

Review Article

A review on Mango gummosis incited by *Lasiodiplodia theobromae*

Abstract:

Mango gummosis caused by *Lasiodiplodia theobromae* (Pat.) Griffon & Moube [synonym: *Botryodiplodia theobromae*] is becoming a serious problem in India on many popular varieties of mango particularly during monsoon and post-monsoon periods. Severe infection with pathogen causes up to 30- 100 % yield losses in mango. Gummosis infected orchards shows abundant gum secretion from branches, stem and main trunk and also Vascular discoloration. In severe cases infected mango trees may die. The pathogen produces grey-brown to black colonies with dense aerial mycelia on the PDA medium. Pycnidia were separate or aggregated, dark brown, thick or thin-walled. Conidiophores were hyaline, cylindrical to sub-obpyriform, with oblong, straight and hyaline single celled conidia and initially. Gradually the conidia became dark brown and produced one septum with longitudinal striations; This review attempts to summarize the Knowledge on mango gummosis, symptomatology, pathogen host range, morphological and cultural characters of *Lasiodiplodia* and management of the disease.

Key words: Gummosis, *Lasiodiplodia theobromae*, Conidia, Pycnidia, *Trichoderma* etc.

1. Introduction

Mango (*Mangifera indica* L.) is one of the world's most important and esteemed fruit of the tropical and subtropical world and is cultivated extensively as a commercial fruit crop in India. It probably originated in Indo-Burma region and has been cultivated for the last 4000 years with the existence of more than 1000 varieties in Indian subcontinent. By virtue of wide range delicious taste superb flavor, very high nutritive and medicinal value as well as great religio-historical significance, it is being called the "King of fruits"(1).

The mango crop is susceptible to various diseases like powdery mildew, anthracnose, die back, blight, red rust, gummosis and sooty mould etc. Gummosis incited by *Lasiodiplodia theobromae* (Pat.) Griffon & Moube [synonym: *Botryodiplodia theobromae*] is becoming a serious problem in India on many popular varieties of mango particularly during monsoon and post-monsoon periods(2). Severe mango gummosis 20-83.3 per cent mango gummosis incidence with a severity of 62.5-85 per cent recorded in Major mango growing areas. The incidence of gummosis was reported to be 20 and 60 per cent in Punjab and Sindh Provinces of Pakistan, respectively and 60 percent in Al Batinah region of Oman(3,4)

In India, Mango dieback disease was first reported by Das-Gupta and Zachariah in 1945 (5) from Uttar Pradesh and also they were the first to emphasize the importance of die back of mango caused by *B.theobromae*. In Allahabad Isolated *B. theobromae* from dead roots of mango seedlings(6). mango gummosis as a serious disease in Jaipur district (7), which was affected with 30-40 per cent of the plantations in the Mora bad region of Uttar Pradesh(8). mango dieback Incidence 0 to 40 per cent (9) and 2-13.33% (10) mango gummosis incidence recorded in major mango growing areas of Andhra Pradesh.

2.Symptomatology

The symptoms of gummosis are dieback, twig-blight, bark splitting or cracks on bark and exudation of gum was severe in advanced conditions (10). Infected plant secretes gum and longitudinal crack of infected stem. In severe cases, the mango trees die due to cracking, rotting and girdling (11). Drying of tip, discoloration and darkening of bark some distance from the tip are common symptoms(12). Later, it moves downward involving bigger branches as well. As a result, the leaves are shed followed by exudation of gum from the diseased portions. In severe cases, bark splitting or cracking has also been noticed. (13) infected twigs die from the tips to back into old wood, which gives a scorched appearance to limb (14). The affected leaves turn brown and rolls upward. In severe cases, the entire plants killed. Gummosis: the infected plants show abundant gum secretion from branches, stem and main trunk. Vascular discoloration: Infected twigs, plants and branches shows internal discolouration. Brown streaks visible in vascular region and these are severe in water stress conditions.(15,16, 17, 18)

Mango gummosis symptoms:



