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## Insights of gummy stem blight disease in Karnataka

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### Abstract

Water melon (*Citrullus lanatus*) is an important commercial, cucurbitaceous vegetable cultivated throughout the year. Gummy stem blight (GSB) poses a significant challenge to the cultivation of cucurbitaceous vegetables worldwide. This disease leads to complete wilting of the plants and potential yield losses of up to 100 percent. In 2022-2023, a roving field survey was conducted in a few watermelon-growing regions of Karnataka. The districts of Karnataka were covered were Chamarajanagara, Chikkaballapura, Koppal, Kolar, Tumkuru and Yadgiri. GSB incidence was found in every district. Disease severity varied from 28.88 to 46.66, where Chikkaballapura district has the maximum disease severity and Bengaluru Urban recorded the lowest disease severity. Gummy stem blight disease, the pathogen was isolated and artificially challenged and proving Koch's postulates showing *S. cucurbitacearum* as the causal organism of GSB in watermelon.

**Keywords:** Watermelon (*Citrullus lanatus*), gummy stem blight (GSB), cucurbitaceous vegetables

### Introduction

Watermelon [*Citrullus lanatus* (Thumb)] is one of the important Cucurbitaceous crops belonging to the family Cucurbitaceae grown in different parts of the world. The crop originated from Southern Africa and has been cultivated since ancient times (Wein, 1997) [21]. In India, watermelon is cultivated in an area of 101 thousand hectares with a production of 24.80 lakh tons. The major watermelon-growing states of India are Punjab, Haryana, Karnataka, Assam, Madhya Pradesh, Andhra Pradesh, Haryana, Maharashtra, Telangana, West Bengal, Odisha, Himachal Pradesh, Uttar Pradesh and Tamil Nadu (Anonymous, 2017) [2]. Cultivation of watermelon and other species of the family Cucurbitaceae is severely affected by several fungal diseases. Among the diseases, gummy stem blight caused by *Didymella bryoniae* is an emerging and devastating disease in the cultivation of watermelon. This pathogen is assumed to be present in most parts of the world where hot and humid weather is prevailing. The maximum incidence of the disease was found in Central and South America, the Caribbean, Asia, Africa, Europe and Oceania (CABI, 2015) [6]. In Tunisia, the first report of GSB was on grafted watermelon (Boughalleb *et al.*, 2007) [5]. In Turkey, *D. bryoniae* was first reported in cucumber (*C. sativus*) plants in the greenhouses across various districts of the Elazığ province by Mutlu *et al.* (2015) [16] with a prevalence rate and disease severity of 10.79 percent and 20.02 percent, respectively. *Stagonosporopsis cucurbitacearum* (Fr.) Aveskamp, Gruyter & Verkley, has been suggested as the anamorph of this pathogen (Aveskamp *et al.*, 2010) [3]. The disease caused complete wilting of plants with an estimated yield loss of up to 100 percent (Bala and Hosein, 1986) [4] in Trinidad. Sudisha *et al.* (2004) [20] first reported gummy stem blight on muskmelon in India, with 41.00 percent disease incidence. The first report of gummy stem blight by *S. cucurbitacearum* on watermelon in India was reported by Mahapatra *et al.*, 2020 [14]. Gummy stem blight is one of the most common foliar diseases on watermelon, muskmelon, honeydew and other melons in the southeastern United States caused by *Didymella bryoniae* anamorph (*Phoma cucurbitacearum*). The pathogen can affect the host at any stage of growth in its development and affects all parts. Gummy stem blight appears in three distinct phases: leaf spots, crown cankers and fruit rots. The common name "blight" indicates the disease often affects the entire plant. However, gummy stem blight starts as distinct dark spots. Symptoms generally consist of circular dark tan lesions that leads to, water-soaked leaves, stem cankers and gummy brown ooze that exudes from cankers, giving it the name gummy stem blight.

Gummy stem blight reduces yields of edible cucurbits by devastating the vines, leaves and rotting the fruits in the later stages. Gummy stem blight is caused by three species of the fungus *Stagonosporopsis citrulli* is by far, the most common species on watermelon and melons in the southeastern United States. The second, less common species is *Stagonosporopsis caricae*. The third species, *Stagonosporopsis cucurbitacearum*, is more common in the northeastern and mid-Western United States than in the Southeast. Gummy stem blight is one of the main reasons for the yield loss of watermelon cultivation in India. Most of the varieties of watermelon are susceptible to gummy stem blight. Therefore, it is necessary to identify the pathogen, disease severity, pattern and survey has to be conducted. In this present study a survey of gummy stem blight disease on watermelon on major watermelon districts of Karnataka has carried-out.

