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Assessment for Chickpea *Fusarium* Wilt in Telangana

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ABSTRACT

Background: Wilt disease caused by *Fusarium oxysporum* f.sp. *ciceris* in chickpea remains a persistent threat, leading to substantial losses in both quantity and quality. A roving survey was undertaken during *rabi* 2022-23 and 2023-24 to assemble information on chickpea wilt affected areas of Telangana state, India.

Methods: Wilt incidence of chickpea was calculated in each field by using the quadrant mode. The coordinates of surveyed fields were additionally recorded with the help of GPS and disease incidence was calculated.

Result: 14 villages in 7 districts namely Gadwal, Naryanpet, Mancherial, Nizamabad, Nirmal, Siddipet and Ranga Reddy districts were surveyed. Maximum (41.92% and 44.24%) wilt incidence was recorded in Basar village of Nirmal district, followed (31.92% and 35.31%) by Mudhole of Nirmal. Wilt incidence was minimum (16.47% and 20.21%) at Hindupur of Naryanpet. Overall incidence level of wilt in seven districts indicated that Nirmal had maximum level of disease incidence ranging from 19-44% followed by Gadwal (19-44%), Nizamabad (19-35%), Ranga Reddy (19-35%), Siddipet (16-25%), Mancherial (16-25%) respectively. These findings highlight the widespread presence of *Fusarium* wilt in chickpea crop growing regions of Telangana. Consequently, it is essential to explore effective management strategies to address this issue, as chickpea is a remunerative pulse crop suitable for cultivation in black soils during early *rabi*.

Key words: Chickpea, Disease incidence, *Fusarium* wilt, Roving survey.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a major crop of semi-arid regions (Imtiaz *et al*., 2011) of the world. It is cultivated for its protein-rich (19% to 25%) seeds. Moreover, pods are lush in fiber, minerals, β-carotene and unsaturated fatty acids (Jukanti *et al*., 2012). It is a cool season legume crop ranking second in global production among food legumes with a global production of 15.87 mt from an area of 15.0 m ha. South Asia is the largest producer and consumer of chickpea that contributes about 90% of area globally. Production share of chickpea by Asian region includes 84.9% followed by Americas and Africa, each with 4.6%. Mediterranean region, India, Turkey, Pakistan, Australia and Myanmar are the key producers (FAOSTAT, 2021). The states of Maharashtra, Madhya Pradesh, Rajasthan, Karnataka, Uttar Pradesh and Gujarat produce the most of the chickpea in India. In India, about 104.74 lakh ha, area coverage has been reported under chickpea cultivation during *rabi* 2023-24 with a production of 122.67 lakhs tons (Anonymous, 2024). Key districts in Telangana that grow chickpea include Adilabad (29,076 ha), Kama Reddy (64,552 ha), Nirmal (23,836 ha), Nizamabad (7,689 ha), Sangareddy (6,492 ha) and Vikarabad (2,803 ha). The crop is being grown in an area of 1.48 lakh ha during *rabi* season with a production of 2.32 lakh tons and with a productivity of 1568 kg ha^{-1} (Anonymous, 2024). Both biotic (Ghosh *et al*., 2016, 2017) and abiotic (Palit *et al*., 2020) stresses were recognized as key barriers to chickpea production resulting in decreased yields. Among the biotic factors, *Fusarium* wilt has historically been the most common disease which can cause considerable problem. *Fusarium* is a highly complex and adaptive genus of *Eumycota*, in particular and has both pathogenic and non-pathogenic strains that can harm plants, animals and humans (Bodah, 2017). Besides causing large pre- and post-harvest losses, several *Fusarium* species create toxins to foods as well as crops (Nayaka *et al*., 2008; 2009; Mudili *et al*., 2014). These are contaminants found in cereal-based diets and other grains and they are known to cause a variety of ailments in organisms (Venkataramana *et al*., 2014; Divakara *et al*., 2014; Kalagatur *et al*., 2015; Kumar *et al*., 2016). Nevertheless, the prevalence and spread of pathogen have shifted significantly over the last decade, as has the emergence of novel and previously identified pathogens

