

Pokkah Boeng

A serious problem in sugarcane during monsoon season

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Introduction

Sugarcane (*Saccharum officinarum*) is a perennial tall belongs to the family Poaceae. It is grown in tropical and sub-tropical regions in UP, India and World. The *officinarum* spp. of sugarcane is the richest source of sucrose. Sugarcane has thick, jointed and fibrous stalks of 2 to 6 meters tall, sucrose accumulated in the stalk internodes in sugarcane. Sugar is produced mainly from sugarcane and sugar beet and more than 75% per cent of the world sugar comes from sugarcane throughout ages, sugarcane remained an important commercial crop of agriculture and trade in India contributing substantial revenue to the exchequer by way of tax and duties. Sugarcane specially that is used for sugar production, the species *officinarum* that are rich in sucrose, which accumulates in the stalk internodes. Sugarcane is the main cash crop of our country which is used for sugar, jaggery and

About background Pokkah Boeing

Many biotic and abiotic stresses affected the sugarcane production which leads to severe losses. Pokkah boeing disease on sugarcane has been recorded in almost all countries where sugarcane is grown commercially, PBD are dependent upon the environmental conditions, one of the current major diseases affecting sugarcane. Pokkah boeing is now playing a very important role due to its economic threats. Pokkah boeing disease (PBD) is an air borne destructive fungal disease in sugarcane growing regions. PBD due to cause by *Fusarium* spp. complex and is responsible for severe yield losses in susceptible varieties of sugarcane worldwide.

khandsari. Sugarcane belongs to the genus *Saccharum* the word saccharum owes its origin to the Sanskrit word “ Sarkara” or “ Sakkara” meaning Sugar; this become “sukkar” in Arabic and “ Sakkaron” in Greek. In 1753, Linnaeus established the genus *Saccharum* along with the other crop in his master-piece “Species Plantarum”. It grows well in deep, well-drained soil of medium fertility of sandy loam soil textures with a pH range from 6.0 to 7.7 It plays a major role in the economy of sugarcanes. Sugarcane is established agriculture field crop with a long history of safe use, which is grown widely in tropical as well in sub-tropical region in world in India. Many part of the sugarcane commonly used as animal feeds where the plants are cultivated .The leaves make a good forage for ruminants.

Fusarium sacchari is associated with both PBD and sugarcane wilting (Viswanathan *et al.*, 2017). The growth of Pokkah boeing fungus *Fusarium* is found better on 28°C temperature and 80 % Relative humidity. *F. moniliforme* is an anamorph imperfect stage of pokkah boeing disease, the pathogen was first described by Sheldon and the perfect Teleomorph stage *Gibberella fujikuroi* of pokkah boeing disease was first described by (Sawada). *Fusarium* species causing leaf and shoot distortion and attack the top part of a plant and young leaves start to become chlorosis. In Malaysia the causal organism of pokkah boeing was known as *F.*

moniliforme var. *subglutinans*, it also could combine with *Colletotrichum falcatum* and cause red rot symptoms on sugarcane, the other species that was reported pokkah boeing belong to *F. sacchari* found on sugarcane in Asia. In South Africa, *F. sacchari*, *F. proliferatum*, and *F. andiyazi* were identified as causal agents as a

History of Pokkah Boeing Disease

Pokkah boeing disease of sugarcane was observed for the first time at Java (now Indonesia) by Walker and Went in 1896. Sugarcane pokkah boeing is an economically important fungal disease worldwide (Siddique, 2007), which was first described in Java by Walker and Went in 1896, and the name was a Javanese term denoting a malformed or distorted top. Since then, pokkah boeing has been recorded in almost all cane growing countries, but it only causes severe damage in areas where susceptible varieties are widely planted during a hot and dry season followed by a wet season (Blackburn 1984). Three to seven month old sugarcane is more susceptible to infection than the plants in later stages of growth (Siddique, 2007). The pathogen can survive for 12 months in the plant debris under natural conditions and it can remain viable for more than 10 months under laboratory conditions. It is also reported that survival of pathogen can be observed for 12 months, although incidence is noticed low after nine months. A survey of different sugarcane areas in India found that the incidence of Pokkah Boeing increased from 2007 to 2013 and affected almost all of the sugarcane cultivars, which was recommended for general cultivation for different agricultural climatic regions. Increasing trend of disease incidence was observed and it was ranged between 1 to 90 per cent in S. 224/20 and 5 to 30 per cent was noticed in CoSe 01434 (Vishwakarma *et al.*, 2013). It was also found major constraints in sugarcane production and was becoming predominant disease in China during the recent year (Wang *et al.*, 2016). Three to seven month-old sugarcane is more susceptible to infection than plants in later stages of growth (Siddique, 2007). After infection, the leaves become crumpled, twisted, and shortened.

result of inoculation experiments in potted plant. *F. sacchari* (*Cephalosporium sacchari*) was also reported to be the causal organism of wilt in sugarcane and *F. moniliforme* was also reported to be the causal organism of pokkah boeing in sugarcane in India.

