Bipolaris cactivora causing fruit rot of dragon fruit imported from Vietnam

He PF [1, 2], Ho H[3], Wu XX[1], Hou MS[2], He YQ[1*]

[1]Key Laboratory of Agricultural Biodiversity and Pests Control, Ministry of Education, Yunnan Agricultural University(YAU), Kunming 650201, China
[2]Department of Plant Pathology, Faculty of Plant Science and Technology, Huazhong Agricultural University, Wuhan 432700, China
[3]Department of Biology, State University of New York, New Paltz, NY 12561, USA

He PF, Ho H, Wu XX, Hou MS, He YQ 2012 – *Bipolaris cactivora* causing fruit rot of dragon fruit imported from Vietnam. Plant Pathology & Quarantine 2(1), 31-35, doi 10.5943/ppq/2/1/5/

In 2009, a new disease of imported dragon fruit (*Hylocereus undatus*) was discovered in a fruit market in Kunming, Yunnan Province of China. The symptoms included water-soaked, olive to black powdery spots to coalescing soft rot in the later stage. The pathogen of this disease was identified as *Bipolaris cactivora* and its pathogenicity was confirmed by satisfying Koch's postulates. This is the first report of *B. cactivora* causing fruit rot of dragon fruit imported from Vietnam. The need for vigilant quarantine measures is discussed.

Key words – China – fungal pathogen – plant disease – Yunnan – Vietnam

Article Information
Received 22 February 2012
Accepted 28 February 2012
Published online 10 April 2012
[*]Corresponding author: Yueqiu He – e-mail – ynfh2007@163.com

Introduction

Dragon fruit, also known as strawberry pear or pitaya is produced by a tropical climbing cactus (*Hylocereus*), a member of Cactaceae. One species, *Hylocereus undatus* (Haw.) Britt. & Rose is grown commercially in Vietnam, Spain, Malaysia, Japan, Mexico and other tropical and subtropical areas because of its high nutrient content and healing properties (Reyes 1995, Rodriguez 2000). In recent years, it has been introduced to Hainan, Guangdong, Fujian, Guangxi, Guizhou, Yunnan and Sichuan provinces of China. Various diseases have been reported on dragon fruit and plants in tropical and subtropical countries, such as anthracnose (*Gloeosporium* sp.) (Masanto et al. 2009a), wilt (*Fusarium oxysporium*), stem rot (*F. semitectum*, *F. oxysporium*, *F. moniliforme*) (Hawa et al. 2010), stem blight (*Diplodia* sp., *Ascochyta* sp. and *Phoma* sp.), soft rot (*Erwinia* sp., *Enterobacter cloacae*) (Masanto et al. 2009b), canker (unknown pathogen), scab (a bacterium) (Yuan et al. 2004), black spot (*Alternaria* sp.), speck blight (*Nectriella* sp.), (Wang et al. 2007), brown spot (*Botryodiplodia* sp.), basal rot (*Pythium* sp.) (Lin et al. 2006) and stem lesion (*Septogloeum* sp.) (Zheng et al. 2009). This paper reports on a new fruit rot disease from dragon fruit imported from Ho Chi Minh City, Vietnam. This information will be helpful for the improvement of the plant quarantine system in China since dragon fruits are mostly imported from Vietnam.

Methods

Diseased dragon fruit, imported from Ho Chi Minh City, Vietnam, was purchased from a Kunming fruit market. Infected black spots had extensive numbers of spores (Fig. 1B). Single spores were isolated with a sterile needle under a dissecting microscope at 200× magnification and cultured on potato sucrose

Table 1 Growth rate of *Bipolaris cactivora* on different media as measured by colony diameter (cm)

Incubation days	OSA	PSTA	PSA	PDA	PMA	V8A	PLA
1	1.42 Bb	1.46 Bb	1.58 Aa	1.70 Aa	1.42 Bb	1.25 Cc	1.38 BCb
2	2.53 DEd	2.72 CDc	2.97 Abb	3.24 Aa	2.89 BCb	2.21 Ee	2.53 Dcd
3	3.79 CDd	3.92 Cc	4.43 Bb	4.75 Aa	4.41 Bb	3.03 Ee	3.64 Dd
4	4.83 Bc	5.05 Bc	5.90 Ab	6.24 Aa	5.74 Ab	3.85 Cd	5.20 Bc
5	6.04 Bd	6.27 Bcd	7.21 Ab	7.58 Aa	7.17 Ab	4.73 Ce	6.27 Bc
6	7.10 Bc	7.70 Bb	8.58 Aa	9.00 Aa	9.00 Aa	5.66 Cd	7.40 Bbc

** the different lowercase letters are significant at α =0.05 level, the different capital letters are the most significant at α =0.01 level.

