Small cones with round or truncate apex distributed upper half of the urediniospores (SEM). G. Germ pores scattered on the urediniospore wall (stained with cotton-blue). Bars: A 5 cm; B 2 cm; C 20 µm; D, G 10 µm; E, F 5 µm

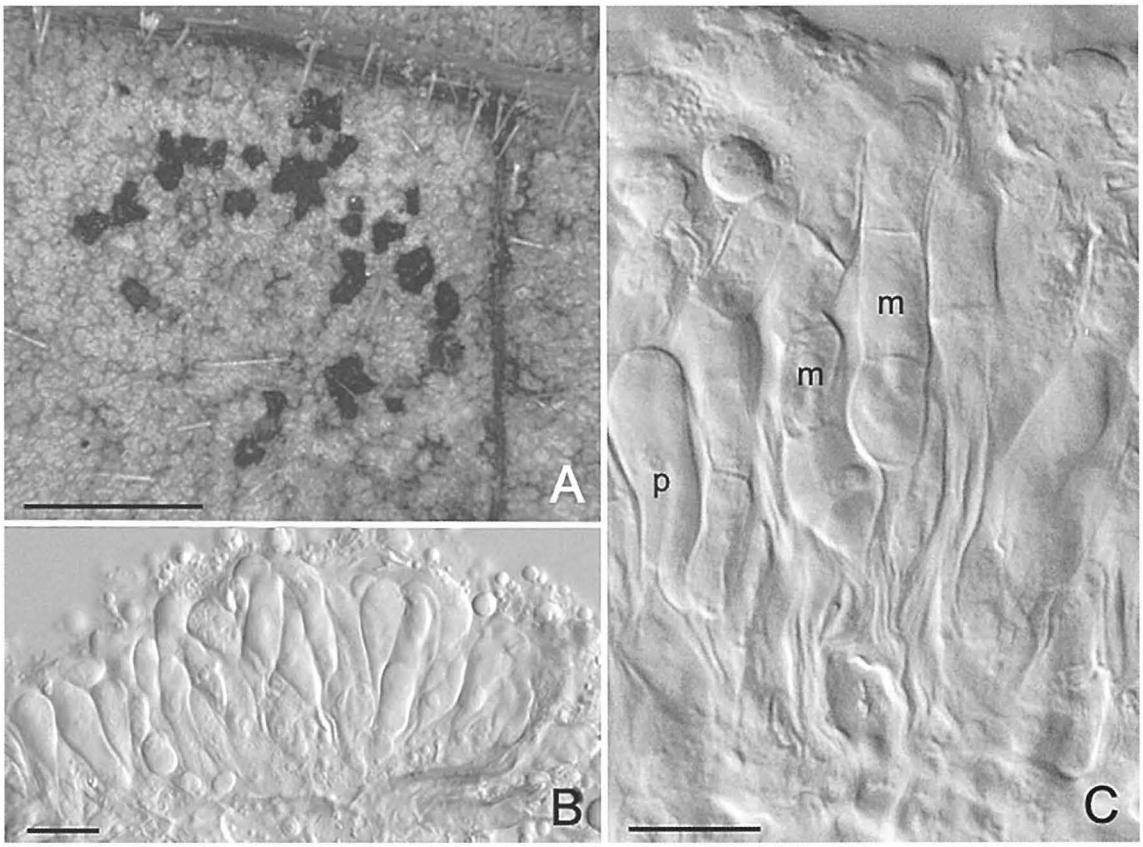

Fig. 2. *Goplana dioscoreae* (IBAR11435). A. A group of basidiosori (telia: pulvinate, light chestnut-brown to blackish brown). B. A cross section of a basidiosorus, showing developing probasidia. C. A cross section of a mature basidiosorus. A transversely septate metabasidium (m) is produced by continuous apical elongation of a probasidium (p). Bars: A 1 mm; B, C 20 µm.

versely septate metabasidia arise by continuous apical elongation of the probasidia (Fig. 2C).

