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Incidence of Fungal Wilt in Tomato and Characterization of Pathogen

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***Abstract*:** A survey work was carried out to determine the incidence of fungal wilt of tomato in three Southern districts of Karnataka *viz*. Bengaluru rural, Chikkaballapur and Kolar during the cropping season in 2019-20. Incidence of fungal wilt in these districts ranged between 8.68 to 13.03 per cent, with a mean incidence of 11.25%. Highest incidence of fungal wilt was observed in Chikkballapur district followed Kolar, whereas the lowest incidence was recorded in Bengaloru rural district. During the survey, symptoms of the disease observed was typical yellowing and vein clearing of lower leaves, stunting, necrosis, discoloration and wilting. The symptoms moved upwards with the gradual upward extension of the pathogen and discoloration of the vascular tissue of stems and roots and also the entire plant got affected and finally dried. Fungal wilt pathogen isolated on PDA was identified to be *Fusarium oxysporum* f. sp. *lycopersici* (Sacc.). The pathogen cultures could produce diverse colors and exhibited two types of conidia *i.e.* macro and micro conidia, could grow between 10^0C and 35^0C and produced abundant spores at 28^0C.

***Keywords*:** Tomato, Fungal wilt, Characterization, *Fusarium oxysporum*

Tomato (*Solanum lycopersicum* L.) is an important vegetable crop grown throughout the world. It is native to South America, botanically similar to cherry tomato. Tomato is grown in Karnataka in an area of 0.60 lakh hectares, it ranks second in production and productivity (20.46 lakh tonnes and 34.10 tonnes/ha respectively) (Anonymous 2017). The fungal wilt of tomato is one of the severe diseases that affect the yield. Fungal wilt is caused by *Fusarium oxysporum* f. sp. *lycopersici* is known to cause severe economic losses in major tomato growing areas worldwide (Abdullah et al 2013). It is a soil born pathogen very destructive in causing 10 to 50 per cent yield loss in some tomato production areas (Ghazalibiglar et al 2016). It is very difficult to control fungal wilt of tomato, since the pathogen can progress within the vascular tissue by limiting the effectiveness of fungicides. Present study was executed towards survey of fungal incidence in major tomato growing districts of southern Karnataka *viz*. Bengaluru rural, Chikkaballapur and Kolar and to characterize the symptoms, extent of damage and the actual causal organism of fungal wilt.

MATERIAL AND METHODS

The present study on survey of fungal wilt disease on tomato in major tomato growing districts of South Karnatka, *viz*. Bengaluru rural (latitude: 13^0 05' 60.00" N and longitude: 77^0 13' 48.00" E), Chikkaballapur (latitude: 13^0 26' 6.43" N and longitude: 77^0 43' 40.33" E) and Kolar (latitude: 13^0 18' 12.16" N and longitude: 78^0 07' 45.01" E) was carried out. Fungal wilt disease incidence and crop loss were recorded in 14 to 17 villages (Table 1) of these districts with sample size of two plants in each field. The diseased samples were analyzed in the Department of Plant Pathology, College of Horticulture Bengaluru, under laboratory conditions during 2019-2020. Fungus infected stem and roots of tomato plants showing typical symptoms of wilt were collected, cut with the help of blade to identify *Fusarium* wilt symptoms in the tomato plants and the incidence of disease was expressed in per cent (Dhingra and Sinclair 1995).

The isolation of wilt pathogen (*Fusarium oxisporum*) of tomato was done from roots and stems which showed characteristic discoloration. The infected plant material was washed with tap water to remove the surface contaminants. One to two cm bits of diseased and healthy portion of roots and collar region of the plant was cut and removed. The bits having diseased portions were surface sterilized with sodium hypo chloride (1%) for 30 seconds, washed thrice with sterile distilled water. The surface sterilized bits were placed on sterile filter paper to remove excess moisture and then placed in sterile petri plates containing potato dextrose agar (PDA). The PDA medium was supplemented with streptomycin (30 mg L^{-1}), while pouring it into petri plates after sterilization (autoclaved at 1.05 kg/cm^2 for 20 minutes). Such

of the inoculated petri plates were kept in incubator at 27±1^{0}C and examined daily for mycelial growth. The fungi were purified by hyphal tip technique and pure culture was maintained on slants containing PDA (Rahimi et al 2019) and preserved at 5^{0}C in refrigerator for further studies. Sub culturing of the stock culture was done at an interval of 20 to 24 days.

The morphology of the fungus was studied from root and stems discoloration of infected tomato plants by sectioning and observing under microscope and also used 5-10 days old culture grown on potato dextrose agar medium by adopting slide culture technique (Rahimi et al 2019). The fungus had produced pure white to creamy white cottony colony on Potato Dextrose Agar surface. The colour of *Fusarium oxysporum* f. sp. *lycopersici*on on PDA medium varied between white, creamish white to cream, light pink to pink and light purple to violet as outlined by Nirmaladevi and Srinivas (2012). Septation, shape and colour of various morphology structures like mycelium, micro and macroconidia, chlamydospores, sporodochia etc. were recorded with the help of microscope to identify the pathogen.