agar (PSA) plates at 28ºC for 3−4 days. Small light brown spots were initially observed on fruit surface when inoculated with spores from culture and directly from the diseased fruit three days after inoculation (Fig. 1A). Gradually, the spots developed into water-soaked to depressed olive to black dense powdery lesions. The lesions expanded outward to the margin with a light yellow colour and coalesced, ultimately resulting in a complete soft rot of the fruit. The pathogen was identified by its cultural and morphological characteristics. Fungal growth was tested on seven agar media with different carbon sources in 90 mm diam Petri dishes: potato dextrose agar (PDA), potato sucrose agar (PSA), oat sucrose agar (OSA), V8 agar (V8A), potato maltose agar (PMA), potato starch agar (PSTA) and potato lactose agar (PLA). Each agar plate was inoculated with a 5 mm diam mycelial disc and incubated at 28 ℃ for six days. The fungal growth was assessed by measuring the colony diameters for six days and each treatment (culture medium) was repeated five times.

Pathogenicity of the fungus was tested on healthy dragon fruit and prickly pear cactus (*Opuntia stricta*) harvested from China. Dragon fruit unwounded or artificially wounded by a sterile needle as well as wounded prickly pear cactus were each inoculated on the surface with a 5 mm diam mycelial PDA disc and incubated at 28º, in a beaker lined with wet paper towels on the bottom and sealed with plastic film to maintain a relative high humid environment. Two to three days after inoculation, symptoms appeared and the pathogen was re-isolated from the margin of the lesions. As a control, the dragon fruit and cactus plant were inoculated with plain PDA agar discs.

Results

Morphological characteristics of the fungus

The fungal colony on PDA medium was pale-olive to black throughout. Young hyphae were hyaline whereas old and mature hyphae were narrower, brownish and sclerotized (Fig. 1Cand produced many black microsclerotia on the plate. Conidiophores were light brown to yellow brown, straight or flexuous, measuring 62.7–254.9 × 4.4–7.9 µm (av. 137.2 × 5.8 µm) and often swollen at the apex and at the base (Fig. 1D). They were cespitose on the diseased fruit. Conidia, each with a basal hilum, were straight, ellipsoidal, fusiform or obclavate, 2–4 septate, pale light brown to brown (Fig. 1E) and measured 29.5–46.9 × 8.2–14.0 µm (av. 35.2×10.3µm). All measurements were based on 110 random samples.

Cultural characteristics of the fungus

Colonies were measured everyday along two perpendicular lines drawn through the center of the colony. The growth rates were fastest on PDA, medium to fast on PSA, and in a decreasing order, on PSTA, PLA , OSA and V8A (Fig. 2, Table 1). Colonies on PDA plates consisted of pale-olive to black aerial mycelia. Mycelia were more exuberant and fluffy on PDA than on other media. On OSA, the colony was whitish to brownish, and appressed with little aerial mycelia. On V8A, the aerial mycelium was white to light gray.