## Materials and Methods

### Field survey and collection of samples

In 2022-2023, a roving field survey was conducted in a few watermelon-growing regions of Karnataka. The districts of Karnataka were covered were Chamarajanagara, Chikkaballapura, Koppal, Kolar, Tumkuru and Yadgiri.

The disease scale given by Gusmini *et al.*, 2002 [8] was used for the scoring.

| Disease scale | Symptoms                                                                                                   |
|---------------|------------------------------------------------------------------------------------------------------------|
| 0             | no symptoms                                                                                                |
| 1             | Yellowing on leaves (suspect of disease only),                                                             |
| 2             | Moderate symptoms (<20 percent necrosis) on leaves only                                                    |
| 3             | Slight necrosis (21-45 percent necrosis) on leaves only                                                    |
| 4             | Severe symptoms (>45 percent necrosis) on leaves only                                                      |
| 5             | Some leaves dead, no symptoms on stem                                                                      |
| 6             | Moderate symptoms (<20 percent necrosis) on leaves, with necrosis also on petioles and stem (<3 mm long),  |
| 7             | Slight symptoms (21-45 percent necrosis) on leaves, with necrosis also on petioles and stem (3-5 mm long), |
| 8             | Severe symptoms (>45 percent necrosis) on leaves, with necrosis also on petioles and stem (>5 mm long)     |
| 9             | plant dead                                                                                                 |

## Isolation, purification and maintenance of the pathogen

### Tissue isolation method

A standard tissue isolation approach was used for the isolation of *Stagonosporopsis cucurbitacearum* from diseased plant samples having typical symptoms of lesions, necrotic spots and gummy ooze. The samples were sliced into bits of 0.5 to 1.0 cm. The tissue bits were initially surface sterilized with one percent sodium hypochlorite (NaOCl) for one minute and washed with sterile distilled water successively 3 times (30 seconds each time). The pieces were then dried with sterile tissue paper before being put on casted PDA media sterile Petri plate. The plates were then incubated at 26±1 °C until the growth started. The standard hyphal tip method was used to purify the cultures. The purified culture was then maintained on potato dextrose agar slants and refrigerated at 4 °C for later use.

## Results and Discussion

A roving survey was carried out in the major watermelon growing districts of Karnataka during 2022-23 to assess the percent disease index in different locations Fig. 1. The survey was conducted in 15 different locations of Karnataka from seven districts viz., Bengaluru Urban, Chamarajanagara, Chikkaballapura, Koppal, Kolar, Tumkuru and Yadgiri.

During the survey, the information on different aspects such as date of survey, farmer's name, village, taluk, district, soil type, age of the crop, name of the cultivar, previous crop, plant protection measures followed, other pest and diseases noticed, symptoms, Global Positioning System (GPS) coordinates, disease incidence was recorded.

Using the McKinney formula (1923) [15], the percent disease index (PDI) was computed using data on the disease scores of individual seedlings.

$$PDI = \frac{\text{Sum of all numerical rating}}{\text{Number of observations} \times \text{Maximum disease rating scale}} \times 100$$

During the field survey, fields were selected randomly and inspected for percent disease index, a (0-9) disease scale was used. Plants were diagnosed based on typical symptoms like lesions on the stem, petiole, necrotic spots on the leaves, gummy ooze on fruits and finally rotting of stem and death of plants. The collar regions, leaves and fruits of infected plants were assessed for lesions, necrotic spots and gummy ooze. Samples were collected, labelled and further work was carried out in the laboratory.

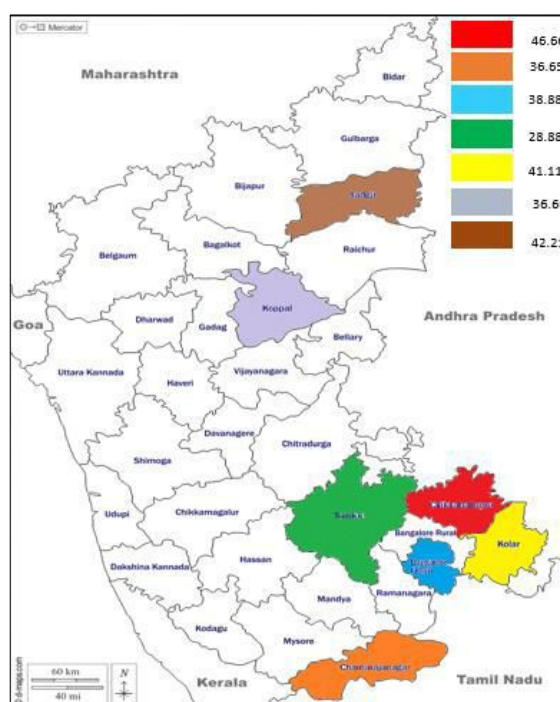


**Fig 1:** Disease incidence of gummy stem blight disease in watermelon growing districts of Karnataka surveyed during 2022-2023

