The Pharma Innovation Journal 2023; 12(9): 3080-3085

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 3080-3085

www.thepharmajournal.com
Received: 11-07-2023
Accepted: 17-08-2023

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Disease spectrum of cornstalk plant [*Dracaena* sp.] and its distribution: A review

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Abstract
Dracaena "female dragon", is a genus of about 120 species of trees and succulent shrubs. In the Angiosperm phylogeny group (APG) IV classification system, it is placed in the family Asparagaceae, subfamily Nolinoideae. It has also formerly been separated into the family Dracaenaceae or placed in the Agavaceae. The majority of the species are native to Africa, with a few in Southern Asia and two in tropical Central America. It is also commonly known as Cornstalk plant or Corn plant. These plants are infected by a number of fungal, bacterial, viral and nematode pathogens, which reduce the economic value of the plants and make them less marketable by reducing their aesthetic value. Thus, in the present aspect, the diseases occurring on *Dracaena*; their relevant comprehensive compilations based on several research and literature findings from different countries including India are made to present their significant importance.

Keywords: Ornamental diseases, cornstalk, dracaena sp., houseplant diseases, female dragon

1. Introduction
On *Dracaena*, 8 major fungal diseases along with few minor leaf spot diseases caused by *Curvularia lunata, Corynespora cassiicola, Haplosporella sp., Coniothyrium concentricum, Diplodia dracaena, Ascochyta graminicola, Phomopsis dracaenae* etc. were reported so far from around the world. Additionally, it was also found to be affected by few bacterial, viral and nematode pathogens.

The detailed list of the diseases affecting the Cornstalk plant is stated below

Table 1: Disease spectrum of *Dracaena*

Disease	Causal organism
Anthracnose and leaf spot	*Colletotrichum sp., Gloeosporium polymorphum*
Physalospora tip- blight and leaf-spot	*Physalospora dracaenae*
Hendersonia leaf pot	*Hendersonia dracaenae*
Phyllosticta leaf spot	*Phyllosticta dracaenicola, Phyllosticta macicola, Phyllosticta hesperidearum*
Sphaerulina leaf spot	*Sphaerulina taxi*
Stem rot and wilt	*Fusarium solani* var. *coeruleum*
Stem rot	*Aspergillus niger*
Dracaena leaf proliferosis	*Fusarium proliferatum* var. *minus*
Other leaf-spot causing fungi	*Curvularia lunata, Corynespora cassiicola, Haplosporella* sp., *Coniothyrium concentricum, Diplodia dracaena, Ascochyta graminicola, Phomopsis dracaenae*
Bacterial leaf spot	*Pseudomonas* sp.
Viruses	Ring spot virus, *Dracaena* mottle virus
Nematodes	*Meloidogyne* spp., *Radopholus citrophilus, Pratylenchus brachyurus, Pratylenchus zeae.*

2. Fungal diseases
2.1 Anthracnose leaf spot
2.1.1. Occurrence of anthracnose disease on Cornstalk plant from around the world
Anthracnose of *Dracaena* was reported to be caused by 3 species of *Colletotrichum viz. Colletotrichum gloeosporioides, Colletotrichum dracaenophilum C. dracaenicola* and leaf spot of the same was caused by *Gloeosporium.*

On *Dracaena hookeriana*, causal organism of the leaf spot was identified as *Gloeosporium polymorphum* from Chandigarh (*c.f.* Sohi, 1990) [26]. On *Dracaena marginata*, *Colletotrichum gloeosporioides* and *C. dracaenicola* were reported. *Colletotrichum dracaenophilum* was reported as the causal agent of anthracnose on *Dracaena braunii* from Brazil, in August 2009 (Macedo, 2016) [16].