Irregular reddish stripes and specks then develop within the chlorotic tissue and form lens or rhomboid-shaped holes. Leaf sheaths may also become chlorotic and develop irregular necrotic areas of reddish color (Siddique, 2007). The most serious injury is infection of the growing tip of the plant, which results in the loss of the entire top of plant and is referred to as top rot (Siddique, 2007, Martin *et al.* 1961). Thus, sugarcane Pokkah Boeing has become a serious threat to sugarcane production in China. The disease is common during rainy months in the field. Although under normal situations it may not cause significant yield loss it has the potential to arrest the crop growth temporarily. Pokkah Boeing disease reported from all sugarcane-growing regions, was considered a minor disease. The disease occurs throughout the world and severe forms of the disease are recorded in high humidity areas. The most common symptom is a malformed or twisted top, which gives this disease its name “*pokkah boeing*” from the Javanese language. Symptoms develop during rainy periods which coincide with growth period. Initially, young leaves are chlorotic at their base and patchy elsewhere on the blade. Chlorosis is most obvious on the lower surface of the leaf or in twisted laminar regions, where white mycelium may be seen. Affected leaves tend to be narrow at the base. Development of further symptoms is dependent on the susceptibility of the variety and on environmental conditions conducive to the pathogen. Young leaves may become infected in the spindle, resulting in pronounced wrinkling, twisting and shortening of the leaves. Sometimes the leaves are shortened to few inches without lamina having malformed midrib or growth of the leaves ceased to few inches without malformation

giving a de-topped spindle. As the leaves mature, irregular reddish stripes and specks develop within the chlorotic areas. Infection in the spindle may reach the growing point and continue into the stalk (Viswanathan, 2012). Sometimes the growing point is killed leading to development of top rot. Due to death of spindle, sprouting of the lateral buds occurs. Most of the Pokkah Boeing infected canes generally recover from the symptoms but in top rot recovery is not there. Upon recovery we notice the normal whorl with remnants of twisted leaf portions of affected

Symptom of PBD

Initially, symptoms of PBD with foliage discolouration were noticed during monsoon / post monsoon months in the farmer's field in different places. The early stages of infection were typified by chlorosis which appears on the basal areas of young leaves as they emerge from the spindle. The infected leaves become crumpled and the twisted leaves unfold normally and the leaves shortened. Leaf sheaths may also become chlorotic and develop irregular necrotic areas of reddish color. The symptom of different stages of Pokkah boeing disease were categorized in three categories namely Chlorotic stage, Top rot (Acute) and Knife cut stage (Patil *et al.*, 1995). All the symptoms were observed during field visit. It is highly influenced by the favourable climatic conditions, viz. high humidity and temperature. Although the disease was considered a minor disease, in the recent

General symptoms of Pokkah Boeing mainly there are three types

1. Chlorotic phase
2. Top rot / Acute phase
3. Knife cut phase

1. Chlorotic Phase: In the Chlorotic stage, typical twisted top with varying levels of leaf deformities was found (Fig. 1). Recovery of the disease was observed in the newly emerging spindle leaves in many of the canes (Fig. 2). The malformed leaves showed extensive lesions on leaf base causing white patches, blackening of affected laminar region and extensive black venial necrosis. These phenotypic symptoms remained static in tolerant varieties but in susceptible varieties severely necrotized leave

leaves still twisting around the spindle. This disease is favoured by warm, moist growing conditions. Symptom development begins early in the rainy season which normally coincides with rapid and vigorous growth of the canes. The three to seven months-old are most susceptible to the disease. Conidia are air borne and are deposited on plants, then washed by rain into infection sites. Pokkah Boeing appeared in severe form in different states causing serious damage to cane cultivation (Viswanathan 2012, 2013).

years the disease occurs in severe form throughout the country (Viswanathan 2012a). The disease has the potential to arrest the crop growth temporarily and if the disease results in top rot phase, crop growth would cease leading to loss of millable canes. Furthermore, it is suspected that severe PB could result in wilting of canes and in such a situation complete loss to the crop occurs. Hence, severity of disease incidence varies depending on the phase or symptom expression of the crop.