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(Sharma and Ghosh, 2017; Chobe *et al.*, 2020). Infected chickpea plants show a variety of symptoms, including reduced development at the seedling stage, followed by tips, fall off of twigs and leaves of mature plants. Even when there is no obvious degradation, these plants exhibit dark brown staining in the xylem (Pande and Sharma, 2012). Highly vulnerable varieties frequently develop symptoms within 25 days after planting. Initial wilting causes huge losses than late, with wilted plant pods being lighter than healthy ones. Yield losses of 10% to 100% have been observed, on agroclimatic conditions and varietal susceptibility (Warda *et al.*, 2017). During *rabi* (November-March, 2022-23), an investigation was undertaken to identify, purify and analyse the pathogenicity of *Fusarium* (Srinivas *et al.*, 2024). The prevalence of the disease across all surveyed districts, with varying degrees of severity. Surveys was undertaken over several decades suggest that the disease is common in major regions such as Asia, Africa, Americas. These surveys recorded varied disease prevalence and severity, which frequently resulted in large yield losses (Pande *et al.*, 2010). The overall sag episode was higher in *rabi* season of 2018-2019 compared to the following season, *rabi* 2019-2020. Across all six districts surveyed, the disease exhibited a widespread and consistent presence with a moderate to severe incidence (Shrivastava and Dhakad, 2021). Mahajan *et al.* (2023) performed monthly surveys throughout several chickpea-growing locations in the Jammu subtropics. The total disease incidence was 15.64% in 2016-17 and 16.86% in 2017-18. Numerous studies showed that plants react differently to combination stressors than to individual stressors, activating unique gene expressions according to the environmental conditions faced. Abiotic stress often alters plant vulnerability to biotic pests or diseases rather than adding to the problems (Sharma and Ghosh, 2017; Tarafdar *et al.*, 2018). The research work was done to better understand disease development pathways, to mitigate yield losses and ensure food availability for vulnerable populations.

MATERIALS AND METHODS

Areas surveyed

A roving survey was enacted in Telangana chickpea cultivating regions, comprising Gadwal, Naryanpet, Mancherial, Nizamabad, Nirmal, Siddipet and Ranga Reddy districts, during the *rabi* seasons 2022-23 and 2023-24 (Fig 1,2,3). Diseased and healthy samples were obtained from diverse fields in these areas and placed in brown paper bags as part of the investigation. These samples were subsequently taken to the Plant Pathology Laboratory and Central Instrumentation Cell at the College of Agriculture, Professor Jayashankar Telangana State Agricultural University in Rajendranagar, Hyderabad, Telangana, for further examination.

Data collection

To evaluate disease incidence, different agronomic practices used by farmers across various chickpea ecosystems were documented using a survey sheet created using Global Positioning System (GPS) technology to collect information on soil type, irrigation, previous crop, crop stage, variety grown, region surveyed and phase of crop (Ghosh *et al.*, 2013).

Data analysis

At each location, wilt incidence of chickpea was calculated every arena by using the quadrant mode. The coordinates of surveyed fields will be additionally recorded with the help of GPS (Harshita *et al.*, 2021) and disease incidence was calculated by the formula:

$$PDI = \frac{\text{Number of diseased plant in quadrant}}{\text{Total number of plant in quadrant}} \times 100$$

RESULTS AND DISCUSSION

A roving survey was reckoned during *rabi* 2022-23 and 2023-24 in different chickpea growing regions of Telangana to assess incidence of wilt disease. Entire 14 villages out of 7 districts were surveyed for wilt, in which local varieties like Annigeri was recurrently grown by the growers and JG-11 an improved variety found in very less areas. The disease incidence was minor on amended variety (<15%) as competed to resident diversities (>25%). The frequency of disease incidence was moderate to severe on local varieties than an improved one (Table 1). To obtain data



Fig 1: Survey for the occurrence of chickpea wilt in Telangana.

about disease occurrence, soil type, crop stage, previous crop data, irrigation and cultivar grown by the farmers, an investigation was carried out using a global positioning system (GPS). Most of the surveyed farmers grew local or improved variety. The disease incidence was nearly even though of cultivars and soil forms. Most of the villages from Nirmal district showed maximum incidence which comes under susceptible category (40.1-100%). The maximum of 41.92 and 44.24 per cent disease incidence was recorded in Basar of Nirmal, tailed Mudhole of Nirmal *i.e.,* 31.92 and