RESULTS AND DISCUSSION

Incidence of fungal wilt in tomato: Disease incidence of fungal wilt of tomato was analyzed using systematic survey of symptoms and occurrence of wilt disease. Incidence of fungal wilt was found in all the three districts surveyed and ranged between 8.68 to 13.03 per cent (Table 1). The mean incidence of fungal wilt in three districts surveyed was 11.25 per cent. Disease incidence was maximum (13.03 %) in Chikkaballapur district followed by Kolar (12.05 %), and it was lowest in Bengaluru rural district (8.68 %). The fungal disease caused by *Fusarium*. *oxysporum* f. sp. *lycopersici* (Sacc) was observed during the cropping season in 2019 in these districts (Sayed farooq 2020). *Fusarium* wilt became a serious disease in many warmer areas, because causal organism of the disease, *Fusarium oxysporium* f. sp. *lycopersici* prefers 25-31^{0}C soil temperature for growth and development (Amini and Sidovich 2010). Gupta and Thind (2006) observed the increased soil temperature during summer to be the major factor for prevalence of *Fusarium* wilt in tomatoes grown under field and polyhouse having temperature 30^{0}C and above in mid hill of Himachal Pradesh. Continuous cropping of tomato round the year under polyhouse might be another reason for increased incidence of this disease, under polyhouse (Narender and Jitender 2014). Increase and spread of soil born disease especially fungal wilt is further high when a specific crop was grown continuously as reported earlier by (Charoenporn et al 2010).

Table 1. Incidence of *Fusarium* wilt of tomato observed in 3 districts of Karnataka during 2019-20

Bengaluru rural Latitude: 13^0 05' 60.00" N Longitude: 77^0 13' 48.00" E		Chikkaballapur Latitude: 13^0 26' 6.43" N Longitude: 77^0 43' 40.33" E		Kolar Latitude13^0 18' 12.16" N Longitude:78^0 07' 45.01" E	
Village	Disease incidence (%)	Village	Disease incidence (%)	Village	Disease incidence (%)
Marasandra	9.50	Marana halli	15.50	Pathand halli	13.50
Kadatanamale	10.50	Doddadasa halli	12.50	Rajendrahalli	8.50
Kampalingana halli	6.50	Bagalur	11.50	Marasana halli	11.40
Pura	7.40	Chimtamani	14.40	Hunegal	13.90
Kommasandra	10.40	Balagere	12.20	Doddapaila gurki	10.40
Ranganth pura	6.10	Shidalgatta	9.12	Mulabagalu	12.30
Meddena halli	8.40	Bagepalli	14.40	Srinivasapura	14.20
Vijaypura	7.30	Gudibande	14.30	Malur	12.50
Thindlu	10.40	Sadhahalli	12.20	Dodda kadatur	9.40
Gollahalli	9.11	Nandhi	16.50	Chavvena halli	14.11
Devanahalli	9.50	Kasaba	12.11	Masti	12.50
Mahadeva Kodigehalli	8.30	Mandikal	9.50	Dypasandra	12.40
Kadatenamele	11.90	Davappangudi	15.40	Perasena halli	11.30
Kranpalingona halli	6.30	Ammagarana halli	16.30	Jakkasandra	11.80
		Mulabagalu	9.30	Narasapura	13.30
		Huepagal	12.10	GaaliAnjaneya	9.14
		Marasasama halli	14.20	Perasenahalli	14.20
Mean	8.68	Mean	13.03	Mean	12.05
Over all mean			11.25		

Isolation, characterization and identification of pathogen: Infected roots and stems of tomato were cut in to small pieces with the help of razor blade and confirmed the presence of fungal wilt. Such infected samples were used for the isolation of the pathogen on PDA. Isolates causing fungal wilt on surface of potato dextrose agar produced diverse colors *i.e.* white, white to cream creamish, pink and light violet to purple and took 8 days to fully cover the petri plate. The two types of conidia *i.e.* macro and micro conidia, microconidia were aseptate, hyaline and oval to round in shape and macroconidia were 3 to 5 in number and they were septate, often blocked at tapered tip and somewhat thicker at upper third portion than in central portion (Table 2). The isolated cultures were characterized and identified to be similar to that of *Fusarium oxysporum* f. sp. *lycopersici* (Booth 1971, Brayford 1992).