The characteristics symptoms of Pokkah boeing disease are the appearance of chlorotic patches towards the base of the young leaves, in acute cases disease shows distortion of stalk with external and internal cut like lesions and rotting of apical part of stalk. Chlorotic stage and top rot (Acute) of the disease were recorded in the affected clones from 5 to 6 months after planting.

Fig 1. Wrinkling and twisting leaf symptom of Pokkah boeing disease in sugarcane.



Fig 1. Wrinkling and twisting leaf symptom of Pokkah boeing disease in sugarcane.



Fig 2. Chlorotic slight etiolation symptom at the base of young leaves, slight shrinkage some irregular reddish stripes.

2. Acute Phase or Top-Rot Phase

The most advanced and serious stage of pokkah boeing is a top-rot phase. The young spindles are killed and the entire top dies. Leaf infection sometime continued to downward and penetrates in the stalk by way of growing points. In advanced stage of infection, the entire base of the spindle and even growing points showed a malformation of leaves, pronounced wrinkling, twisting and rotting of spindle leaves. Red specks and stripes also developed, and the whole base of the spindle gets rotten and dries up very fast and finally, it formed a Top-Rot of the tender tissues of the apical part of the cane. Sprouting of the buds are also observed in a severe infection. In such cases, the apical part of the stalk is seriously damaged.

The most serious injury is when the fungus penetrated the growing points that caused the entire top of the plant dies and this is referred to as top rot. Top rot (Acute) stages as inter nodal

elongation was drastically reduced in the affected stalk region and, up to five or six internodes showed shortened internodes (Fig. 3). Axillary buds of variety Co 0238 also was found sprouted due to rotting of top in acute phase infection (Fig 4). Top rot stage of PBD was also observed on variety Co 0238 in various location of sugar mill as well as research farm. The acute phase of the disease resulted in top rot phase, which was characterized by rotting of growing point / spindle leaves. Occasionally, PBD infected canes generally recovered from the symptoms, but top rot phase never recovered from the damage. Many of the top rot affected clones showed death of emerging leaves inside the crown and formed a whip-like dried spindle (Fig. 4). Sometimes partial blight symptoms similar were conspicuous due to stunted growth, paleness and withering/ drying of the canes in a background of healthy canes / resistant varieties.



Fig 3. The entire top (growing point) of the plant dies, in the stem, the fungus causes a dark-brown discoloration of the infected tissues.



Fig 4. Whip-like dried spindle and axillary buds sprouted in pokkah boeing affected plant.

3. Knife cut

Patil *et al.* (2007) additionally described a third phase of the disease termed 'knife cut phase' based on the disease occurrence. Knife cut phase occurs just below to the affected apical stalk and shortening of internodes also appears (Martin *et al.*, 1961). Knife cut symptom was observed on variety Co 0238 in every sugar mill area (Fig 5), shortening of internodes was also found on Co 0238 (Fig 6). The symptoms include one to two or even more transverse angular cuts on the top portion of stalks as though the tissues are removed with a sharp knife. Knife cut symptom

with partial damage of the growing meristem was observed on Co 0238 and other varieties in various sugar mill areas. Patil *et al.* (2007) opined aggressive strains of the pathogen would cause knife-cut infection while the non-aggressive strains cause chlorotic phase infection. Overall, exhibition of various stages of the disease depends on the strains of the pathogen, cane variety and prevailing weather conditions. Severe knife-cut phase of the disease was reported from Java, Florida and Brazil (Whittle and Eravan 2000).



Fig 5. Knife cut stage of Pokkah boeing disease in sugarcane, shortening of internode and knife cut symptom with partial damage on stalk.

Management

- Do not sow disease susceptible varieties and infected seeds of sugarcane.
- Co 0238 variety susceptible to pokkah boeing disease, hence, do not sow the latest released varieties in the same field with Co 0238. Because by doing this other varieties can also be affected by this disease is one or two years.
- To prevent the disease, recommended fungicides should be sprayed on the leaves before the onset of monsoon, which reduces the possibility of spreading of the disease.
- In the early days of monsoon in second week of June, when sporadic disease symptoms start appearing of the leaves of the plants, then 0.2% solution of copper oxychloride 50% WP or 0.1% solution of Carbendazim 50% WP should be sprayed on the leaves.