The earliest legitimate name of this fungus is *Aecidium dioscoreae* Berk. & Broome [(1873) 1875]. The name is based on the uredinial anamorph collected in Peradenia, Sri Lanka, in 1868. Cummins (1935) found the teleomorph on the specimens identified as *Uredo dioscoreae-alatae* Racib. collected in Manila, the Philippines, in 1912 (Sydow, Fungi exotici exsiccati no. 230) and the other specimen from Samoa. The telia were characteristic of the genus *Goplana* and, therefore, proposed a new combined name, *G. dioscoreae* (Berk. & Broome) Cummins. Because Cummins (1935)'s proposal lacked a Latin diagnosis of the teleomorph, the name was then referred to as a "legitimate new combination based on the specimen of the anamorph that typifies the basionym" (Hernández and Cline 2010; International Code of Botanical Nomenclature (Vienna Code), Art. 36 , https://www.iapt-taxon.org/icbn/main.htm, accessed 5 November 2020). Later, Cummins (1960) proposed a name, *G. dioscoreae* Cummins (as sp. nov.), with a Latin description of the teleomorphic state and its holotypification (Sydow, Fungi exotici exsiccati no. 230). However, *G. dioscoreae* Cummins (1960) automatically becomes a later homonym of *G. dioscoreae* (Berk. & Broome) Cummins (1935) [International Code of Botanical Nomenclature (Vienna Code), Art. 59.6, Ext. 7]. Therefore, Hernández and Cline (2010) proposed a new name, *G. dioscoreae-alatae* J.R. Hern. & E.T. Cline (as nom. nov.), to replace the illegitimate name, *G. dioscoreae* Cummins. *Uredo dioscoreae-alatae* Racib. (Raciborski 1900, Paras. Alg. Pilz. Java's 1: 29) was cited as a uredinial anamorph, which can be regarded as a basionym of *G. dioscoreae-alatae* (Vienna Code, Art. 33.4).

However, the earliest legitimate name of the fungus is *Aecidium dioscoreae* Berk. & Broome (Berkeley and Broome 1875) under International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code 2017), Art. F. 8 (https://www.iapt-taxon.org/nomen/pages/intro/ti-

tle_page.html, accessed 5 November 2020). After the discovery of the teleomorph of the fungus, Cummins's combination of the epithet "*dioscoreae*" with the genus name "*Goplana*" [as *G. dioscoreae* (Berk. & Broome) Cummins] becomes legitimate (also see Aime et al. 2018 for the nomenclature of rust fungi classified in the genus *Aecidium*). Further detailed nomenclatural treatments can be found in Ono (1982) and Hernández and Cline (2010).

This fungus occurs on *D. alata* L., *D. bulbifera* L., *D. esculenta* (Lour.) Burkill, *D. pentaphylla* L., *D. pyrifolia* Kunth, *D. cayenensis* subsp. *rotundata* (Poir.) J.Miège (= *D. rotundata* Poir.), and *D. transversa* R. Br. in a broad geographic range of Asia, Australasia, Micronesia, Melanesia, and Polynesia (Ono 1982; Ono and Hennen 1983; Farr DF and Rossman AY. Fungal Databases, U.S. National Fungus Collections, ARS, USDA, https://nt.ars-grin.gov/fungaldatabases/, accessed on 5 November 2020).

Phakopsora dioscoreae Thaung, Trans. Br. Mycol. Soc. 62: 218. 1974. Fig. 3

On *Dioscorea* aff. *alata* L., Chiang Mai Prov., Chiang Mai, Doi Suthep National Park, on a trail from accommodation area to Sai Yoi Waterfall, ca. 18°48'N, 98°55'E, 10 Feb 2019. Y. Ono, J. Unartngam and C. Ayawong (U & T, IBAR 11494, 11497 & 11499); on *D. bulbifera* L., Chiang Mai Prov., Chiang Mai, Doi Suthep-Pui, 1st National Park Protection Unit, ca. 1400 m asl, ca. 18°48'N, 98°55'E, 23 Nov 2003. Y. Ono (U & T, IBAR 9148); on *Dioscorea* sp., Chiang Mai Prov., Chiang Mai. Doi Suthep-Pui National Park, Doi Suthep, ca. 900 m asl, ca. 18°48'N, 98°55'E, 23 Nov 2003. Y. Ono (U & T, IBAR 9151); between Sai Yoi Waterfall and Montha Tan Waterfall, ca. 18°48'N, 98°55'E, 10 Nov 2019. I. Okane, C. Ayawong, J. Unartngam and Y. Ono (U, T, IBAR11553).

