OCCURRENCE AND DISTRIBUTION OF COCOA (Theobroma cacao L.) DISEASES IN INDIA

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ABSTRACT

A random survey of cocoa gardens in 4 southern cocoa growing states of India revealed that Phytophthora diseases such as black pod, stem canker and seedling blight are the major problems leading to heavy economic loss to the growers. Stem canker caused by Phytophthora palmivora and zinc deficiency were observed as major problems in Andhra Pradesh compared to other states. Colletotrichum disease, stem canker and zinc deficiency were observed in all the cocoa gardens surveyed in Andhra Pradesh. Though Colletotrichum pod rot was reported long back from India, it has recently emerged as a serious problem in several gardens in India. Vascular streak dieback was noticed only in Kerala state. Therefore, it is important to follow strict quarantine measures to prevent the entry of this disease to other cocoa growing states. Other major diseases like swollen shoot (virus diseases) witches broom and monilia pod rot are not observed in India. All agencies importing planting materials from other countries should take special care in not introducing these diseases to India.

Cocoa (Theobroma cacao L.) is extensively cultivated in the four southern states of India, viz., Kerala, Karnataka, Tamil Nadu and Andhra Pradesh, getting both South – West (heavy rainfall) and North – East monsoonal rainfall. Coconut (Cocos nucifera L.) and arecanut (Areca catechu L.) are the principal plantation crops in the southern states of India. Cocoa being a shade loving crop has been found to be a suitable and highly profitable mixed crop in existing coconut and arecanut gardens. Commercial cocoa cultivation was started during 1970s in India. At present, cocoa occupies an area of 31,885 ha with an annual production of 10,560 metric tonnes. Andhra Pradesh and Tamil Nadu which are new entrants in commercial cocoa cultivation have an area of 12734 ha and 1421 ha respectively under cocoa cultivation in 2007-2008. During 2001-02 Kerala state had the largest area of 8949 ha whereas at the same time the area under cultivation of cocoa in Andhra Pradesh and Tamil Nadu was only 2744 ha and 92 ha respectively. Now the largest area under cocoa cultivation is in Andhra Pradesh. The area expansion of cocoa cultivation is progressing fast. Though several major diseases of cocoa were recorded from other cocoa growing countries (Thorold, 1975), only a few have been noticed so far in India. Among the Phytophthora diseases, black pod (Ramakrishnan and Thankappan, 1965), stem canker (ChandraMohanan, 1978), Chupon blight and twig dieback (ChandraMohanan et al., 1979) and seedling dieback (ChandraMohanan, 1979) have been recorded in India. Of these, black pod disease has been found to be of greater economic importance owing to the heavy loss it causes year after year during the raining season. With the recent expansion in cocoa cultivation and with increasing age of the existing plantations the incidences of diseases are also on the increase. Hence, the present studies were undertaken to find out the incidence and overall distribution of the diseases in the cocoa growing states of India.

MATERIAL AND METHODS

A random survey was undertaken from July to November in 2009 and 2010 in the cocoa growing areas in Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. A total of 490 gardens were covered in the present study. In Kerala all districts viz., Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Kottayam, Idukki, Ernakulam, Thrissur, Palakkad, Malappuram, Wayanad, Kozhikode, Kannur and Kasaragod were included in the random survey. Here, a total of 292 gardens were surveyed. Occurrence and intensity of diseases (Percentage of the gardens with disease incidence) were recorded from 5-49 gardens per district depending on the area under cultivation and intensity of diseases. In Karnataka it is mainly grown in Dakshina Kannada, Coorg, Uduppi, Uttara Kannada, Chikmagalur, Shimoga and Mysore districts. Of the 105 gardens

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surveyed in this state, thirty were from Dakshina
Kannada, the major cocoa growing district in
Karnataka. In Tamil Nadu, cocoa cultivation with
yielding plants is mainly found in Coimbatore district,
and 23 gardens were covered in this district.
Observations were recorded from 8 gardens in
Kanyakumari district. Since majority of cocoa
plantings in Andhra Pradesh are restricted to West
Godavari and East Godavari districts, the present
study was concentrated in thes:- two districts, where
a total of 62 gardens were covered.

