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Prevalence and Distribution of Collar Rot in Brinjal (*Solanum melongena* L.) caused by *Sclerotium rolfsii* from major Brinjal growing Regions of Tamil Nadu

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Abstract

Brinjal (*Solanum melongena* L.), a key berry-producing vegetable in the family Solanaceae, is susceptible to numerous biotic and abiotic stresses. Among various biotic diseases, collar rot is one of the highly destructive diseases responsible for 55-95% yield losses. A roving survey conducted across major brinjal-growing areas of Tamil Nadu and recorded percent disease incidence ranging from 8.28% to 34.79%. The highest incidence (34.79%) was recorded in Kottumulai village in Cuddalore district, while the lowest incidence (8.28%) was recorded in Navakurichi village in Salem district. Morphological characterization of the isolates showed significant variation in growth and sclerotial formation. Radial mycelial growth ranged from 59-90 mm and the sclerotial production ranges from 75 to 1,338 per plate. Among the twenty isolates, the maximum mycelial growth and the highest number of sclerotia was produced in Sr3 isolate and the minimum mycelial growth and the lowest sclerotial production was observed in the Sr17 isolate.

Key words : Survey, Brinjal, *Sclerotium rolfsii*, morphological characters.

Eggplant (*Solanum melongena* L.) is one of the most important berry-producing vegetable crop grown across the world. It is belonging to the family *Solanaceae* and ranked as the fifth most economically important crop in its family, following potato, tomato, pepper, and tobacco[23]. It is regarded as the "King of Vegetables" in India and is also known as the "poor man's crop" due to its affordability and accessibility[1]. It is commonly referred as Kathiri in Tamil Nadu and 'brinjal' in India, where it has been cultivated for over 4,000 years, the name is derived from Arabic and Sanskrit origins[22]. Brinjal is a highly adaptable crop, thriving in various climatic conditions, which allows it to be grown throughout the

year[15,23]. In 2021, world brinjal production reached 58.64 million metric tons over an area of 1.96 million hectares, with China, India, Egypt, Turkey, and Indonesia as the top producers. India alone produced approximately 12.78 million tons of brinjal from 6.77 lakh hectares in 2022-2023, with the leading cultivation states being West Bengal, Odisha, Gujarat, Bihar, and Madhya Pradesh[4].

Nutritionally, brinjal is highly valued for its low calorie and fat content, making it a staple in diets worldwide. It is rich in water, fibre, carbohydrates, and essential vitamins and minerals. Moreover, the bioactive compounds present in brinjal, such as chlorogenic acid and anthocyanins, offer numerous health benefits. Chlorogenic acid has been linked to anti-inflammatory, antimicrobial, and anticancer properties, while anthocyanins, primarily found in the skin of the fruit, are potent antioxidants that protect against oxidative stress and inflammation[13,21]. These compounds also contribute to the management of chronic diseases like diabetes, cardiovascular conditions, and liver disorders[7,16].

Despite its nutritional value, brinjal is highly susceptible to a variety of diseases, including fungal, bacterial, and viral infections. Of these, collar rot caused by *Sclerotium rolfsii* is a serious threat, particularly in environments with favorable conditions such as high humidity and soil temperatures between 25-30°C. This pathogen produces oxalic acid and tissue-degrading enzymes like polygalacturonase and cellulase, which lead to tissue maceration and eventual plant death[5]. The maceration process disrupts nutrient and water transport within the plant, causing visible symptoms like wilting, necrosis, and eventual plant mortality, with seedling loss rates ranging from 55-95% under optimal conditions[9]. *Sclerotium rolfsii* is a highly versatile soil-borne pathogen that functions as both a saprotroph and a facultative parasite, capable of infecting over 500 plant species globally[10]. This omnipathogenic fungus is known for producing distinctive white, fan-like mycelia at the collar region of infected plants. It poses a significant threat to agricultural crops due to its ability to survive unfavorable environmental conditions through the formation of sclerotia. These sclerotial bodies, initially creamy white, progressively darken to brown and eventually black as they mature, enabling the pathogen to persist in the soil for extended periods. The durable nature of sclerotia act as a primary inoculum source for future disease outbreaks in subsequent cropping seasons, even in the absence of a host plant[24]. The objectives of the present study are i) survey on the incidence of collar rot of brinjal from different districts of Tamilnadu ii) to assess the morphological characteristics.