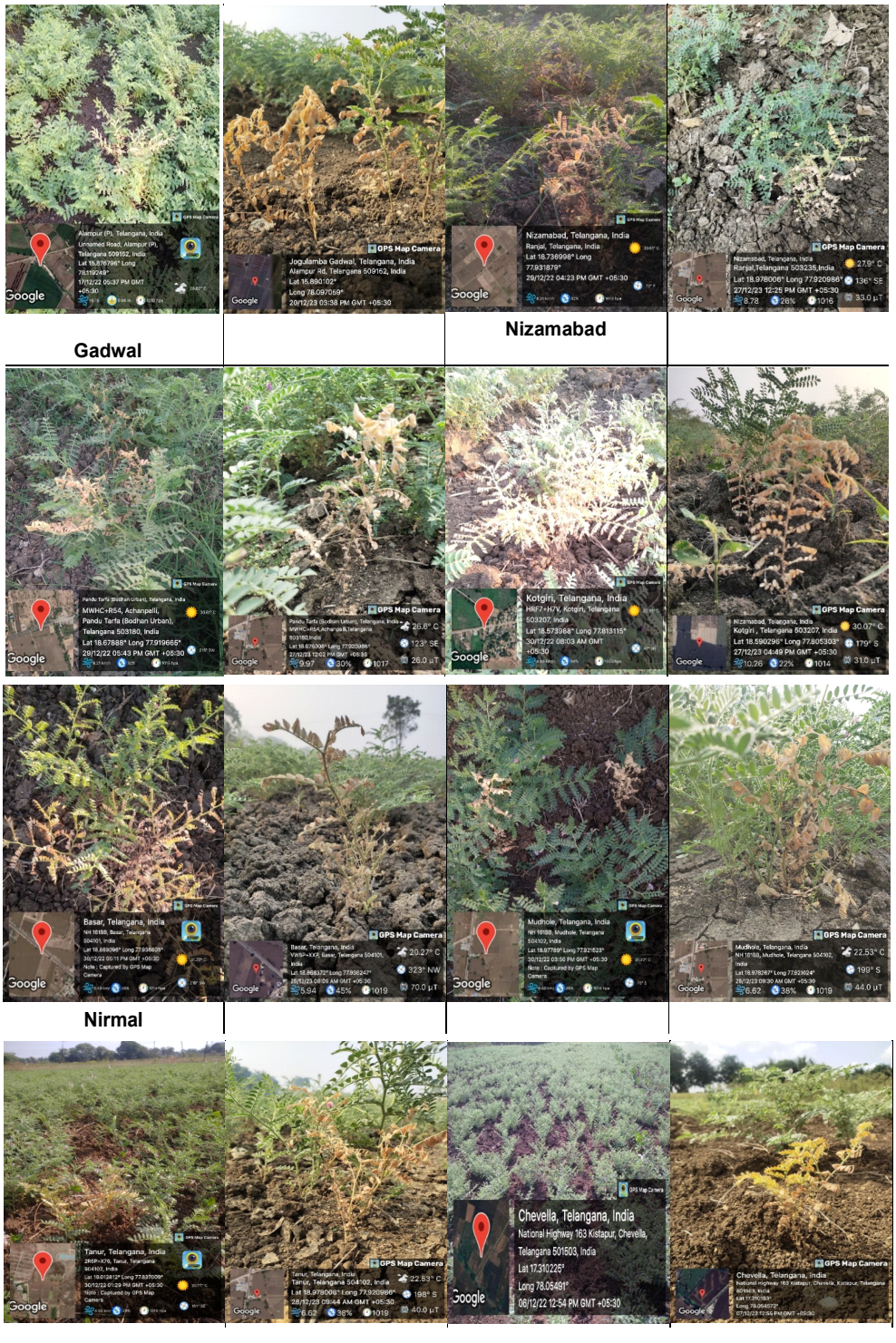


Fig 2: Continue...



