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Fusarium wilts symptomatology in tomato crop

Sandhya Deepika D*, Gayatri Devi N and Lakshmi Sri M

Department of Botany, Andhra University, Visakhapatnam, Andhra Pradesh, India.

ABSTRACT

Tomato is a valuable food ingredient that nourishes both rural and urban people around the world and is the second most important horticultural crop. Low yields of tomatoes are associated with many factors, including fungi, bacteria, nematodes, and viral invasion, with competing weeds predominant. Among them, *Fusarium oxysporum* lycopersici induced tomato *fusarium wilt* is one of the most important and most prevalent diseases of cultivated tomatoes. It is a soil-borne pathogen of incomplete filamentous fungi that is the only host of pathogens that cause tomato wilt disease. The first symptom of young plants is the dissolution of veins and the sagging of petioles. The first symptom of *Fusarium wilt* disease is yellowing of the old lower leaves. Thus yellowing lower leaves will die. Tomato fields were selected based on external symptoms i.e., leaves drooping, yellowing, stunted in growth, initially yellowing on one side of the plant at on lower leaves and branches, browning and dead of entire plant at advanced stage of infection. List of districts surveyed with mandalas and villages along with GPS were presented In this present article we have given the detail view *Fusarium wilts* symptomatology in tomato crop with the help of images.

Keywords: *Fusarium oxysporum lycopersici*, Symptomatology, Lycopersicon esculentum, Diseased plant.

INTRODUCTION

Tomatoes (*Lycopersicon esculentum*) are annual or short-lived hairy herbs and gray-green wavy, non-uniform feather-like leaves. The flowers are white and bear red or yellow fruits. World tomato production in 2001 was about 105 million tons of fresh fruit from an estimated 3.9 million hectare. It is a self-pollinating plant. The main tomato producing states are Maharashtra, Bihar, Karnataka, Uttar Pradesh, Orissa, Andhra Pradesh, Madhya Pradesh and Assam. Tomatoes can be grown in a variety of soils i.e., from sandy to heavy clay soils. However, well-drained sandy or red loam soils with high organic matter content and a pH range of 6.0-7.0 are ideal for their growth. Tomatoes are a warm seasonal harvest. The best fruit color and quality are achieved in the temperature range of 21°C-24°C. Temperatures above 32°C impair fruit set and growth. Plants cannot tolerate frost and high humidity. Requires low to moderate rainfall. The bright sunlight at the time of fruiting helps to grow dark red fruits. Temperatures below 10°C have a detrimental effect on plant tissue and slow down physiological activity.

Fusarium wilts is the fungal disease caused by *Fusarium oxysporum*. *Fusarium* wilts disease is common around the world, and resistant tomato varieties can also be affected. The fungus grows naturally in the soil and penetrates the plant from the roots. Once penetrated, it blocks xylem, tissue, water, and some nutrients through the plant, preventing water from climbing the stem and entering the branches and leaves. It may not kill your tomato plants, but they won`t be very productive. Species of *Fusarium* can infect many plants including potatoes, peppers, eggplants, legumes, and bananas. Symptoms of Verticillium wilt can be very similar to *Fusarium* wilt. Verticilliam wilt occurs more often in cooler temperatures while *Fusarium* thrives in warmer, dry conditions.

Interactions between plants and pathogens are highly dynamic and complex relationships, including a high degree of specificity. It is this last property that triggers a survival response that is

very important to either one. Tomato (*Solanum lycopersicum* L.) and *Fusarium oxysporum* f. Sp. *Lycopersici* (Fol) is the cause of the importance of vegetables around the world and the wilting of blood vessels in tomatoes, several times due to the economic and ecological effects of the fungus, which causes up to 100% loss, has been studied. In this present article we have given the detail view *Fusarium* wilts symptomatology in tomato crop with the help of images.

METHODOLOGY

Field study

A total of 27 fields from three districts were surveyed during kharif and Rabi 2017-2018, and recorded with wide spread occurrence of *fusarium* wilt disease of tomato. List of districts surveyed with mandals and villages along with GPS were presented (Table 1). Tomato fields of East Godavari district were selected based on external symptoms i.e., leaves drooping, yellowing, stunted in growth, initially yellowing on one side of the plant at on lower leaves and branches, browning and dead of entire plant at advanced stage of infection. On proper identification of infected plants, plants were uprooted and checked for vascular discolouration by split opening the stem, chief characteristic symptom of *fusarium* wilt of tomato.

Table 1. List of villages surveyed.