C. dracaenophilum caused anthracnose on *Dracaena* sp. in Bulgaria (Farr and Rossman, 2012) [7] and China (Farr *et al*., 2006) [8] and on *D. braunii* in Bulgaria (Bobev *et al.*, 2008) [3] and in China (Liu *et al.*, 2014) [15]. There were reports of four species of *Colletotrichum* in association with *Dracaena braunii*, namely: *C. dracaenophilum, C. gloeosporioides, C. petchii* (Farr and Rossman, 2012) [7] and *C. boninense* (Farr *et al*., 2006) [8]. During July-August 1967, severe infection of leaf-spot caused by *Hendersonia dracaenae* was noticed on *Dracaena marginata* Lam., confined mostly to the leaf-margins, was also observed on a *Dracaena* sp. growing in the compound of the C.I.B.C Laboratory, Bangalore (Ponnappa, 1969) [21]. On *Dracaena fragrans victoriae* causal organism of anthracnose disease was identified as *Colletotrichum fragrans* from West Bengal (Katakam, 2016) [12].

2.1.2. Symptomatology of anthracnose disease of Cornstalk plant

The leaf spot of *Dracaena hookeriana* was reported to be caused by *Gloeosporium polymorphum* on a sample collected from Chandigarh. The diseased leaves showed small, circular to irregular, rosy buff- colored spots from the leaf tips and margins. Infected leaves later showed drying and downward curling (*c.f.* Sohi, 1990) [26]. On *Dracaena marginata*, *Colletotrichum gloeosporioides* and *C. dracaenicola* formed buff- colored spots with cinnamon, wavy margins arose from tips and margins of leaves and severe infection killed the growing point of the plant producing tip-blight symptoms (*c.f.* Sohi, 1990) [26]. On *Dracaena braunii*, the anthracnose caused by *Colletotrichum dracaenophilum* was reported from Brazil, in August 2009. Stems of *D. braunii* were observed bearing a combination of chlorotic and blackened and pinkish mucilaginous areas apically. These were recognized as anthracnose-like symptoms by Macedo (2016) [16]. On lotus bamboo (*Dracaena sanderiana* Lotus), the anthracnose caused by *Colletotrichum karstii* was reported from China (Li *et al*., 2018) [14]. The tips of infected leaves initially showed yellow sunken spots which later turned irregular with light-brown necrotic lesions. Black acervuli developed in concentric rings on the infected leaves.

In another study by Bobev *et al*. (2008) [3] it was demonstrated that in the winter of 2007, severe damage was observed in Bulgaria on imported *Dracaena sanderiana*. Initially, the internodes of infected stems appeared pale green with yellowish lesions. An upward spreading necrosis led to a weakness of the stems with wilt and death of the plants occurring within 2 weeks. Eventually, entire stems were covered with numerous, black, globose-to-ellipsoid acervuli with sparse, black setae.

On *Dracaena fragrans victoriae*, anthracnose symptoms initiated on the lower leaves were small, 0.8 - 1.5 cm (av. 1.04 cm) x 0.34 - 1.01 (av. 0.66 cm) size, brown, circular to oval/ellipsoidal in shape, sunken necrotic spots on the leaf lamina. In some cases, the spots were surrounded by yellow halo. These spots gradually became big and covered a large area turning dark brown with a greyish centre. Spots appeared from the margin or could start any part of the leaf blade. The leaf tips bore characteristic blighting and dried appearance with dark brown wavy margins with brownish grey tips over which fruiting bodies of the fungus were observed. Diseased tissues were slaughtered or torn off. Black dot- like, circular to globoid, acervuli were arranged in concentric fashion (sometimes scattered) on the central greyish portion of the spots. The lower surface of the spots was dark brown and sunken (Katakam, 2016) [12]

2.1.3 Morphometric and cultural characteristics of anthracnose pathogens affecting Cornstalk plant

On *Dracaena, Gloeosporium polymorphum* produced acervuli which were numerous, dark, arranged in rings, discoid, sub-epidermal, later becoming erumpent. Conidia were hyaline, 1-celled, elliptical to cylindrical, guttulate, 15 - 25 µ x 6 - 8 µ (*c.f.* Sohi, 1990) [26]. In *C. dracaenicola*, acervuli were many, punctiform, epiphyllous, sub-cuticular and dark, with dark brown, septate setae. Conidia were hyaline, 1-celled, obovate to elliptical, 12 - 15 µ x 6 - 8 µ (*c.f.* Sohi, 1990) [26].