A) Die back



B) Gummosis



C) Bark Splitting



D) Vascular Discolouration

Fig 1 : A) Die back B) Gummosis C) Bark Splitting D) Vascular Discolouration

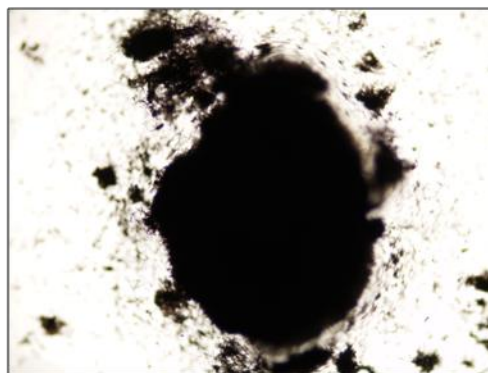
3.Morphological and cultural characteristics of the test pathogen:

Lasiodiplodia theobromae belongs to Ascomycota in the order Botryosphaeriales and the family Botryosphaeriaceae (19, 20). The sexual stage (teleomorph) *Botryosphaeria rhodina*; Morphological variation among *B. theobromae* (*L.theobromae*) isolates causing mango twig-blight/die-back. The size of the immature and mature pycnidia varied greatly with the substrate. The pycnidia were smallest in naturally infected twigs and biggest in nutritionally rich medium such as oatmeal agar. No such distinct variation was observed in the size of immature and mature conidia. The measurement range of mature pycnidia (189-886 x 154-704 4m) should be taken into account for identification of a species(21). The pycnidia are mostly aggregated, spherical and dark brown in colour with thick walls; the conidia are two celled, oval and dark

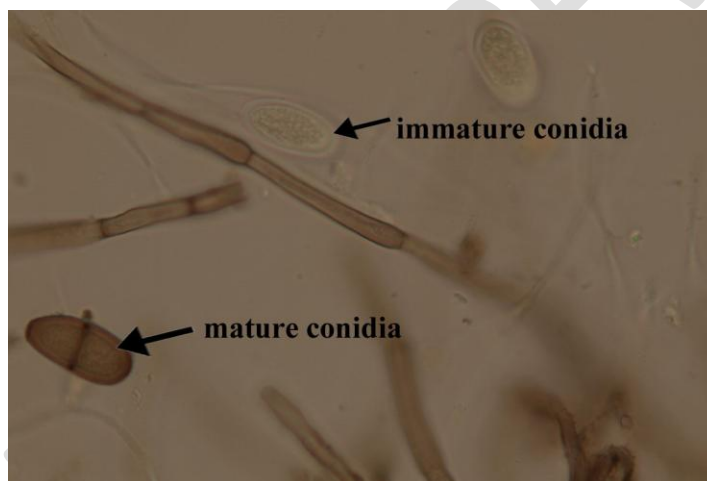
brown in colour produced on Potato Dextrose Agar (PDA). (22). Pycnidia are uniloculate, dark brown to black, immersed in the host becoming erumpent when mature. (23, 24).



(a) Pure Culture of *Lasiodiplodia theobromae*



(b) Pycnidia of *Lasiodiplodia*



(c) Mature and Immature Conidia

Fig 2 : (a) Pure Culture of *Lasiodiplodia theobromae* (b) Pycnidia of *Lasiodiplodia*
(c) Mature and Immature Conidia

4. Physiology

B.theobromae found that 25-30°C temperature optimum (25) for the pathogen. And also reported highest sporulation occurred at 30°C. Mycelium growth was higher in glucose and Sucrose contain(26) media because of contain more presence of 'Carbon' sources (27) reported that lactose and glucose had similar effect on growth of *B. theobromae*. Optimum temperature of *L. theobromae* was 28°C (29) and also reported PDA and PSA were most suitable for vegetative growth. Potato sucrose agar (PSA), Corn meal agar (CMDA) and Yeast extract

manitol agar (YEMA) were most suitable for mycelial growth but Potato carrot agar (PCA) was not suitable for either mycelial growth or pycnidia production. The YEMA found best medium for pycnidial formation as well as maximum numbers of pycnidia were produced at 35-40°C. Glucose and sucrose were found superior for growth. Potassium nitrate supplemented media showed maximum growth amongst the tested inorganic nitrogen sources while peptone produced maximum growth among the tested organic nitrogen sources(30). *L. theobromae* grows at pH 5.0-9.0 and optimum growth was observed at pH 7.0(31)

5.Host range of the pathogen: *L. theobromae* causes different diseases viz., Gummosis, rots, dieback, blights canker and root rot in a variety of different hosts in tropical and subtropical regions.