S.No.	District	Mandals	Villages	GPS
1.	East Godavari (NTZ)	Amalapuram	Amalapuram	16.5775° N, 82.0031° E
			Nadipudi	16.6488° N, 81.8340° E
			Palagummi	16.4744° N, 81.8798° E
		Kothapalle	Kothapalle	15.0176° N, 78.6136° E
			Subbampeta	17.0591° N, 82.3153° E
			Ponnada	17.1196° N, 82.3642° E
		Ramachandra puram	Ramachandra puram	16.8372° N, 82.0325° E
			Kandulapalem	16.8180° N, 82.0850° E
			Venkatayapalem	17.5641° N, 81.2574° E
2.	West Godavari (CTZ)	Yelamanchili	Yelamanchili	17.5472° N, 82.8573° E
			Abbirajupalem	16.5021° N, 81.8416° E
			Medapadu	17.0054° N, 82.0993° E
		Kovvur	Kovvur	17.0126° N, 81.7274° E
			Chidipi	17.0912° N, 81.6816° E
			Seethampeta	17.1202° N, 81.3434° E
		Achanta	Achanta	16.6020° N, 81.8077° E
			Penu Lingagudemi	16.5847° N, 81.8211° E
			Bimalapuram	16.5558° N, 81.8491° E
3.	Krishna (STZ)	Agiripalli	Agiripalli	16.6800° N, 80.7852° E
			Adavinekkalam	16.6312° N, 80.7235° E
			Edara	16.7274° N, 80.7526° E
		Ibrahimpatnam	Ibrahimpatnam	16.5928° N, 80.5228° E
			Elaprolu	16.6019° N, 80.5584° E
			Jupudi	16.6042° N, 80.4980° E
		Penuganchiprolu	Penuganchiprolu	16.9017° N, 80.2475° E
			Anigandlapadu	16.8938° N, 80.2875° E
			Lingagudem	16.9010° N, 80.2175° E

RESULTS AND DISCUSSION

Plants are exposed to different phytopathogenic agents and insects that could affect their normal development, to respond the attacks they have implemented local and systemic defense mechanisms such as structural barriers that could block the infection and colonization processes (Yadeta and Thomma, 2013). The genus *Fusarium* is composed of about 300 species (Rampersad, 2020), and Fol is one of the more than 200 disease-causing pathogens that affect tomatoes (Djidonou et al. 2016), either alone or in natural habitat. Along with other pathogens that are soil (including Singh, 2017). The origin of *Fusarium* dates back about 91.3 million years. This is consistent with the emergence of woody and flowering plants and was obtained from indigenous soils in different parts of the world (Koyyappurath et al., 2015). Fungal species occur in the tropics, temperate, desert, alpine and arctic circles, and bad weather is widespread (Okungbowa and Shittu, 2014).

Fusarium wilt diseased symptoms on tomato observed during survey are drooping of leaves, stunted in growth, loss of leaf turgidity, yellowing of lower leaves (Figure 1), interveinal clearing, initial yellowing of leaves and stem on one side of the plant (Figure 1), chlorosis, necrotic browning and dead of whole plant on advanced stage of infection. *Fusarium* wilt of tomato incidence often occurs on mature plants on initiation of flowering and during fruit set stage. Vascular discoloration with brown in colour was observed when epidermis and cortical tissue of the main stem is cut and opened (Figure 1).