Survey and sample collection :

A roving survey was conducted during 2023-2024 to assess the incidence of collar rot in key brinjal-growing districts of Tamil Nadu, including Cuddalore, Dindigul, Erode and Salem districts (Fig. 1). Selected villages from each district were surveyed, and infected brinjal plants were collected. The survey documented the soil type, brinjal variety, crop stage affected, geographical coordinates (latitude and longitude), and the percentage of disease incidence. The collected infected

samples were carefully placed in plastic bags, labelled with the respective village name and isolate number using a marker for further laboratory work. Percent disease incidence was calculated by using the formula,

$$PDI = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

Isolation, purification, and maintenance of the pathogen :

The infected plant samples (Fig. 2) were isolated by tissue segment method in PDA media[3]. The infected samples were washed in tap water and blotted. The samples were cut into small sections and surface-sterilized using 1% sodium hypochlorite for 30 seconds and then rinsed with sterile distilled water for three times and dried in tissue paper. 3-4 sections were then placed on petri dishes containing 15 ml of potato dextrose agar (PDA) media, impregnated with streptomycin to prevent bacterial contamination, and incubated at 25°C for 3 days. After incubation, the fungal cultures were purified using the hyphal tip method[18] and incubated at 28 ± 2°C for 5-7 days to encourage mycelial growth and sclerotia production (Fig. 3). Then the sclerotia were transferred to PDA slants and stored at 4°C for further studies. The isolates were subcultured periodically to maintain the cultures. Totally 20 isolates were obtained and designated as Sr_1-Sr_{20}. The culture was identified as *Sclerotium rolfsii* based on the morphological characteristics given by Butler *et al.*[8] and further confirmed by NFCCI at Agharkar research institute and got a NFCCI accession number (NFCCI 5791).

Morphological characterization of the pathogen :

The pathogen is identified by observing the mycelial growth and morphological characters. Mycelial growth of *Sclerotium rolfsii* isolates (Sr_1-Sr_{20}) were measured at 24,48, and 72 hours after incubation. The isolates were observed for colony color and type, as well as the color, shape, and arrangement of sclerotia. The number of sclerotia produced per plate, and the days required to complete the sclerotial production were also recorded. Further, the cultures were confirmed through microscopic and scanning electron microscopic (SEM) observation.

Incidence of Collar Rot in Different Brinjal-growing Regions of Tamil Nadu :

A roving survey was conducted during 2023-2024 across Cuddalore, Dindigul, Salem, and Erode districts in Tamil Nadu to assess the incidence of collar rot disease (Fig. 1). In the surveyed villages, the incidence of collar rot ranges from 8.28% to 34.79%. Among the isolates collected, the highest disease incidence (34.79%) was recorded in Kottumulai village, followed by Keelakundalapadi village (32.61%) in Cuddalore district and the lowest incidence was observed in Navakurichi village in Salem district, with an incidence of 8.28% (Table-1). Modi and Kumar[14] surveyed major brinjal growing areas in Tamil Nadu during the year 2019-2020 and reported that the highest disease incidence was recorded in Kaveripat-tinam of Krishnagiri district (36.16%) and the lowest incidence was recorded in Kottur village of Theni district (7.73%). Vignesh *et al.*[25] surveyed and reported that the disease incidence of collar rot ranged from 15.67 to

35.69%. Similarly, Sivakumar *et al*.[20] surveyed Cuddalore district for the incidence of groundnut collar rot and reported that the disease incidence ranged from 7.88% to 32% and revealed that the maximum disease was recorded in Adhivaraganallur and the minimum disease incidence was recorded in Rajakuppam. This may be due to continuous cropping and presence of pathogen over long period, because continuous cultivation of any crop over the season and years will build up inoculum level to such an extent. The above results lend support to the present investigations.

Morphological characterization of the pathogen :

Mycelial growth and colony morphology :

A study on the morphological characteristics of twenty isolates revealed notable variation in colony morphology on potato dextrose agar (PDA) medium. The isolates displayed a range of mycelial growth patterns, including white fluffy cottony growth, thin white mycelial growth, aerial cottony structures, and dull white thin mycelial growth, as detailed in Table 2. Upon examination on the third day post-inoculation, the isolates (Sr1, Sr2, Sr3, Sr10, Sr11, Sr14) exhibited rapid radial expansion, reaching the maximum growth limit of 90 mm. Meanwhile, isolates Sr4, Sr9, Sr12, Sr13, Sr15, Sr16, Sr18, Sr19, Sr20 displayed moderate growth ranges from 84-89mm. A comparatively slower growth was observed in isolate Sr5 and Sr7 with 79mm and 73 mm respectively. The lowest radial growth was recorded in isolate Sr17 at 59 mm, followed by Sr8 at 61 mm.