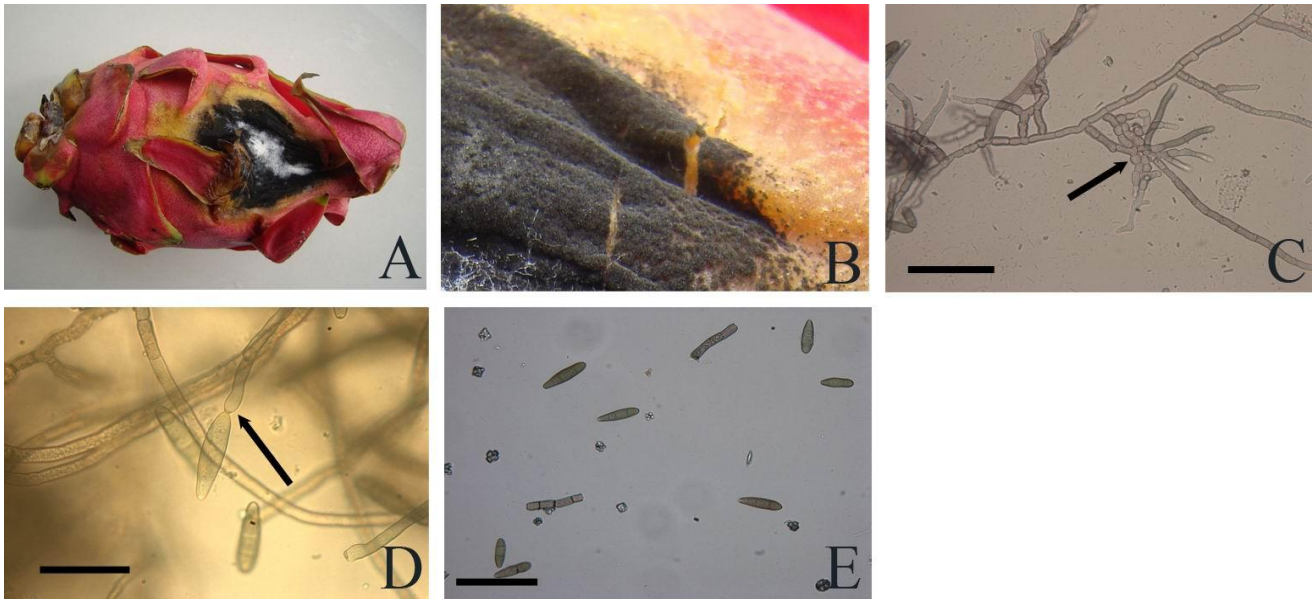

Fig. 1 – A The symptoms of dragon fruit (*Hylocereus undatus*) fruit rot caused by *Bipolaris cativora*. **B** Black powdery spot of the infected fruit showing profuse conidial production. **C** Mycelia of *Bipolaris cativora* (arrow indicates sclerotized cell). **D** Conidiophore and conidia (arrow indicates conidiophore). **E** Conidia of *Bipolaris cativora*. Scale Bar = 50µm.

Pathogenicity

Dragon fruit and prickly pear cactus showed disease symptoms 2–3 days after inoculation, indicating that the fungus was pathogenic (Fig. 3). Initially, water-soaked and brownish lesions appeared on the inoculated sites, and gradually they turned black 5–7 days after inoculation. However, the disease was more severe on wounded fruit than on unwounded fruit (Fig. 3 A,B). The pathogen were re-isolated from the inoculated fruit and cactus, and cultured on PDA medium plates again. It was morphologically identical to the fungus isolated originally from the infected fruit in this study.

Discussion

Based on the morphological and cultural characteristics, the fungus was similar to and thus identified as *Bipolaris cactivora* (Petrak) Alcorn (Taba et al. 2007). Its pathogenicity to dragon fruit and prickly pear cactus was confirmed by satisfying Koch's postulates. The fungus has previously been reported to cause soft rot of dragon fruit in Taiwan (Wang & Lin 2005), Japan (Taba et al. 2007), South Florida (Tarnowski et al. 2010) and most recently from Zhanjiang district of Guangdong Province, China (Liu et al. 2011), whereas fruit blotch and stem rot of dragon fruit induced by *B. cactivora* has been reported in Israel (Israel et al. 2011). This is the first report of the disease in Yunnan Province connecting it to dragon fruit imported from Vietnam. Since Guangdong Province is in close proximity to Yunnan Province, it is conceivable that the diseased dragon fruit in that province also came from Vietnam which provides almost all the dragon fruit consumed in South China.

As the China-ASEAN Free Trade Area was established in 2010, more agricultural products can easily be transferred among the countries (Zhang et al. 2011). Tropical fruits, including dragon fruit, will be imported into China on a large scale. It is important to understand the pests and diseases that occur in their places of origin so that they do not become problematic to the Chinese growers in the future. Although the disease has not been reported in Vietnam where the diseased fruits came from the imported fruit might harbour fungal spores which could start the infection later in China when the conditions are favourable for disease development. The disease may cause the entire fruit to rot completely in 10 days when temperature is optimum to the pathogen. Therefore, this study is significant and more vigilant quarantine measures must be adopted to screen dragon

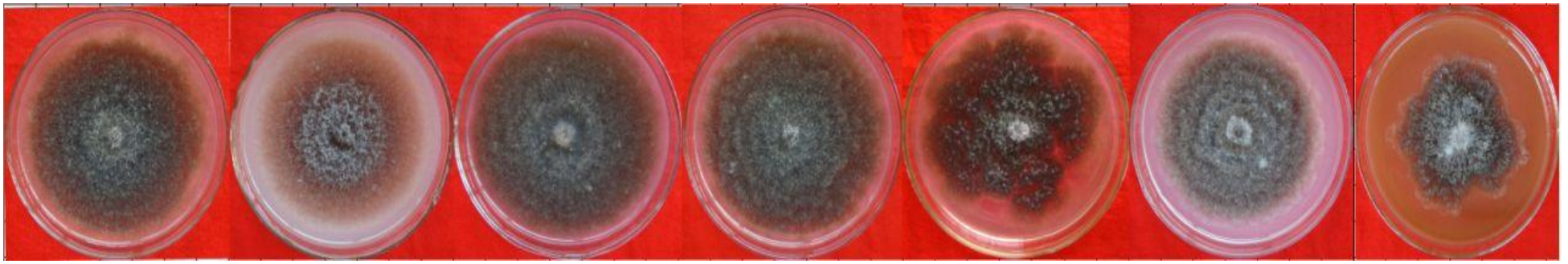

Fig. 2 – Colonies of *Bipolaris cactivora* growing on different carbon source media (6 days) {from left to right: PMA(maltose), OSA (oat-sucrose-agar), PDA (glucose), PSA (sucrose), PLA (lactose), PSTA (starch) and V8A}