Only uredinia and telia are known for this fungus. These sori occur on circular, discolored spots on the abaxial leaf surface. The uredinia are solitary and scattered or in small groups, often concentrically arranged and surrounded by dense groups of minute telia (Fig. 3A). The uredinia are subepidermal, covered by thin-walled peridium (Fig. 3B), paraphysate both at periphery (Fig. 3B) and on hymenium (Fig. 3C) of the sori, and becoming erumpent by irregular central aperture. Paraphyses are thin-walled, cylindric or narrowly clavate, and 20−38×6−14 μm in size (Fig. 3C). Urediniospores are produced on a short pedicel, often appearing almost sessile, subglobose, obovoid, obovoid-ellipsoid or pyriform, sometimes irregularly angular, and (14−) 20−31×(13−) 16−22 μm in size (Fig. 3D). The wall is thin, colorless, and finely echinulate (Fig. 3D, E). No germ pore is observable. The telia are subepidermal and composed of one-celled teliospores in 2−3 (−4) layers (Fig. 3F). The sori appear amber-colored at an early developmental stage and become dark brown later. Individual teliospores are broadly ellipsoid or oblong, and often angular. The wall is smooth, light cinnamon-brown or light chestnut-brown, 1−1.5 μm thick at sides, and 1.5−2 (−4) μm at the apex.

This fungus was previously known only from the type material collected on unidentified *Dioscorea* plant at Yankin Hill, Mandaley, Burma (now Myanmar) in 1972 (Thaung 1974). It is now known on three *Dioscorea* species found at three sites in Doi Suthep National Park and likely to occur widely in warm regions in Asia.

Commentary

The genus *Dioscorea*, yams, comprises 600 or more species, individual species being variously distributed across warm regions of Africa, Asia, Latin America, the Caribbean and Oceania (Coursey 1967; Lebot 2008; Asiedu and Sartie 2010; Price et al. 2016). About seven to ten species are estimated to have been domesticated on a large scale, primarily for staple food (Coursey 1967; Purseglove 1972; Lebot 2008: Asiedu and Sartie 2010; Scarcelli et al. 2017). In Thailand, *D. alata* L., *D. esculenta* (Lour.) Burkill, and *D. hispida* Dennst. are either collected or grown, but cultivation of these yams on a commercial base is negligible. Nonetheless, a recent ethnobotanical survey in local tribes, particularly in Peninsular Thailand revealed that fifteen (including two unidentified) species of yams are either cultivated or collected (Maneenoon et al. 2014). Unlike three major tropical tuberous root crops (cassava, sweet potato, and taro) species of yams have scarcely drawn attention for a large-scale exploration. However, yams maintain a long history of utilization for staple crops and traditional medicines (perhaps more than 2000 years). The high productivity and long-term storage potential of the tubers of yams will increasingly be vital for food security in developing countries. In addition, a recent metabolite profiling of yams (Price et al. 2016; Padhan and Panda 2020) revealed diversity of high-value compounds that could be important renewable sources