Colletotrichum dracaenophilum produced internal mycelia which were intercellular, 3 - 5 µ diameter, branched, septate, hyaline. Conidiomata were acervular, separate or confluent, 140 - 380 × 135.5 - 240 µ, sub-epidermal. Setae were sub-cylindrical, 55 - 95 × 3 µ tapering towards the rounded apex, 1 - 3 septate, pale to medium brown and smooth-walled. Conidiophores were sub-cylindrical, 26 - 60 × 4 - 5 µ, 0 - 3 septate, unbranched, dark brown and smooth. Conidiogenous cells were terminal, integrated, enteroblastic, sub-cylindrical, 15 - 20 × 4 - 5 µ and sub-hyaline to brown. Conidia were sub-clavate to cylindrical, straight to somewhat curved, 16.5 - 31 × 5 - 8 µ, aseptate and hyaline. Appressoria were single or in loose groups, pale to dark brown, smooth-walled, clavate, ovate or irregular, margin entire or undulate, sometimes lobate and 6 - 15 × 4 - 10 µ (Macedo, 2016) [16]

In a separate experiment, *C. karstii* infecting *D. sanderiana* was grown on potato dextrose agar (PDA) medium and was incubated at 28 °C under a 12-h light/dark cycle. Colonies produced were flat, with a white margin that turned grey with age, with pink conidial masses and yellow to dark brown from underneath. Conidia produced were 5.0 to 6.5 × 15.0 to 19.5 µ (average 5.7 ± 0.7 × 16.8 ± 1.7 µ), hyaline, unicellular, cylindrical and obtuse at the apex (Li *et al*., 2018) [14].

In a study conducted by Macedo (2016) [16], *Colletotrichum dracaenophilum* was grown on vegetable broth agar (VBA) and potato dextrose-agar (PDA) and incubated at 25±2 °C either in the dark or under a 12 h light regime for culture description. The cultural morphology and colour were recorded after 1-week growth and described as a combination of observations made from colonies in all treatments. Colony colour was described according to Rayner (1970) [22]. The appressoria were described from slide cultures as described by Gams *et al*. (1998) [9]. Two 7 mm diameter culture plugs obtained from 1-week old cultures formed on VBA were placed on the surface of healthy stems of plants at three different points. Plants were then transferred to a humid chamber for 48 hr at 25 °C and then taken to the bench of a greenhouse, where they were maintained at approximately 25 °C. Plants sprayed with sterile tap water served as controls. In culture it was fast-growing, (90 mm diam in 15 days), circular, flat to slightly convex, cottony to velvety, white, with orange mucilaginous and black punctuations distributed over colony, with diurnal zonation (visible only on PCA -

potato carrot agar - under 12 h light regime); sporulation was abundant.

Colletotrichum fragrans was reported as the causal organism of anthracnose disease on *Dracaena fragrans victoriae* where the acervuli produced were black, numerous, arranged in concentric rings, erumpent, 82.6 - 132.4 µ (av. 109.9 µ). Setae were a few, black, 42 - 82.4 (av. 61.2 µ) x 2.5 - 3µ (av. 2.4 µ), 1 - 3 septate, unbranched and tapered towards the tip. Conidia were hyaline, single celled, numerous, cylindrical to elongated with both ends rounded, 13.1 - 26.0 (av. 16.6 µ) x 4.0 -6.8 µ (av. 4.2 µ) in size. When cultured on PDA medium the fungus formed thick cottony mycelial growth without any formation of acervuli and sporulation. The aerial hyphae at this medium were hyaline to pale white whereas those at the bottom of the plate were black. On peptone agar medium the fungus showed huge productions of acervuli. Different sizes of acervuli were observed with huge sporulation. The hyphae were hyaline. The acervuli were initially hyaline, later turned to orange - yellow and a few gradually turned to black (Katakam, 2016) [12].