Fig. 3 – *Bipolaris cactivora* fruit rot symptoms. **A** wound inoculated dragon fruit **B** Non wound inoculated dragon fruit **C** Wound inoculated prickly pear cactus.

fruit from Vietnam for *Bipolaris cactivora*.

Acknowledgements

The work was supported by Ministry of Agriculture, China under the Program of Special Fund for Agro-scientific Research in the Public Interest. The authors would like to thank Prof. Dilantha Fernando, Department of Plant Science, University of Manitoba, Winnipeg, MB R3T 2N2, Canada for his useful suggestions and critical review.

References

Hawa Masratul M, Salleh B, Latiffah Z. 2010 – Characterization and intraspecific variation of *Fusarium semitectum* (Berkeley and Ravenel) associated with red-fleshed dragon fruit (*Hylocereus polyrhizus* [Weber] Britton and Rose) in Malaysia. African Journal of Biotechnology 9, 273–284.

Israel BZ, Issac A, Edna L, Genya E. 2011. First report of *Bipolaris cactivora* causing fruit blotch and stem rot of dragon fruit (pitaya) in Israel. Phytoparasitica 39, 195–197.

Lin CC, Guo WB，Cai SF. 2006 – Diseases of red dragon fruit in Taiwan. Good Year (Chinese）56, 38–42.

Liu YL, Zhou J, Zhao ZH, Xi PG, Jiang XD. 2011 – Identification of pathogen causing fruit rot of *Hylocereus undatus* in Guangdong Province. Journal of Huazhong Agricultural University (Chinese) 30, 585–588.

Masanto M,Kam aruzaman S, Yahya A. 2009a – The first report of the occurrence of anthracnose disease caused by *Colletotrichum gloeo-sporiodes* (Penz.) Penz. & Sacc. on dragon fruit (*Hylocereus* spp.) in Peninsular Malaysia. American Journal of Applied Science 6, 902–912.

Masanto M, Kamaruzaman S, Yahya A. 2009b – First report on bacterial soft rot disease on dragon fruit (*Hylocereus* spp.) caused by *Enterobacter cloacae* in peninsular Malaysia. International Journal of Agriculture & Biology 11, 659–666.

Reyes RN. 1995 – E1 Cultivo de la Pitahaya y sus Posibilidades de Desarrollo en Mexico. GOHE, Villahermosa, Tabasco, Mexico.

Rodriguez CA. 2000 – Pitahayas: Estado Mundial de su Cultivo y Comercialization. Fundacion Produce Yucatan A.C., Universidad Autonoma Chapingo. Chapingo, Edo. de Mexico.

Taba S, Miyahira N, Nasu K, Takushi T, Moromizato Z. 2007 – Fruit rot of strawberry pear (pitaya) caused by *Bipolaris cactivora.* Journal of General Plant Pathology 73, 374–376.

Tarnowaski TLB, Palmateer AJ, Crane JH. 2010 – First report of fruit rot of *Hylocereus undatus* caused by *Bipolaris cactivora* in South Florida. Plant Disease 94, 1506.

Wang DF, Wei Q, Yang R, Sang WJ, Fan GQ, Jin YL. 2007 – Preliminary identification of disease of pitaya in Luodian Country. Journal of Mountain Agriculture and Biology（Chinese) 26, 267–270.

Wang CL, Lin CC. 2005 – Fruit rot of pitaya and stem rot of cacti in Taiwan. Plant Pathology Bulletin (Chinese) 14, 269-274.

Yuan CL, Zhang WF, Yuan HX. 2004 – Preliminary report on investigation and control practices for pitaya diseases in Shuyuexi Prefecture. South China Fruits (Chinese) 33, 49–50.

Zhang GM, Ling XY, Feng JJ, Cheng YH, Zheng Y, Li YN, Long H, Li FR, Wang Y, Jiao Y, Xiang CY, Yu DJ, Kang L. 2011 – Overview of plant quarantine in Shenzhen, China. Plant Pathology & Quarantine 1, 103–114.

Zheng W, Wang B, Cai YQ. 2009 – Inhibitory test for *Septogloeum* sp. causing stem lesion of pitaya with fungicides. Jiangsu Agricultural Sciences (Chinese) 5,151–152.