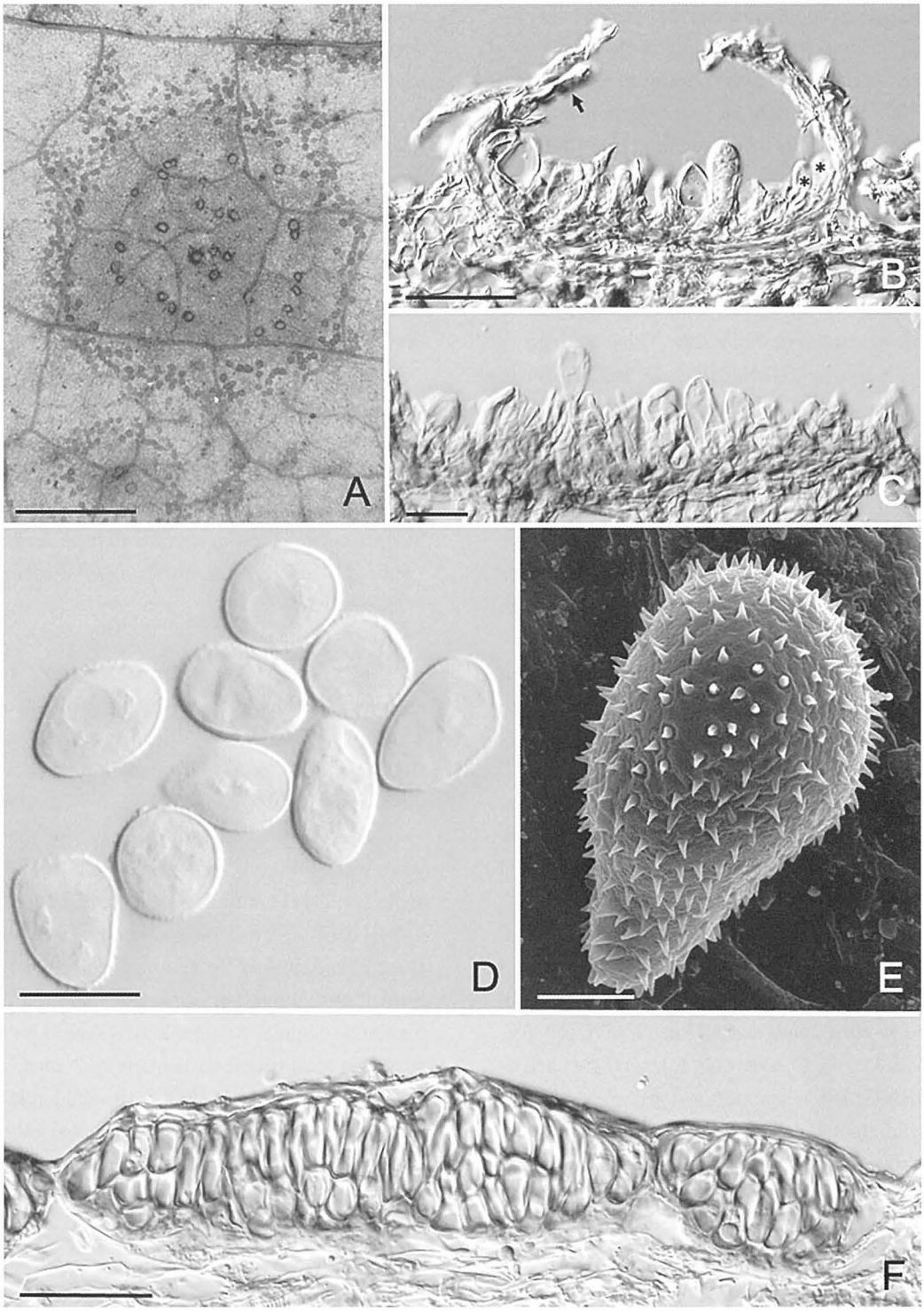

Fig. 3. *Phakopsora dioscoreae* (A, B: IBAR9151; C–F: IBAR11494). A. Sori produced on a discolored circular lesion on the abaxial leaf surface of unidentified *Dioscorea* plant. Uredinia are arranged more or less concentrically at the center of the lesion. Minute, umber-colored telia are surrounding a group of the uredinia. B. A cross section of subepidermal, peridiate (arrow) uredinium with peripheral paraphyses (asterisk). C. A cross section of uredinium, showing hymenial paraphyses. D. Urediniospores focused on horizontal plane. E. Surface structure of urediniospore (SEM). F. A cross section of subepidermal telia. The telia are composed of two or three (less frequently four) layers of teliospores. Bars: A 2 mm; B 50 μm; C, D, F 20 μm; E 5 μm.

for pharmaceutical purposes. Currently no rust diseases are problematic in yam cultivation, even in western Africa, where over 90% of ca. 50 million tons is produced annually (Nweke 2016). However, *G. dioscoreae* would become an invasive rust pathogen where yams become intensively cultivated as indicated by the observed fact that wild *D. alata* and *D. bulbifera* were severely diseased in Thailand and by the incidence of its serious infections on cultivated purple yams (*D. alata*) in Okinawa, Japan, in 1993 (Imazu et al. 1995).

Acknowledgments

Scanning electron microscopy was assisted by Kodai Gibu, Graduate School of Life and Environmental Sciences, University of Tsukuba. This study was carried out under the permission from the National Research Council of Thailand (NRCT). We thank the Department of National Parks, Wildlife and Plant Conservation, Ministry of Natural Resources and Environment, Thailand for permitting to survey plant rusts and to sample rusted plants. This study was supported, in part, by a Grant-in-Aid for Scientific Research Nos. 18570081, 25450056 (YO), and 20H03006 (IO) from the Japan Society for the Promotion of Sciences.

Disclosure

The authors declare no conflict of interests.

摘　要

ヤマノイモ属植物に寄生するサビキン *Goplana dioscoreae* と *Phakopsora dioscoreae* がタイで見出された. *Goplana dioscoreae* はチェンマイ県で *Dioscorea bulbifera* と未同定ヤマノイモ属植物に，パンガー県で *D. wallichii* に，そしてプラチュアップキリカン県で未同定ヤマノイモ属植物に寄生していた. *Phakopsora dioscoreae* はチェンマイ県で *D. alata* に近似した植物，*D. bulbifera* 及び未同定ヤマノイモ属植物上で見出された. *Phakopsora dioscoreae* は1972年にミャンマーで採集された基準標本でしか知られていなかった.