RESULTS AND DISCUSSION

Observations on cocoa diseases occurring
in the southern states of India revealed the
occurrence of the following fungal diseases and zinc
deficiency in cocoa plantations and in nurseries.

I. Pod rot
   a. Black pod dissae (Phytophthora palmivora
      Bult.)
   b. Charcol Pod rot (Lasiodipoldia theobromae
      Pft.)
   c. Chrelle rot (Colletotrichum gloeosporioides
      Penz.)

II. Trunk and branch diseases
   a. Stem canker (P.palmivora)
   b. Vascular streak dieback (Oncobasidum
      theobromae Talbot & Keane)
   c. Chupon blight and twig dieback
      (P.palmivora)
   d. Foliar infection caused by
      C. gloeosporioides

III. Nursery diseases
   a. Seedling dieback (P.palmivora)
   b. Leaf blight and shot hole
      (C. gloeosporioides)
   c. Stem canker of grafted seedlings
      (P.palmivora)

IV. Nutritional disorder
   a. Zinc deficiency

Among the diseases occurring in India, Phytophthora
diseases were found to be very important owing to
the intensity and economic loss. Of these, black pod
disease caused by *P.palmivora* was found to be the
most important disease in all the four southern states
of India and found occurring in 84.3 % of the gardens
surveyed (Table 1). Among the gardens surveyed in
Kerala, black pod incidence was noticed in 90.75% of
the gardens. In India, black pod disease was
reported as early as in 1965 (Ramakrishnan and
Thankappan, 1965). A preliminary study conducted
in Dakhina Kannada District revealed the incidence
of black pod disease in 22.1 % of the total pods
observed in five gardens. (ChandraMohan, 1985).

Stem canker caused by *P.palmivora* infection
was found to be a serious problem in India especially
in the cocoa gardens in Andhra Pradesh .
Anthracnose or rotting of young pods referred as
chrelle rot caused by *C. gloeosporioides* during pre
and post monsoon season was also found to be a
major problem in some of the cocoa plantations in
the four states. The highest incidence of Stem canker
(100 %) based on the gardens surveyed was observed
in Andhra Pradesh followed by Tamil Nadu (82.1%).
It was observed in 57.8 % of the gardens in Kerala
(Table 1). Though chrelle rot causal by *C.
gloeosporioides* was observed in all the gardens
surveyed in Andhra Pradesh it was not a serious
problem in all the gardens. But colletotrichum pod
rot observed in all the four states indicated that this
disease has recently emerged as a serious problem
in many locations and warrants control measures in
gardens with high incidence, especially in Andhra
Pradesh and some parts of Kerala and Karnataka.

Vascular streak dieback was noticed mainly
in Kerala State. But it was not observed in the
gardens surveyed in the other three states. The
incidence of vascular streak dieback was high in
Kozhikode, Kottayam, Idukki and Pathanamthitta
districts (Table 2). It was observed in 17.8 % of the
gardens surveyed in Kerala. During 1981 vascular
streak dieback was found occurring only in Kottayam
and Thrissur districts of Kerala (ChandraMohan and
Kaveriappa, 1981). It is important to follow strict
quarantine measures to prevent the entry of this
disease to other cocoa growing areas in India.

Though foliar infection caused by *C. gloeosporioides*
and charcoal pod rot were observed in most of the gardens (Table 2), they were
not considered as serious problems as the intensities were very low. Other fungal diseases such as chupon blight and twig dieback, white thread blight, horse hair blight and pink disease were observed as minor problems. Cephaleuros leaf spot and knob gall were very rarely observed. But chupon blight and twig dieback/leaf infection caused by Phytophthora should not be neglected as they contribute to a great extent to the Phytophthora inoculum build up in the garden which may lead to higher incidence of black pod and canker diseases. Therefore, frequent removal of chupons, proper pruning of cocoa plants, removal and destruction of Phytophthora infected pods and proper spacing of cocoa plants are very important factors in the integrated management of black pod and canker diseases. Similarly, though foliar infection caused by C. gloeosporioides was observed in almost all gardens, it was not found directly causing much damage or loss in adult / yielding plants. But this phase of C. gloeosporioides infection will definitely contribute to the inoculum build up in the plantations which in turn may cause severe pod infection leading to direct loss in yield. The incidence of Colletotrichum foliar infection was reported throughout the year with peak intensity during September - November (Chandra Mohanan et al., 1989).