Table 1 : Hosts and their disease with scientific name.

S.No.	Host	Disease	Scientific name	Reference
1	Papaya	Fruit rot	<i>Carica papaya</i>	32
2	Horsegram	Seed rot	<i>Dolichus biflorus</i>	33
3	Pyrussps.	Seed rot and seedling rot	<i>Pyrus calleryana</i>	33
4	Dates	Decaying disease	<i>Delonix regia</i>	34
5	Pigeon pea	Seed rot	<i>Cajanus cajan</i>	35
6	Mango	Dieback	<i>Mangifera indica</i>	36
7	Dogwoods	Canker	<i>Cornus florida</i>	37
8	Lemon	Fruit rot	<i>Citrus aurantifolia</i>	38
9	Guava	Fruit rot	<i>Psidium guava</i>	39
10	Coconut	Fruit rot	<i>Cocus nusifera</i>	40
11	Yellow passion fruits	Black rot	<i>Passiflora edulies</i> <i>f.sp. flavicarpa</i>	41

12	Sweet potato	Java black rot	<i>Ipomoea batatas</i>	42
13	Shisham	Decline	<i>Dalbergia sissoo</i>	43
14	Kumquat	Decline	<i>Fortunella margarita</i>	44
15	Cashew	Gummosis	<i>Anacardium occidentale</i>	45
16	Jackfruit	Leaf blight	<i>Artocarpus heterophyllus</i>	46
17	Guava	Wilt	<i>Psidium guava</i>	47
18	Aubergine	Fruit rot	<i>Solanum melongena</i>	48
19	Banana	Crown rot	<i>Musa paradisiaca</i>	49
20	Jatropha	Gummosis	<i>Jatropha podagrica</i>	50
21	Pawpaw	Stem-end rot	<i>Asimnatribola</i>	51
22	Grapevine	Dieback	<i>Vitis vinifera</i>	52
23	Cattleya	Necrotic spots on stem	<i>Cattleya labiata</i>	53
24	Ballon plants	Dark necrosis	<i>Asclepias physocarpa</i>	54
25	Pummelo	Fruit rot	<i>Citrus maxima</i>	55
26	Jute	Stem end rot	<i>Corchorus olitorus</i>	56
27	Cocoa	Dieback	<i>Theobromae cocoa</i>	57
28	Mamey trees	Dieback	<i>Pouteria sapota</i>	58
29	Nutmeg	Fruit rot	<i>Myristica fragrans</i>	59
30	Eucalyptus	Gummosis	<i>Eucalyptus citriodora</i>	60

31	Peach	Gummosis	<i>Prunus percisa</i>	61
32	Bottle guard	Seed rot	<i>Lagenaria siceraria</i>	62
33	Cycas	Dieback	<i>Cycas circinalis</i>	63
34	Cassava	Rot	<i>Manihot esculenta</i>	64
35	Mulberry	stemcanker	<i>Morus alba</i>	65
36	Euphorbia	Decline	<i>Euphorbia ingens</i>	66
37	Kinnow fruits	Stem end rot	<i>Citrus reticulata</i>	67
38	Avacado	Fruit rot	<i>Persea americana</i>	68
39	Mangosteen	Decline	<i>Garcinia mangostana</i>	69
40	Parthenium	Foliar pathogen	<i>Parthenium hysterophorus</i>	70
41	Tuberose	Peduncle blight	<i>Polianthes tuberosa</i>	71
42	Sapota	Dieback	<i>Achras sapota</i>	72
43	Ficus	Dieback	<i>Ficus carica</i>	73
44	Elephant tree	Canker	<i>Boswellia papyrifera</i>	74
45	Mara Manjal	Leaf spot	<i>Coscinium fenestratum</i>	75

6. Management studies on *L. theobromae*: This Pathogen is one of the significant constraints in mango cultivation, the management of the disease is very essential.