2.1.4. Molecular characterization studies on *Colletotrichum* sp. infecting *Dracaena*

Colletotrichum dracaenophilum was reported to cause anthracnose on *Dracaena braunii* in Brazil. Total genomic DNA was extracted from mycelium produced in PC (potato-carrot) decoction in steady plates for 1 week, with the Wizard® Genomic DNA purification Kit (Promega corporation, Madison, WI, USA) following the manufacturer's protocols. Isolated DNA was visualised by electrophoresis in 0.8% agarose gels (w/v) stained with Gelred™ (Biotium Inc, Hayward, CA, USA) and viewed under near ultra-violet light. Quantification was performed as described by the manufacturer. The following regions were PCR-amplified: Internal Transcribed Spacer (ITS) region primers ITS4 + ITS 5 (White *et al.* 1990) [28]; Actin (ACT) ACT-512F + ACT-783R (Carbone and Kohn, 1999) [5]; Beta tubulin (Btub) - Bt-2b (Glass and Donaldson, 1995) [10] + T1 (O'Donnell and Cigelnik, 1997) [20]. All PCR mixtures and conditions followed as per the recommendations of Dream Taq™ PCR Master Mix manufacturer (Thermo Scientific®). Following PCR amplification, amplicons were visualised on 0.8% agarose gels stained with Gelred™ (Biotium Inc, Hayward, CA, USA) and viewed under near ultra-violet light. Sizes of amplicons were determined against GeneRuler™ molecular marker (Thermo Scientific®). The PCR amplicons were subsequently diluted to 50 ng in preparation for further DNA sequencing reactions. The DNA sequencing reactions used the same primers as those for the PCR. DNA sequencing amplicons were purified and sequenced by Macrogen-Korea (http://dna.macrogen.com/eng/). The ITS, ACT and Btub sequences were submitted to GenBank: with accession numbers KJ396954, KJ653228 and KJ653227, respectively.

The Brazilian sequences of *C. dracaenophilum* had high identities to the ex-type sequences for ITS 100% homology (562/562 identities to NR119572) and Btub 100% homology (492/492 identities to JX519247). The ACT gene region had 96% homology to the extype specimen (248/257identities to JX519238). They interpret this discrepancy as representing within-species variation not deserving special taxonomic recognition (Macedo, 2016) [16].

In another study, polymerase chain reaction was performed on the internal transcribed spacer (ITS) and 28S rDNA regions of three isolates of *Colletotrichum* collected from infected samples of lucky bamboo (*Dracaena sanderiana*). These sequences were further compared with sequences of *Colletotrichum* spp. in GenBank. Sequence analysis indicated that the *Colletotrichum* isolates obtained from *D. sanderiana* in Florida belonged to *C. dracaenophilum* or the *C. gloeosporioides* species complex (Sharma *et al*., 2014) [24].

2.2 *Diplodia* tip- blight and leaf-spot

The characteristic symptoms of the leaf tip blight disease of *Dracaena fragrans victoriae* were studied by Banerjee, *et al.* (2017) [2] from West Bengal. The results showed that the causal pathogen, *Lasiodiplodia theobromae* caused typical tip and marginal blighting of leaves along with numerous productions of concentric black dot like structures was observed on the upper surface of the dead part of leaf. Blighted portion was surrounded by a dark brown zonate margin followed by yellow halos. The leaves dried up basipetally. Color of the leaves was changed from brown to grey or straw at later stages. The length and breadth of straw-colored regions varied from 1.5 - 6.5 cm and 0.4 - 4.6 cm. Numerous ostiolate erumpent pycnidia were formed sub-epidermally on straw - colored dead tissues.

2.3 *Physalospora* tip- blight and leaf-spot

The infection started at the tips of lower leaves and spread down towards the base. Infected areas were sunken and straw-colored. It resulted in the death of most of the leaves except a few at the top. Perithecia of *Physalospora dracaenae* were with papillate mouths, immersed and dark. Numerous 8-spored asci were present in each perithecium. Ascospores are 1-celled and hyaline.