Similar results were observed by Sekhar *et al.*[19] reported that the different isolates exhibited variation in their cultural characteristics. Similarly, Praveen and Kannan[17] reported that the twenty different isolates of *Sclerotium rolfsii* showed variation in their mycelial growth pattern such as fluffy white mycelium, profuse cottony white mycelium, dense cottony white mycelium, dull white profuse mycelium, and white cottony mycelium. Ayyandurai *et al*.[5] stated that virulent isolate SR-8 showed fast growing of purest white with thin mycelia growth and the least virulent isolate SR-10 showed slow growing of dull white with thin mycelial growth. These earlier reports corroborates with the present observations.

Sclerotial characters :

The sclerotial formation among the twenty *S. rolfsii* isolates varied considerably, ranging from 9 to 34 days post-inoculation, as shown in Table-2. The isolates Sr1, Sr2, and Sr3 showed early sclerotial formation, within 9 days of inoculation. In contrast, isolate Sr17 required the longest period, taking 34 days for complete sclerotial formation. The variability in sclerotial development among the isolates suggests potential differences in their physiological adaptations and may indicate varying survival and virulence capabilities within the population.

This was in confirmation with findings of Sekhar *et al.*[19] reported that the *Sclerotium rolfsii* isolates takes 8 to 14 days for sclerotial production. Similarly, Praveen and Kannan[17] stated that the isolates took 9 to 14 days for sclerotial production. The above reports lend support to the present findings.

Sclerotial numbers, color, shape and arrangement :

Among the twenty *S. rolfsii* isolates, the number of sclerotia per plate ranged from 75 to 1,338, as presented in Table-2. Isolate Sr3 produced the highest sclerotial count at 1,338 per plate, while isolate Sr17 yielded the lowest with 75 sclerotia per plate. The morphology of the sclerotia varied widely among isolates, exhibiting shapes such as oval, spherical, irregular, and round. Additionally, sclerotial coloration spanned light brown, brown, chocolate brown, and dark brown. The arrangement patterns also differed, with sclerotia distributed centrally, scattered, or peripherally on the plate.

Similar findings were reported by Le *et al.*[11] they stated that 79 to 1,080 sclerotia per plate were produced by the isolates. Ayyandurai *et al.*[5] reported that the SR8 isolate produced highest number of sclerotia 538 per plate and the SR10 isolate produced least number of sclerotia 60 per plate. Praveen and Kannan[17] reported that the maximum number of sclerotia of 330 was produced by the isolate Sr_6 and the least number of sclerotia of 78 was produced by the isolate Sr_{13} and also stated that the shape, colour and arrangements also

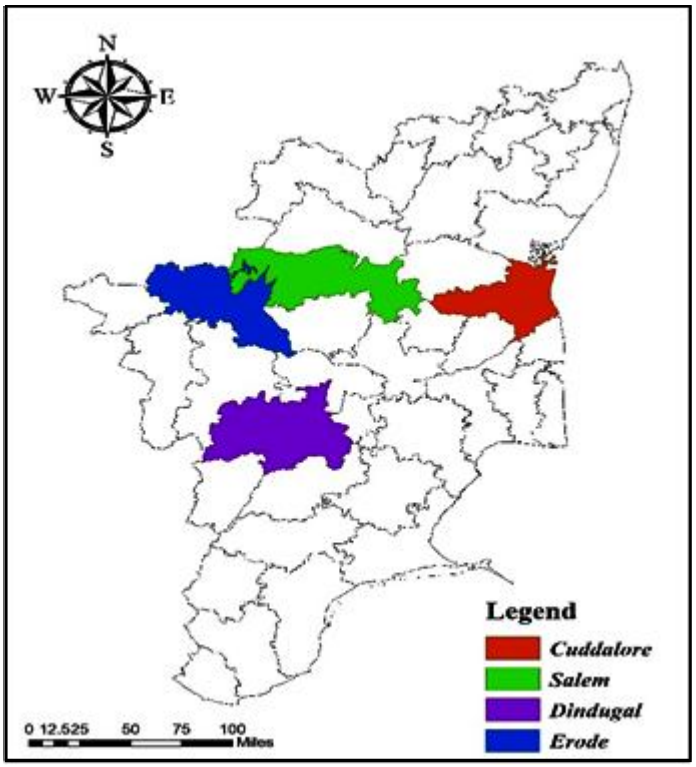

Fig. 1. Survey on the Incidence of Collar Rot from Major Brinjal Growing Regions of Tamil Nadu