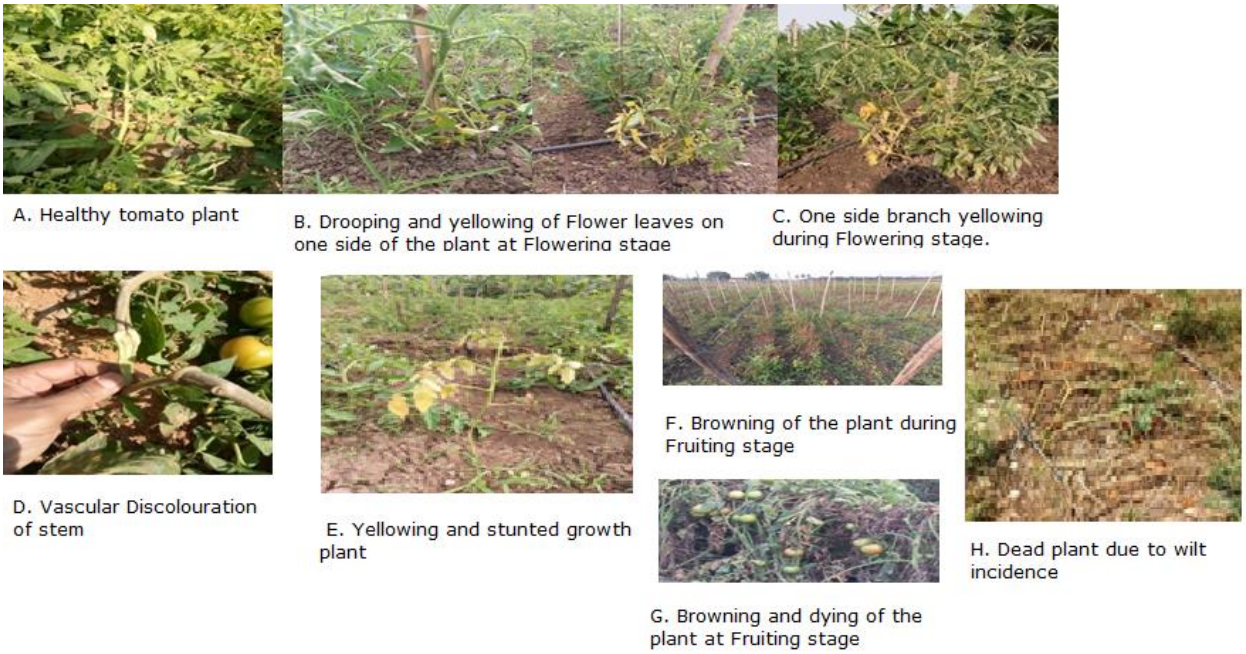

Figure 1. *Fusarium* wilt diseased symptoms on tomato crop.

Initially *fusarium* wilt diseased symptoms on tomato plants were observed during flowering stage coinciding with initiation of lateral roots having minimum of 8-12 branches. Partial or total absent of fruits were noticed on diseased plants. *Fusarium* wilt disease incidence was mostly visible at flowering and fruit set stage initially in patches extending to the entire field with increase on age of the plant and accompanying with favourable environmental conditions.

Favorable conditions for disease development

The pathogen is soil borne and persists for many years in the soil without a host. Most infections originate from the fungus associated with infected tomato debris. Root-knot nematode infection makes *Fusarium* wilt-resistant varieties more susceptible to the fungus because of physiological changes in the root. Disease development is favoured by warm temperatures (for example, 27°C-28°C), dry weather, and acidic soil (pH 5-5.6). Rapidly growing, highly succulent tomato plants exposed to fertilization with ammonium nitrate are especially susceptible to the disease. The fungus can be disseminated by infected seed or by transplants grown in infested soil. The fungus can be introduced into a field on contaminated equipment, training stakes, packing crates or shoes. Soil particles from infested fields may be blown into disease-free fields.

Decal *et al*. (2000) observed and reported similar characteristic symptoms of *fusarium* wilt of tomato such as browning of vascular system due to blocking of xylem vascular bundles, impending water movement with half of the leaf or branch getting affected with the other half seemingly unaffected.

Ramamoorthy and Samiyappan (2001) and Smith *et al.* (1998) reported similarly that browning of the vascular tissue is the chief characteristic symptom of *fusarium* wilt of tomato and symptoms become more apparent during between flowering and fruit set stage.

Snyder and Hans (2003), Sally *et al*. (2006) and Ignjatov *et al*. (2012), observed similar characteristic symptoms of *fusarium* wilt such as drooping of leaves, yellowing, yellowing initially on one side of the plant, stunted in growth "netted" appearance due to clearing of the vein lets, vein clearing on the outer portion of the young leaves followed by epinasty of the older leaves, vascular discolouration, more pronouncedly during flowering and fruit set stage during warm climatic conditions.

The life cycle in *Fusarium* species can be divided into three stages: latent, which includes the inhibition and subsequent germination of resistance structures; parasitic, by which the pathogen penetrates, colonizes, moves through the xylem, induces the appearance of symptoms and causes the death of the host, and the

saprophytic stage characterized by the formation of new resting structures on the residues of the dead host (Okungbowa & Shittu, 2014).

CONCLUSION

Based on the symptoms, we conclude that the causal agent of *fusarium* wilt is *Fusarium oxysporum* f. sp*. lycopersici*. It is a soil borne fungus that is found throughout the India, especially in warm regions of the country. The disease is associated with plant debris for up to ten years. Disease development is favored by warm soil temperatures, and symptoms are most prevalent when temperatures range 80-90 degrees F. The fungi enter the plants through their roots and are then spread throughout the plant by the plant's water-conducting vessels. Now a day's fungal proteomics become an appropriate tool for obtaining molecular map about pathogenicity and factors involved in virulence, thus opening up new insights for plant pathogen detection and protection.

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