\textit{P. palmivora} infection of seedlings causing high mortality in the nurseries during rainy season was the major problem in all the nurseries especially in nurseries with very young seedlings. Seedling infection was observed initiating from tip of the seedling (dieback), leaf, cotyledonal region or collar region and ultimately leading to death of seedling (Thorold, 1975, Gregory, 1974). Phytophthora infection of cocoa seedlings was observed to be very high when seedlings were raised during rainy season without proper shade and hygienic conditions. \textit{P. palmivora} infection on the stem (canker) of grafted seedlings was also observed in the nurseries in Dakshina Kannada district. In such cases the infection was mostly initiated from the grafted region. Foliar infection of seedling caused by \textit{C. gloeosporioides} caused stunted growth with blighted or malformed leaves (with shot hole). Shot hole symptom caused by \textit{C. gloeosporioides} was mostly observed in seedlings kept under open conditions without proper shade and in the nurseries raised inside coconut gardens.

Zinc deficiency was observed as a major problem in the cocoa gardens of Andhra Pradesh and Tamil Nadu. It was observed in all the gardens surveyed in Andhra Pradesh in varying intensities. Chlorosis of leaves was the initial symptom of zinc deficiency in cocoa. As the symptoms progressed, green portion was found only along the sides of the veins giving a vein banding appearance to the leaves. Affected leaves also showed mottling and wrinkling with wavy margin and sickle shape. By observing the leaf symptom many cocoa growers suspected it as a virus disease. Twig symptoms included rosette, defoliation and dieback. Severe defoliation and dieback caused gradual death of young plants. Inadequate shade, high pH and poor aeration of the soil were attributed as some of the probable causes of zinc deficiency (Jurrinak and Thorne, 1955: Schroo, 1959).

The present study clearly indicated that Phytophthora diseases especially black pod and stem canker are the major problems causing economic loss to the cocoa gardens in South India. Vascular streak dieback was noticed only in Kerala state. Adequate care should be taken to prevent the entry of this disease into other cocoa growing states where area expansion of cocoa cultivation is fast increasing. Seedlings and cocoa grafts raised in Kerala state should not be transported to other cocoa growing states. Swollen shoot disease, one of the most economically important plant diseases in the world (Thresh, 1958) which is widespread in Ghana, Ivory Coast, Nigeria, Sri Lanka, Colombia, Trinidad, Venezuela, Indonesia, Sabah etc. has not been observed in the present study in any of the cocoa growing areas in India. Special care has to be taken to prevent the introduction of such major diseases to India.

\section*{REFERENCES}


Chandra Mohanan, R. 1985. Incidence of cocoa black pod disease in Dakshina Kannada District (Karnataka) - a major cocoa growing area in India. \textit{Indian Cocoa, Areca nut & Spices Journal} 8: 91-92.
Table 1. Percentage of gardens with incidence of cocoa diseases out of total garden surveyed in four southern states of India

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<th>Disease</th>
<th>Kerala</th>
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* Not observed


Table 2. District wise occurrence of cocoa diseases in south India

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<td>-</td>
<td><strong>9</strong></td>
<td><strong>0</strong></td>
<td><strong>62</strong></td>
</tr>
<tr>
<td><strong>Total gardens</strong></td>
<td><strong>490</strong></td>
<td><strong>413</strong></td>
<td><strong>374</strong></td>
<td><strong>288</strong></td>
<td><strong>275</strong></td>
<td><strong>467</strong></td>
<td><strong>52</strong></td>
<td><strong>216</strong></td>
<td><strong>67</strong></td>
<td><strong>152</strong></td>
</tr>
</tbody>
</table>

- Not observed
Black pod caused by *P. palmivora*

Charcoal pod rot caused by *Lasiodiplodia theobromae*

Chupon blight caused by *P. palmivora*

Cocoa garden with zinc deficiency

Symptoms of zinc deficiency

Knob gall

Rotting of cherelles and young pods caused by *Colletotrichum gloeosporioides*

Seedling blight caused by *P. palmivora*

Stem canker caused by *P. palmivora* (External lesion)

Stem canker caused by *P. palmivora* (Internal lesion)