Fig 2: Chickpea wilt symptoms observed during roving survey conducted in *rabi* 2022-23 and 2023-24.

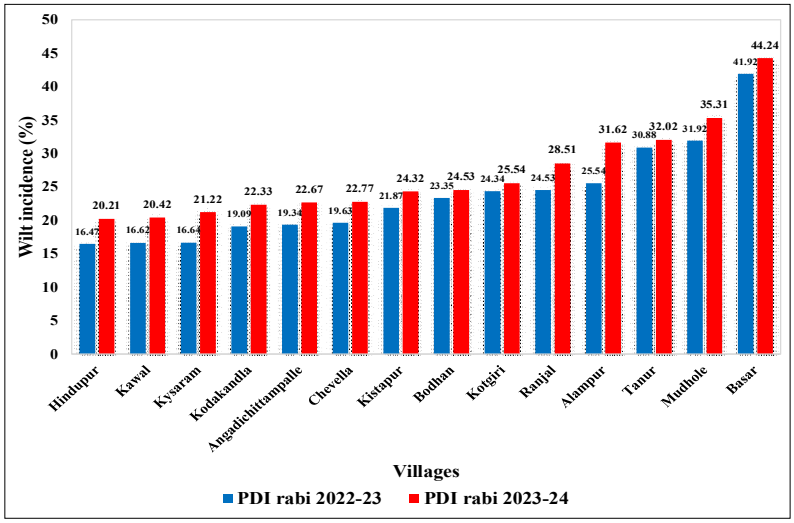


Fig 3: Results of survey on occurrence of chickpea wilt incidence in seven districts of Telangana during *rabi* 2022-23 and 2023-24.

Table 1: Survey on occurrence of chickpea wilt in seven districts of Telangana during *rabi* 2022-23 and 2023-24.

Location			GPS coordinates		Soil type	Irrigation	Previous crop		Crop stage	Varietal information		Per cent disease incidence (PDI)		Mean disease incidence (%)	
District	Mandal	Village	Latitude	Longitude			*Rabi* 2022-23	*Rabi* 2023-24		*Rabi* 2022-23	*Rabi* 2023-24	*Rabi* 2022-23	*Rabi* 2023-24	*Rabi* 2022-23	*Rabi* 2023-24
Gadwal	Alampur	Alampur	15.8761°	78.1147°	Black soil	Rainfed	Maize	Cotton	Vegetative stage	Annigeri	Annigeri	25.54	31.62	19-44	19-44
Naryanpet	Krishna	Hindupur	16.4382°	77.3431°	Black soil	Rainfed	Cotton	Maize	Flowering stage	JG-11	JG-11	16.47	20.21	16-25	16-25
Mancherial	Jannaram	Kawal	19.1189°	78.9990°	Black soil	Rainfed	Maize	Cotton	Flowering stage	JG-11	JG-11	16.62	20.42	16-25	16-25
Nizamabad	Ranjal	Ranjal	18.7364°	77.9310°	Black soil	Rainfed	Paddy	Jowar	Pod formation stage	Annigeri	Annigeri	24.53	28.51	19-35	19-35
	Bodhan	Bodhan	18.6785°	77.9199°	Black soil	Rainfed	Jowar	Paddy	Pod formation stage	Annigeri	Annigeri	23.35	24.53		
	Kotgiri	Kotgiri	18.5739°	77.8131°	Black soil	Rainfed	Paddy	Jowar	Pod formation stage	Annigeri	Annigeri	24.34	25.54		
Nirmal	Basar	Basar	18.8804°	77.9538°	Black soil	Rainfed	Paddy	Jowar	Vegetative stage	Annigeri	Annigeri	41.92	44.24	19-44	19-44
	Mudhole	Mudhole	18.8801°	77.9538°	Black soil	Rainfed	Jowar	Paddy	Vegetative stage	Annigeri	Annigeri	31.92	35.31		
	Tanur	Tanur	19.0125°	77.8256°	Black soil	Rainfed	Paddy	Jowar	Vegetative stage	Annigeri	Annigeri	30.88	32.02		
Ranga Reddy	Chevella	Chevella	17.3102°	78.0549°	Black soil	Rainfed	Maize	Cotton	Pod formation stage	Annigeri	Annigeri	19.63	22.77	19-35	19-35
		Angadichittampalle	17.3074°	78.0443°	Black soil	Rainfed	Cotton	Maize	Pod formation stage	Annigeri	Annigeri	19.34	22.67		
		Kistapur	17.3096°	78.0538°	Black soil	Rainfed	Maize	Cotton	Pod formation stage	Annigeri	Annigeri	21.87	24.32		
Siddipet	Gajwel	Kysaram	17.8443°	78.7143°	Black soil	Rainfed	Jowar	Paddy	Flowering stage	JG-11	JG-11	16.64	21.22	16-25	16-25
		Kodakandla	17.8623°	78.7459°	Black soil	Rainfed	Paddy	Jowar	Flowering stage	JG-11	JG-11	19.09	22.33		