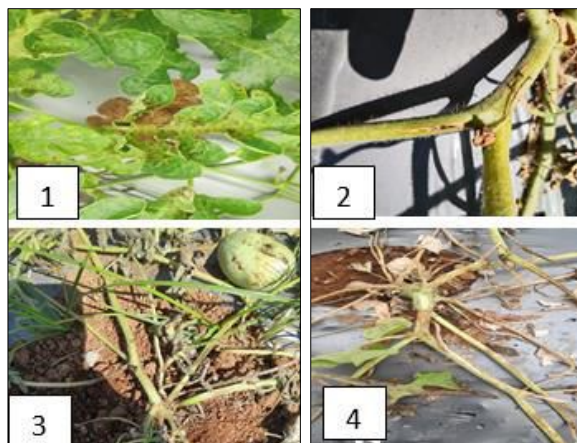


**Plate 1:** Different stages of gummy stem blight in watermelon plants under field condition

**Table 1:** Survey for the gummy stem blight disease in watermelon growing districts of Karnataka during 2022-23

| Sl. No. | District        | Taluk           | Village         | Latitude  | Longitude | Per cent disease index (PDI) |       |          | Age of the crop (days) | Variety | Soil type | Other diseases/pest                                                              |
|---------|-----------------|-----------------|-----------------|-----------|-----------|------------------------------|-------|----------|------------------------|---------|-----------|----------------------------------------------------------------------------------|
|         |                 |                 |                 |           |           | Village                      | Taluk | District |                        |         |           |                                                                                  |
| 1       | Chamarajanagara | Chamarajanagara | Yeriyur         | 11.996848 | 76.912524 | 24.44                        | 32.21 | 36.65    | 45                     | Max     | Black     | Watermelon bud necrosis virus disease (WBNV), serpentine leaf miner, leaf spots  |
|         |                 |                 | Homma           | 12.037752 | 76.967859 | 55.56                        |       |          | 60                     | Melody  | Red sandy | WBNV, serpentine leaf miner, leaf spots, Thrips                                  |
|         |                 |                 | Santhamarahalli | 12.040612 | 76.982136 | 26.66                        |       |          | 45                     | Melody  | Red loamy | WBNV, leaf spots                                                                 |
|         |                 |                 | Kavduvadi       | 12.062629 | 76.982730 | 27.77                        |       |          | 45                     | Melody  | Black     | Leaf spots, watermelon mosaic disease, whitefly                                  |
|         |                 |                 | Chungadipura    | 12.032136 | 76.984151 | 25.55                        |       |          | 45                     | Max     | Red sandy | Leaf spots                                                                       |
|         |                 |                 | Hullepura       | 12.153682 | 77.105397 | 33.33                        |       |          | 65                     | Max     | Black     | Anthrachnose, leaf spot WBNV                                                     |
|         |                 |                 | Kollegala       | 12.013815 | 77.076753 | 41.11                        |       |          | 70                     | Melody  | Red sandy | Leaf spots, WBNV                                                                 |
| 2       | Chikkaballapura | Chintamani      | Munganahalli    | 13.573857 | 78.177748 | 31.11                        | 46.66 | 46.66    | 45                     | Melody  | Red sandy | Watermelon bud necrosis virus disease, serpentine leaf miner, leaf spots, Thrips |
|         |                 |                 | Devapalli       | 13.565942 | 78.175722 | 62.22                        |       |          | 60                     | Melody  | Red sandy | Watermelon mosaic virus disease, Anthracnose                                     |
| 3       | Kolar           | Srinivasapur    | Hosahalli       | 13.301867 | 77.970359 | 41.11                        | 41.11 | 41.11    | 60                     | Max     | Red loamy | Leaf spots, WBNV                                                                 |
| 4       | Koppal          | Hospete         | Dhanagaladoddi  | 15.392452 | 76.287136 | 36.66                        | 36.66 | 36.66    | 70                     | Max     | Red loamy | Serpentine leaf miner, leaf spots                                                |
| 5       | Tumkuruu        | Tumkuru         | Mantya          | 12.96592  | 76.910957 | 28.88                        | 28.88 | 28.88    | 45                     | Melody  | Red sandy | Leaf spots                                                                       |
| 6       | Bengaluru urban | Bengaluru north | Hessaraghatta   | 13.126716 | 77.487881 | 38.88                        | 38.88 | 38.88    | 70                     | Melody  | Red       | Leaf spots, watermelon mosaic disease, whiteflies                                |
| 7       | Yadgiri         | Yadgiri         | Arekera         | 16.890991 | 77.019705 | 46.66                        | 42.21 | 42.21    | 50                     | Melody  | Red       | Leaf spots, WBNV                                                                 |
|         |                 |                 | Khanahalli      | 16.850516 | 77.044318 | 37.77                        |       |          | 60                     | melody  | Red       | Leaf spots, watermelon mosaic disease, whitefly                                  |