The fungus was collected from Chandigarh. Removal and disposal of infected leaves followed by spraying with copper oxychloride (0.2%) or Dithane M-45 (0.2%) were recommended. (c.f Sohi, 1990) [26]

2.4 *Hendersonia* leaf- spot

During July-August 1967, severe infection of leaf-spot caused by *Hendersonia dracaenae* was noticed on *Dracaena marginata* Lam., confined mostly to the leaf-margins, was observed on a *Dracaena* sp. growing in the compound of the C.I.B.C laboratory, Bangalore. The pathogen was described as foliicolous, spots epiphyllous, brown, sparse, mostly along the margin of the leaf, oval or elliptical measuring up to 10 mm in diameter. Pycnidia were many, amphigenous, dark, immersed, sub-epidermal, globose to discoid, ostiolate, 160 - 320µ x 140-240µ. Conidia were numerous, sub-hyaline to dark, ovoid to ellipsoid, mostly 3- or 4-celled with transverse septa, ends rounded, rarely 1 end pointed, 10 - 13µ x 4 - 4.5µ. The fungus was collected from Chandigarh. Earlier the disease was reported from Bangalore (Ponnappa, 1969) [21]

The fungus grew well on potato-dextrose agar, with light yellow fluffy aerial mycelium and yellowish- brown submerged mycelium. When the fungus was grown on steam-sterilized leaf bits in test tubes at laboratory at temperature of 18 – 28 °C (ambient temperature 16 – 34 °C) numerous fructifications were produced after 12 days with scanty mycelium. The spores germinated readily on PDA and on tap-water and formed stromatic mycelium within 3 days. Minute, black, solitary pycnidia appeared on PDA tubes after the 10th day (Ponnappa, 1969) [21].

2.5 *Phyllosticta* leaf-spot

It is reported to be caused by 3 species namely *Phyllosticta dracaenicola*, *P. maculicola* and *Phyllosticta hesperidearum*.

On *Dracaena marginata*, *Phyllosticta dracaenicola sp.* nov**.** was reported to cause leaf spots which were amphigenous, initially red on both surfaces, later centre turns to white with dark red margin, elongated, 2 - 35mm in length and 2 - 20 mm in width from Bhubaneswar, (Orissa). Pycnidia were epiphyllous, scattered in group (3 together), somewhat depressed, globose, 120 - 150 µ in diameter, with 15 - 30 µ wide pore. Wall 1 - 5 cells (10 - 15µ) thick, brownish with thicker cell walls in the upper part and around the pore, hyaline and flattened towards the conidiogenous region. Conidiogenous cells were cylindrical, 5 - 10 x 1.5 - 2 µ. Pycnidiospores were one-celled, ovoidal, ellipsoidal or pyriform, broadly rounded apically, 7 - 10 x 4 - 5.5 µ surrounded by thick slime layer, containing greenish granules with apical appendage (Chowdhury, 1982)[6]. *D. frgrans* was reported to be attacked by *P. maculicola*, small brown leaf-spots with yellow margin was observed. Conidia measured 5 - 8.5 x 1.7 - 3.3µ (c.f Sohi, 1990) [26]

On *Dracaena terniflora*, *Phyllosticta hesperidearum* produced spots that were light to dark -yellow surrounded by dark-reddish yellow boundaries. Black, punctiform and scattered pycnidia were present. Hyphae were closely septate, poorly branched, colorless to light-brown, 2.4 - 4.6µ wide. Pycnidia were spherical, purple brown to dark, 33.6 x 201.6 µ in diameter (av. 178.6 µ). Conidiophores were simple, hyaline, erect, 1.2 - 3.8µ long. Conidia were hyaline, single celled, oval to elliptical with rounded ends, 3.8 - 6.6 x 2.4 - 3.8µ (av. 4.8 x 2.9µ). It was reported from Jodhpur (Shreemali, 1974) [25]