References

Aime MC, Castlebury LA, Abbasi M, Begerow D, Berndt R, Kirschner R, Marvanová L, Ono Y, Padamsee M, Scholler M, Thines M, Rossman AY (2018) Competing sexual and asexual generic names in *Pucciniomycotina* and *Ustilaginomycotina* (*Basidiomycota*) and recommendations for use. IMA Fungus 9: 75－89

Asiedu R, Sartie A (2010) Crops that feed the world 1. Yams. Food Sec 2: 305－315

Berkeley MJ, Broome CE (1875) Enumeration of the fungi of Ceylon. J Linn Soc Bot 14: 29－140

Coursey DG (1967) Yams. An account of the nature, origins, cultivation and utilization of the useful members of Dioscoreaceae. Longmans Green, London, pp 244

Cummins GB (1935) Notes on some species of the Uredinales. Mycologia 27: 605－614

Cummins GB (1960) Description of tropical rusts. IX. Bull Torrey Bot Club 87: 31－45

Hernández JR, Cline ET (2010) *Goplana dioscoreae-alatae* nom. nov. and other Uredinales on Dioscoreaceae: nomenclature and taxonomy. Mycotaxon 111 : 263－268

Imazu M, Tanaka Y, Masuhara G, Yamaoka Y, Kakishima M (1995) Occurrence of rust disease on *Dioscorea alata* caused by *Goplana dioscoreae* in Ishigaki Isl. (Abstract in Japanese) Ann Phytopathol Soc Jpn 61: 217

Judith C, Rossman A (2014) Revised scientific names of the genus *Hemileia* (Pucciniales) based on the new ICN. Mycokey 8: 1－10

Lebot, V. 2008. Section III. Yams. In: Atherton J & Rees A (Eds.), Tropical root and tuber crops: Cassava, sweet potato, yams and aroids. Wallingford: CAB International, pp 181－275

Maneenoon K, Sirirugsa P, Sridith K (2008) Ethnobotany of *Dioscorea* L. (Dioscoreaceae), a major food plant of the Sakai tribe at Banthad range, peninsular Thailand. Ethnobot Res Appl 6: 385－394

Nweke FI (2016) Yam in West Africa: Food, money, and more. Michigan State University Press, East Lansing, MI, pp 167

Ono Y (1982) Rusts of yams in Southeast Asia and South Pacific. Trans Br Mycol Soc 79: 423－429

Ono Y, Hennen JF (1983) Taxonomy of the Chaconiaceous genera (Uredinales). Trans Mycol Soc Jpn 24: 369－402

Ono Y, Okane I, Chatasiri S, Pota S, Unartngam J, Ayawong C, Nguyen HD, Le CTM (2020) Taxonomy of

Southeast Asian-Australasian grapevine leaf rust fungus and its close relatives. Mycol Prog 19: 905－919

Padhan B, Panda D (2020) Potential of neglected and underutilized yams (*Dioscorea* spp.) for improving nutritional security and health benefits. Front Pharmacol 11: 496

Price EJ, Wilkin P, Sarasan V, Fraser PD (2016) Metabolite profiling of *Dioscorea* (yam) species reveals underutilized biodiversity and renewable sources for high-value compounds. Sci Rep 6: 29136

Purseglove JW (1972). Tropical crops. Monocotyledons. Vol. 1. Longman, London, pp 334

Raciborski M (1900) Parasitische Algen und Pilze Java's. I. Theil. Staatsdruckerei, Batavia, pp 39

Saccardo PA, Sydow P (1902) Sylloge Fungorum omnium hucusque cognitorum vol. 16. Supplementum universale pars V. R. Friedlander & Sohn, Berlin, pp 1291

Scarcelli N, Chaïr H, Causse S, Vesta R, Couvreur TL, Vigouroux Y (2017) Crop wild relative conservation: Wild yams are not that wild. Biol Conserv 210: 325－333

Sydow P, Sydow H (1924) Monographia uredinearum seu specierum omnium ad hunc usque diem descriptio et adumbratio systematica. Vol. 4. Uredineae imperfectae. Fratres Borntraeger, Leipzig, pp 671

Thaung MM (1974) Two new rusts from Burma. Trans Br Mycol Soc 62: 218－222

Unartngam J, Janruang P, Sawatsuk T, Ayawong C, Okane I, Ono Y (2020) Two rare chaconiaceous rust fungi with unique anamorph spores found in Thailand. Jpn J Mycol 61: 115－120