Field view of watermelon fields visited during survey are depicted in (Plate 1). The percent disease index noticed in

1. Water-soaked necrotic spots on leaves
2. Lesions on stems and petiole
3. Gummy ooze on fruits
4. Death of the plant

all the locations surveyed ranged from 28.88 to 46.66 percent and the data is presented in Table 1. Among the surveyed districts maximum mean percent disease index was observed in Chikkaballapura district (46.66) whereas, the least percent disease index was recorded in Tumkuru district (28.88). Among the eight taluks surveyed, the maximum percent disease index was noticed in Chintamani taluk (46.66) of Chikkaballapura district followed by Yadgiri taluk (42.21) of Yadgiri district. Among the villages surveyed, the percent disease index was found highest in Devapalli village (62.22) of Chintamani taluk of Chikkaballapura district followed by Homma village of Chamarajanagara taluk of Chamarajanagara district while, it was found lowest in Mantya village (28.88 percent) of Tumkuru taluk of Tumkuru district. In many countries, especially those where watermelon is cultivated on a large

scale for commercial purposes, one of the main obstacles to the successful production of the crop is the gummy stem blight caused by *S. cucurbitacearum*. India is among the countries in the world where the disease is most prevalent. The gummy stem blight pathogen has a severe effect on watermelon and the disease's incidence is rising more quickly every day. Gummy stem blight has been detected in all watermelon-growing states in India, with varying degrees of severity. Global cucurbit production is impacted by GSB, which has a major effect on both profit and food security. Fruit quality and yield can both be decreased by GSB (Keinath, 2000) [10]. GSB accounts for 17 percent to 43 percent of losses (Keinath, 2001; Keinath & Duthie, 1998) [11, 9].

The present results are similar to the results of Jabouri and Hussaini (2020) [23] who conducted survey in the fields of Salah Al-Din, Kut, Diwaniya and Sulaimaniyah provinces of Iraq in 2019. Maximum disease infection of 84 percent was reported in the Diwaniya province and the lowest disease infection of 52 percent was observed in the Salahaddin province. Maximum infection of 89 percent was recorded in the Sumer area of Diwaniya province and the lowest in Ishaqi area of Salahaddin province. In the present

study, the percent disease index varied from district to district and higher incidence was observed in Chikkaballapura and Yadgiri districts. This might be due to the type of cropping pattern that farmers have been practicing, environmental conditions prevailing and hence, the buildup of the pathogen inoculum and even due to monocropping of susceptible hybrids Melody and Max that aggravates the disease occurrence. Seed-borne nature of the pathogen also makes it difficult for early detection of the disease. Apart from this, a lack of knowledge regarding the prophylactic management practices also made it difficult to manage the disease and even due to the use of local planting materials which are neither certified nor completely ensured that are from disease-free fields. Thus, initial inoculum through planting material, accompanied with susceptible variety and prevailing congenial soil and climatic conditions helps the disease to aggravate in the field condition. In the present investigation, critical susceptible stages for the gummy stem blight disease were flowering and flowering stages. Similar results were reported earlier by other workers too. (Chiu and Walker 1949; Santos *et al.*, 2009; Keinath 2013) [7, 19, 12].

### Collection and isolation of the pathogen

Isolates of the GSB pathogen were collected and isolated by tissue isolation method as in material and methods. Isolates were confirmed by cultural and morphological characteristics as *Stagonosporopsis cucurbitacearum* by Li *et al.*, 2018; Zhao *et al.*, 2018; Rahman *et al.*, 2022; Santos *et al.*, 2022 [13, 22, 17, 18].

### Conclusion

GSB-affected watermelon plants produced typical symptoms of necrotic spots on leaves and water-soaked lesions on stems and petioles. In severe cases, gummy ooze was seen on the collar region and rotting of fruits was seen. The causal organism of the GSB is *Stagonosporopsis cucurbitacearum* and it is a potential threat to watermelon production in Karnataka. The survey for gummy stem blight disease in major watermelon growing districts helps to pin down the real status of the disease.

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