Resistant (≤10%), Moderately resistant (10.1%-20.0%), Moderately susceptible (20.1%-40.0%) and Susceptible (40.1%-100%).

35.31 per cent. The minimum 16.47 and 20.21 per cent disease incidence was recorded at Hindupur of Naryanpet. Overall disease incidence in seven districts indicated, that Nirmal had utmost of disease incidence ranging from 19-44% followed by Gadwal (19-44%), Nizamabad (19-35%), Ranga Reddy (19-35%), Siddipet (16-25%), Mancherial (16-25%) respectively (Fig 1,3).

During roving survey, the variation in the wilt incidence within the hamlets of various regions of Telangana were observed which was due to different environmental conditions. The frequency of wilt was greater in humid conditions because of the unfavourable environmental circumstances such as prevalence of humidity and extreme heat during produce phase, which favored disease development under dry conditions. The black cotton soil has more flora, causes the deposition of high organic nutrients, resulting in abundance of carbon source in black soil which lead to increase in fungal inoculum, resulting in higher incidence. In most regions, grown a single crop but in certain regions, growers cultivated double crop including maize and cotton in Gadwal, Mancherial, Naryanpet and Ranga Reddy districts; paddy and jowar in Nirmal, Nizamabad and Siddipet.

Similar findings were also reported by Dubey *et al.* (2010) conducted a survey in various Indian states and discovered that the manifestation of pathogen ranged from 14.1 to 32.0 per cent, which was widespread. According to Ghosh *et al.* (2013) manifestation of pathogen in Central and Southern India was 9.7 to 13.8 per cent. The present observations were also supported by Biswas and Ali (2017) who observed *Fusarium* wilt of chickpea tendencies in West Bengal's lateritic belt, the larger array of soil and atmospheric heat are the causes for faster multiplication and pathogen growth in the soil (Table 1). Chickpea plants with *Fusarium* wilt symptoms were gathered from a variety of Indian states. During the *rabi* season of 2012 and 2013, two samples were collected from Andhra Pradesh and Karnataka and one from each of Delhi, Gujarat, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Uttar Pradesh and West Bengal Chaithra *et al.* (2019). Systematic field surveys were performed on chickpea growing seasons between 2015 and 2016 in the main chickpea growing areas in Turkey to evaluate factors such as disease severity, location, field size, weed density, growth stage, nodule count, plant height, as well as latitude, longitude and altitude using a Global Positioning System (Kocalar *et al.,* 2020). Wilt-infected plants of chickpea were collected from different places in Andhra Pradesh and parts of Telangana state during 2014-15 and 2015-16 Venkataramanamma *et al.* (2023). This survey exhibited that *Fusarium* wilt affecting 16-44% of the crop at different growth stages, with the highest severity occurring during the vegetative stage. The findings provide a clear picture of disease, crucial for understanding the illness dynamics, developing effective management methods.

CONCLUSION

The present study demonstrates that, *Fusarium* wilt incidence ranging from 19-44% at the vegetative stage, 16-25% at the flowering stage and 19-35% during the pod formation stage in Telangana. Further research is necessary to explore the underlying causes of the widespread occurrence of these diseases.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All the procedures for experiments were approved by Department of Plant Pathology and Central Instrumentation Cell, Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana (No animals involved in these investigation).

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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