2.6 *Sphaerulina* leaf spot

Greyish necrotic lesions appeared at the leaf tips and grew further with a wavy margin. Pseudothecia of *Sphaerulina taxi* were epiphyllous, scattered, immersed, ostiolate thick-walled, dark. Asci were clavate, 8-spored, bitunicate, 75 - 95µ x 9-10.5µ. Ascospores were hyaline, elliptical, biseriate, septate (up to 7 septa present) and 28 - 35µ x 5.5 - 7µ. Disease specimens were collected from Bangalore (c.f Sohi, 1990) [26].

2.7 Stem rot and wilt

Fusarium solani var. *coeruleum* is reported on *Dracaena* by Cappelli *et al.* (1986) [4]. The disease was characterized by browning of the proximal part of basal leaves, cortical stem tissues might be affected. In case of severe symptoms complete wilt of plants was noticed

In July 2013, *Fusarium solani***,** causal pathogen of stem rot, was isolated from infected *D. sanderiana* cuttings in greenhouses in Mahallat County, Markazi Province, Iran. The symptoms first appeared as severe wilting. Later, the leaves became brown and necrotic. Symptoms on the cuttings were observed as rotted areas on the middle of the stems. Cortical tissues of plant showed a distinct brown discoloration. Eventually, the infected plants died (Mostafa *et al*., 2016) [18].

The isolated fungus was morphologically identified as *F. solani* on carnation leaf agar (CLA) and PDA media (Nelson *et al*., 1983) [19]. Fungal colonies on PDA medium were cream or white and in rare cases, the lower surface was light violet. Ring shaped sporodochia, with a cream or sometimes blue color were observed. Macroconidia, and microconidia as micromorphological features of this fungus, were observed in CLA medium. The fungus produced two types of spores on CLA: microconidia which were thin-walled, hyaline, fusiform to ovoid, generally 1- or 2-celled (3.2 - 9.1 × 1.5 - 2.5 µ) and macroconidia which were slightly curved with blunt and rounded apical cell and rounded or foot-shaped basal cells, mostly 3- to 4-celled (14.2 - 34.2 × 2.3 - 3.5µ). Conidiogenous cells were observed as monophialides (quite long) (Mostafa *et al*., 2016) [18].

2.8 Other minor fungal diseases

Leaf spot, almost similar to those of *Gloeosporium polymorphum, was* caused by *Curvularia lunata*. Leaf-spots caused by other fungi like *Coniothyrium concentricum, Ascochyta graminicola* Vasant Rao, *Diplodia dracaena*, *Phomopsis dracaenae* Sahni, *Haplosporella Speg., Corynespora cassiicola* were also reported. All these fungi either alone or in combination caused stray infection (c.f Sohi, 1990) [26].

Stem rot caused by *A. niger and C. dracaenophilum* was reported previously from *D. sanderiana* in Iran and Bulgaria, respectively (Abbasi and Aliabadi, 2008; Bobev *et al*., 2008) [1, 3]. The *Dracaena* genus had several species, such as *D. marginata*, *D. braunii* and *D. americana. Thielaviopsis paradoxa* causing stem rot of *D. marginata* had been reported from Brazil (Santos *et al.*, 2012) [23].

3. Bacterial leaf spot

Miller and Wehlburg (1969) [17] first reported this disease. It was first seen as circular to irregular water-soaked spots which might form anywhere on the leaf blade. A thin, reddish-brown margin occasionally formed around the water-soaked centers. Diffuse chlorotic patterns developed around the lesions. The spots continued to enlarge and the affected area turned papery and dry. Severely infected leaves became brown and necrotic. Infection did not seem to progress into the canes.

The bacterium was a short rod, motile by one polar flagellum. On lima bean agar the colonies were dirty white and turned light brown with age. It did not produce acid from lactose and was not fluorescent on King's B Medium. Gelatin was not liquefied and milk turns slightly alkaline in 4 days. It was considered to belong to the genus *Pseudomonas*, but its physiological characteristics do not conform to those of any described species.