Fig. 2. Symptom of brinjal collar rot

Fig. 3. Pure culture of *Sclerotium rolfsii*

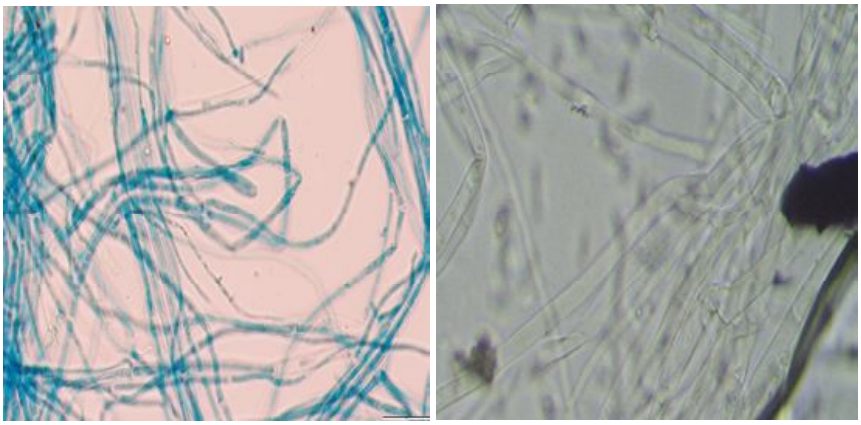

Fig. 4. Microscopic view of *Sclerotium rolfsii*

varied among the isolates. Similarly, Adhikari *et al.*[2] reported that the number of sclerotia produced per plate ranges from 340 to 890. Manu *et al.*[12] stated that the *Sclerotium rolfsii* isolates showed variation in the sclerotial shape and arrangements in the plate. These earlier reports corroborates with the preent observations.

Microscopic identification :

Microscopic examination of all isolates revealed hyaline, branched, and septate mycelium, with the presence of clamp connection (Fig. 4).

The survey on collar rot incidence in major brinjal-growing areas of Tamil Nadu revealed significant regional variation in disease occurrence, largely influenced by pathogen virulence and local environmental conditions. The highest disease incidence (34.79%) was recorded in Kottumulai village in the Cuddalore district, whereas the lowest incidence (8.28%) was observed in Navakurichi village in the Salem district. The Sr3 isolate exhibited maximum mycelial growth (90mm) and sclerotial production (1,338), indicating a high virulence level and Sr17 isolate exhibit the

Table-1. Survey on the incidence of brinjal collar rot in major brinjal growing areas in Tamil Nadu