Effect of temperature on, growth and sporulation of *Fusarium oxysporum* in vitro: The effect of various temperatures on growth and sporulation of *Fusarium* revealed that the fungus mycelium could grow between 10^{0}C and 35^{0}C (Table 3). The maximum mycelium growth of the pathogen was at 28^{0}C (85.0 mm), followed by 77.0 mm and 55.0 mm at 30^{0}C and 20^{0}C respectively. No growth was observed at 0^{0}C, 5^{0}C and 40^{0}C temperatures. The abundant sporulation was observed at 28^{0}C, and moderate sporulation was between 20^{0}C and 35^{0}C. However poor growth and sporulation was observed at 15^{0}C and there was no sporulation at 0^{0}C, 5^{0}C and 40^{0}C temperatures. Fayzalla et al (2008) observed maximum favorable temperature range for growth and sporulation of *Fusarium* wilt pathogen to be 25^{0}C - 30^{0}C. Sharma et al (2011) also reported for most favorable growth and sporulation of the *Fusarium* wilt pathogen, *Fusarium oxysporum* f. sp. *lycopersici* that causes wilt of tomato.

Table 2. Morphological characters of *Fusarium oxysporum* f. sp. *lycopersici*

Isolated wilt pathogen character	
Microconidia	Present
Macroconidia	Usually abundant
Sporodochia	Orange to brown colour and relatively common
Morphology	Thick and blunty pointed at their apex. The dorsal side is somewhat curved, but the ventral side is almost straight.
Size	Microconidia = 2.2-4.7 × 1.4-2.5 µm Macroconidia size = 23.0-38.0 × 2.7-5.4 µm
Development	Develop singly from phialides
Chlamydospores	Usually abundant and form relatively fast, requiring 3-5 week
Location	In hyphae and macroconidia
Morphology	Thick walled and globose
Appearance	Found singly, in chains
Size	8-10 µm in diameter

Table 3. Effect of temperature on growth and sporulation of *F. oxysporum* f. sp. *lycopersici*

Temperature (^{0}C)	Mean colony diameter in (mm) after 7 days of inoculation*	Sporulation*	Index
0	0.0	-	- :No sporulation
5	0.0	-	
10	15.00	-	
15	30.00	+	+:Poor sporulation
20	55.00	++	++:Moderate sporulation
25	70.00	+++	+++: Good sporulation
28	85.00	++++	++++:Abundant sporulation
30	77.00	+++	*Mean of three replication
35	56.00	++	
40	0.00	-	
CD (p=0.05)	2.34		

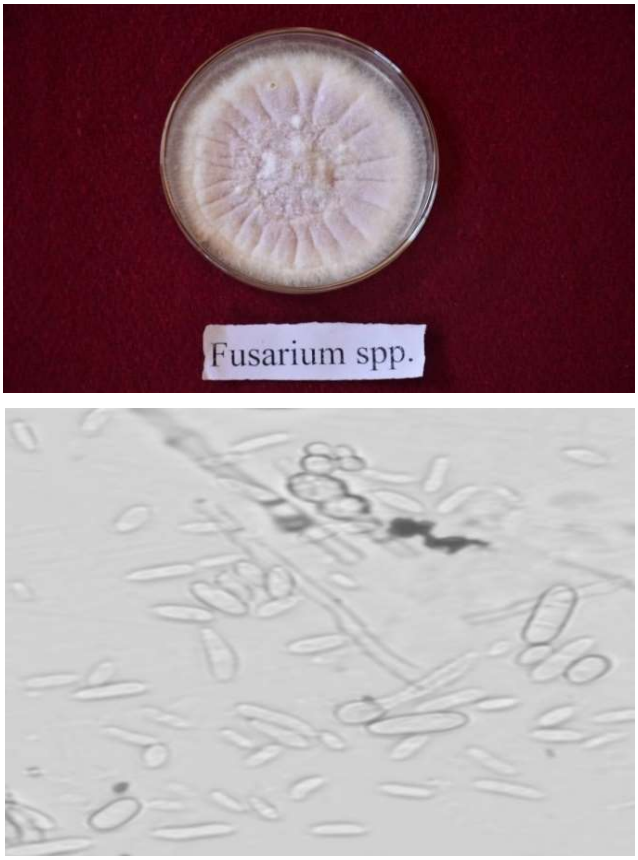

Fig. 1. Pure culture of *Fusarium* wilt fungi on PDA; mycelium and conidia of *F. oxysporum* f. sp. *lycopersici* (×40X)

CONCLUSION

The incidence of fungal wilt was highest in Chikkabalapur (13.30%), followed by Kolar (12.05 %) and Bangalore rural (8.08%). The fungus produced diverse colors and took 8 days for complete growth on potato dextrose agar plates. The fungus produced aseptate, hyaline and oval to round shaped microconidia as well as septate macroconidia. Fungus could grow between 10^{0}C and 35^{0}C and produced maximum mycelial growth at 28^{0}C (85.0 mm) on potato dextrose agar. The cultural and morphological identification showed that the pathogen was *Fusarium oxysporum* f. sp. *lycopersici*.

CONTRIBUTION OF AUTHOR

Sayed Farooq Mahboobi did surveying, isolation and characterization of the fungus. T.H. Shankarappa done conceptualization, analysis and write up, V. Devappa identified the disease and fungus and J.S. Arvinda Kumar reviewed and supervised the work.

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