Young potted plants of *Dracaena sanderiana* were used as host plants in the experiments. Inoculum was prepared by suspending the bacteria from 2 to 4 day old slant cultures on potato dextrose agar or lima bean agar in sterilized tap water. Two methods of inoculation were employed - one consisted of placing drops of the bacterial suspension on the leaves and puncturing through the drops with a ring of fine dissect needles in order to provide wounds for entrance into the leaves and other method involved spraying the bacterial suspension onto the leaves of plants without wounding. Following either method of inoculation, the plants were covered immediately with polyethylene bags and placed in a mist chamber to maintain high humidity. The bags were removed after 48 - 72 hours. The effectiveness of two bactericides, AgriStrep (100 ppm streptomycin sulfate) and copper-maneb (3 lb tribasic copper sulfate + Wz lb Dithane M-45 in 100 gal water), was tested for disease control. Two treatments were used in the test. In one treatment, plants were inoculated by both methods described above, followed by

spraying with the chemicals one day later. In the second treatment, the plants were sprayed with the chemicals first, allowed to dry, and then were inoculated via the two methods. Checks were inoculated by both methods, but received no chemical sprays. Final disease evaluations were made 26 - 27 days after inoculation.

Following either method of inoculation, lesions usually developed in 3 - 4 days. In the control experiment, the check plants developed water-soaked spots which continued to spread rapidly. Many of the non-injured inoculated leaves became necrotic. Lesions on plants sprayed with either chemical developed more slowly and usually did not become as severe as in the checks. In treatments where plants were inoculated first and chemically treated one day later, disease was more severe than in plants which were sprayed first and then inoculated. Agri-Strep appeared to give better control than copper-maneb. The disease possibly originated on plants imported from Puerto Rico. Thus, rogueing out the infected tips before planting should help control this disease. Chemical treatment was not wholly successful in providing adequate control in the experiment. Although disease incidence was reduced and development of the lesions was retarded, no effective chemical control was recorded.

4. Viral diseases

4.1 Ring spot virus

Prominent virus-like symptoms were observed on leaves of *D. surculosa* in Croatia. Filamentous virus particles and pin-wheel-like inclusions were detected in leaf squash preparations. dsRNA were isolated from symptomatic plants after reinoculation. It was suggested that the virus belonged to the potyviruses (Krajacic and Plese, 1993) [13].

4.2 Dracaena mottle virus

The genome of Dracaena mottle virus (DrMV) was cloned from infected *Dracaena sanderiana* plants and its complete nucleotide sequence was determined and analyzed. The circular DNA genome consisted of 7531 base pairs (bp) and possessed seven putative open reading frames (ORFs) on the plus-strand that potentially encoded proteins of 17.6, 14.9, 215.0, 11.9, 11.3, 16.1, and 11.0 kDa, respectively. ORF 3, the largest ORF, encoded a putative polyprotein that contained sequences for viral aspartyl proteinase, reverse transcriptase (RT) and ribonuclease H (RNase H), characteristic of pararetroviruses. Phylogenetic analysis based on the amino acid sequence of ORF 3 showed that DrMV was related to other badnaviruses. However, the nucleotide sequence coding for the RT and RNase H domain of DrMV shared less than 68% homology with that of any known badnaviruses. The seventh ORF of DrMV was not found in other badnaviruses described before. Our results strongly supported that DrMV was a distinct species of the genus Badnavirus, family Caulimoviridae. Evidence that the DrMV sequence was integrated in the *D. sanderiana* genome was presented and discussed (Su *et al*., 2007) [27]

5. Nematode disease

Meloidogyne spp., *Radopholus citrophilus, Pratylenchus brachyurus* and *P. zeae* were known to occur on *Dracaena* (Gonzaga and Santos, 2009) [11].

6. Conclusion

The occurrence, symptomatology and distribution of various biotic stresses occurring on the Cornstalk plant are collected, compiled and presented in the present work.

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