Si. no.	District	Village	Latitude	Longitude	Soil type	Variety	Stages of crops	Disease incidence (%)
1	Cuddalore	Sivapuri	11°22'24"N	79°42'23"E	Clay loam soil	Annamalai	Vegetative	26.94^{e} (31.26)
2		Jayankon-dapattinam	11°22'05"N	79°44'02"E	Sandy loam soil	Annamalai	Fruiting	22.87^{g} (28.56)
3		Kottumulai	11°27'13"N	79°26'48"E	Black soil	PLR1	Fruiting	34.79^{a} (36.14)
4		Ayeepettai	11°37'43"N	79°35'09"E	Clay loam soil	Annamalai	Flowering	21.39^{h} (27.54)
5		Perampattu	11°21'21"N	79°43'07"E	clay loam soil	PLR1	Fruiting	31.08^{c} (33.88)
6		Toppaiyankuppam	11°34'00"N	79°37'39"E	Black soil	PLR1	Flowering	20.52^{i} (26.93)
7		Keelakundalapadi	11°21'28"N	79°43'59"E	Sandy loam soil	Annamalai	Fruiting	32.61^{b} (34.82)
8	Salem	Kattukkottai	11°35'35"N	78°39'38"E	Alluvial soil	CO1	Vegetative	9.41^{q} (17.86)
9		Navakurichi	11°36'26"N	78°45'14"E	Sandy loam soil	PKM1	Flowering	14.65^{m} (22.50)
10		Govindampalayam	11°32'03"N	78°49'51"E	Alluvial soil	CO1	Vegetative	14.03^{m} (21.99)
11		Pattuthurai	11°35'57"N	78°43'43"E	Alluvial soil	PKM1	Flowering	10.77^{op} (19.15)
12		Sankagiri	11°28'36"N	77°52'56"E	Black soil	CO1	Fruiting	17.32^{k} (24.59)
13	Dindigul	Keeranur	10°34'44"N	78°46'18"E	Red soils	PLR1	Flowering	18.74^{j} (25.65)
14		Vedasenthur	10°32'27"N	77°57'07"E	Black cotton soil	CO2	Fruiting	28.76^{d} (32.43)
15		Kasipalayam	10°36'59"N	77°57'09"E	Black cotton soil	CO2	Fruiting	24.12^{f} (29.41)
16		Oddanchatram	10°29'35"N	77°45'12"E	Red soil	PLR1	Flowering	29.57^{d} (32.94)
17	Erode	Kosavampalayam	10°59'25"N	77°16'05"E	Brown soil	CO2	Vegetative	8.28^{r} (16.72)
18		Kolandhapalayam	11°22'58"N	77°16'02"E	Brown soil	CO2	Fruiting	15.97^{l} (23.55)
19		Mettupalayam	11°19'00"N	77°21'38"E	Red soil	PLR1	Vegetative	8.96^{q} (17.41)
20		Rangampalayam	11°18'24"N	77°42'20"E	Red loam soil	CO1	Fruiting	12.13^{n} (20.38)

Mean of three replications

Values in the column followed by common letters do not differ significantly at 5% level by Duncan's multiple range (DMRT)

Table-2. Morphological identification of *Sclerotium rolfsii* in different brinjal growing tracts in Tamil Nadu

Iso-lates	Colony morphology	Mycelial growth (mm)			SCLEROTIAL CHARACTERS				
		24 hrs	48 hrs	72 hrs	Days taken for complete formation	No. of sclerotia per plate	Color of sclerotia	Shape of scleotia	Arrange-ments of sclerotia
Sr1	White fluffy cottony growth	34	76	90	9	537	Dark brown	oval	Central
Sr2	White fluffy cottony growth	35	63	90	9	540	Dark brown	Spherical	Scattered
Sr3	Fluffy aerial white mycelial growth	40	75	90	9	1338	Dark brown	Round	Central
Sr4	Cottony white mycelial growth	35	62	89	19	214	Light brown	Round	Scattered
Sr5	White with thin mycelial growth	16	49	79	31	125	Brown	Spherical	Scattered
Sr6	Aerial cottony mycelial growth	17	38	63	14	610	Dark brown	Spherical	Central
Sr7	White aerial cottony mycelial growth	23	50	73	27	211	Dark brown	Round	Scattered
Sr8	White with thin mycelial growth	25	45	61	15	530	Dark brown	Spherical	Peripheral
Sr9	Cottony white mycelial growth	28	57	86	17	180	Dark brown	Irregular	Peripheral
Sr10	White with thin mycelial growth	31	73	90	15	455	Dark brown	Irregular	Peripheral
Sr11	Fluffy aerial white mycelial growth	36	76	90	20	356	Chocolate brown	Spherical	Scattered
Sr12	Cottony white mycelial growth	25	59	88	25	255	Brown	Round	Peripheral
Sr13	Cottony white mycelial growth	23	55	86	31	118	Chocolate brown	Round	Scattered
Sr14	White with thin mycelial growth	26	67	90	25	316	Chocolate brown	Spherical	Scattered
Sr15	Aerial cottony mycelial growth	29	54	87	26	115	Dark brown	Spherical	Peripheral
Sr16	White with thin mycelial growth	23	50	86	21	114	Light brown	Irregular	Peripheral
Sr17	White fluffy cottony growth	18	38	59	34	75	Brown	oval	Scattered
Sr18	Dull white with thin mycelial growth	22	54	84	15	736	Dark brown	Spherical	Peripheral
Sr19	Aerial cottony mycelial growth	23	59	88	22	478	Dark brown	Round	Scattered
Sr20	White with thin mycelial growth	19	51	87	31	126	Brown	Round	Scattered

minimum mycelial growth (59 mm) and sclerotial production (75).

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