6.1 Effect of fungicides on *L. theobromae*: Many workers have used different chemicals to control *Lasiodiplodia sp.*

Table 2 : Different chemicals to control *Lasiodiplodia sp.*

S.No.	Chemical management of <i>L. theobromae</i>	References
1	Mixture of oil and 5 per cent phenol	76
2	Copper oxychloride sulphate	77
3	Carbendazim and Bordeaux mixture	78

4	Carbendazim (0.1%) or Topsin M (0.1%) or Chlorothalonil (0.2%).	79
5	Topsin-M (20 ppm) and Benlate (100 ppm)	80
6	Topsin M and Score (100 ppm)	81
7	Mancozeb (3g a.i./l) and Iprodione (0.5 - 0.75g (a.i./l))	82
8	Carbendazim @ 1 ppm, Thiophanate-methyl@1 ppm, Allite@ 1000 ppm	83
9	Acrobat MZ, Dithane M-45, Mancozeb, Metalaxyl+Mancozeb@ 0.1%, 0.75% and 0.50%	84
10	Carbendazim (0.1%) and Thiabendazole (0.2 %)	85
11	Difenoconazole(75; 100; 125 L.ha-1)	86
12	Spergon, Propiconazole, Flusilazole, Prochloraz, Iprodione, Difenoconazole, Tebuconazole, Myclobutanil, Pyraclostrobin, Validamycin, Carbendazim, Chlorothalonil and Mancozeb	87
13	Thiophanate-methyl, Carbendazim and Precure @ 50 ppm and 100 ppm	88
14	Topsin-M (Thiophanate-Methyl) and Carbendazim (25-200 ppm)	89
15	<u>Carbendazim@0.1 %</u>	90
16	Carbendazim and Topsin-M	91
17	Topsin M and Daconil	92
18	Difenaconazole	86
19	Carbendazim, Carbendazim + Mancozeb and Propiconazole @ 250 & 500 PPM	93

20	Carbendazim@0.5%	94
21	Flutriafol@0.75%	95

6.2 Effect of botanicals on *L. theobromae*

Table 3: Effect of botanicals on *L. theobromae*

S.No.	Botanicals	References
1	<i>Acorus calamus</i> @1 %	96
2	<i>Cymbopogon citrates</i>	97
3.	Garlic @1 %	98
4	Neem extract	99
5	<i>Amomum subulatum</i> @ 500 µL/L	100
6	<i>Ocimum gratissimum</i>	101
7	<i>Allium sativum</i>	102
8	<i>Azadirecta indica</i> and <i>Eucalyptus camaldulensis</i>	103
9	<i>Alpinia galangal</i>	104
10	<i>Zingiber officinale</i>	105
11	Zimmu, <i>Zehneria scabra</i>	106
12	Garlic and neem	93
13	<i>Chromolaena odorata</i>	94

6.3 Biological control: Various biological control strategies have been used to reduced the mango gummosis disease.

Table 4: Various biological control strategies

S.No.	Bio control agent	References
1	<i>T. virens</i> and <i>T. hamatum</i>	107
2	<i>T. pseudokoningii</i>	108, 109
3	<i>T. viridae sps</i>	93
4	<i>T. asperellum</i>	110
5	<i>T. hematum</i>	111

6.4 Screening of varieties against *L. theobromae*

Table 5 : Screening of varieties against *L. theobromae*

S.No.	Resistant/ Tolerant varieties	References
1	Dosehri,	112
2	Willard, 'Rata' and 'Kohu'	113
3	Baneshan, Alphonso, Imam pasand and Pandurivari mamidi	93
4	Langra and Desi	115
5	S13, M5	116
6	Dosehri	117
7	Dasheri, Mahmooda, Neeleshan, Baneshan	114

7. Conclusion: Mango gummosis is caused by *Lasiodiplodia theobromae*, becoming a serious problem in India on many popular varieties of mango. mango gummosis is reported from major mango growing areas and is gaining importance due to the death of the trees with high disease severity. The pathogen have wide host range and the large potential for transmission, make it difficult to control the disease and also very meager data available on gummosis. So the future research approach is to develop new resistant varieties through a breeding selection program, studies to develop epidemiological prediction models, host pathogen interactions, molecular, cultural and biochemical characters, develop integrated disease management programme viz., Chemical, Biological and other ecological models for disease management.

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UNDER PEER REVIEW