Original Research Article

Scenario of wilt incidence of chickpea in major chickpea growing regions of northern Karnataka

Abstract

The chickpea (*Cicer arietinum* L.) is one of the most important pulse crops grown in India. Chickpea wilt complex is one of the most devastating crop diseases in northern Karnataka. Because of abundant inoculum in the soil and suitable ~~the~~ environment circumstances, infected plants die, resulting in full ~~yield~~ loss of yield. A random roaming study was done in important chickpea farming districts of northern Karnataka, namely Dharwad, Belagavi, Haveri, Gadag, Bagalkot, Kalaburgi, and Vijayapur, during Rabi 2021-22 and 2022-22, to establish disease incidence and its severity in different~~verse~~ places. The survey results demonstrated a link between three pathogens: *Fusarium oxysporum* f. sp. *ciceri*, *Rhizoctonia bataticola*, and *Sclerotia rolfsii*. Dharwad district has the highest illness incidence (30.20%), followed by Kalburgi district.with 29.85 per cent.

Key words: Chickpea, wilt complex, *Fusarium oxysporum* f. sp. *ciceri*, *Rhizoctonia bataticola* and *Sclerotia rolfsii*

Introduction

Chickpea (*Cicer arietinum* L.) is an important pulse crop grown in tropical, subtropical and temperate regions of the world. It is the world's third most important grain legume after common bean and pea (Anwar *et al.*, 2009). Seventy per cent of total global production of chickpea is contributed by India as it ranks first in area and production. Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Uttarkhand and Karnataka are the major chickpea growing states of India covering 89 per cent of total area and chickpea production of the country. Madhya Pradesh is the leading state in terms of area and production as it contributes around 35-40 per cent share to the total area and production of gram in the country (Anon., 2020). Chickpea is grown as a post monsoon (*rabi*) crop and it occupies very important position in semi-arid farming system both for human nutrition and restoring the soil fertility (Singh and Sirohi, 2003).

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Comment [h1]: Is it a technical term? Please check.

Comment [h2]: For this section, please follow the following instructions:
- It's better to make paragraphs for different information(s) author(s) intend to include herein; like L.No. 25-35 reveal the production scenario in pan India, L. No. 36-38 about the importance(s) of chickpea, L. No. 39-53 showcase the information(s) related to biotic stress in the target crop….
- A balance b/w the length of the content of each paragraph should be maintained; here the 2nd paragraph (L.No. 36-38) is too short; it is suggested to include more information(s) here;
-Inclusion of recent references (i.e within 5 years) are encouraged; throughout the text it should be followed;
-Albeit the author(s) here have only focused about the wilt incidence in Northern part of Karnataka but a holistic view, may be in a comparative manner (either graphical or literature-based), concerning the wilt incidence in other parts of India alongwith Karnataka should be given under this section which may highlight a clear picture about the current scenario of occurrence of concerned disease in pan India;
-Objective(s) of the present study is unclear;
-Overall improvement of 'Introduction' section is needed.

It is a protein-rich supplement to all cereal based diets, especially for vegetarians. Its protein is rich in lysine and has low sulphur containing amino acids and hence, it is widely appreciated as health food.

Among various factors attributing to low productivity of chickpea, biotic and abiotic factors are very important. The estimated yield loss due to insects and diseases ranges from 5 to 10% in temperate and 50 to 100% in tropical regions (Van Emden *et al*., 1988). More than 172 pathogens have been reported to infect chickpea crop but only few are economically important diseases. Wilt and root rot complex caused by soil borne pathogens is the major yield reducing element. Among them, Fusarium wilt (*Fusarium oxysporum* f. sp. *ciceri* (Pad Wick)) Snyd. & Hans, black root rot (*Fusarium solani* (Mart.) Sacc.), dry root rot (*Rhizoctonia bataticola*) and root rot (*Sclerotia rolfsii*) are of considerable importance (Nene *et al*., 1981). Losses of chickpea from Fusarium wilt have been stated to vary from 10 to 15 per cent (Jalali and Chand., 1991; Trapero-Casas and Jimenez-Diaz., 1985) but losses of up to 70 per cent have been indicated in some years in northern India and Pakistan (Grewal and Pal., 1970).

In the present study, a random roamving survey was carried out in important chickpea growing districts of northern Karnataka, viz., Bagalkot, Belagavi, Dharwad, Gadag, Haveri, Vijayapura and Kalburgi in *rabi* 2021-22 and 2022-23 to know the disease prevalence and its severity in various locations.

Materials and Methods

An intensive roamving survey was conducted in major chickpea growing districts *viz*., Dharwad, Belagavi, Haveri, Gadag, Bagalkot, Kalaburgi and Vijayapur districts of Nnorthern Karnataka, during Rabi 2021-22 and 2022-22. The details of locations and number of villages visited are tabulated hereunder. The disease incidence in the fields was assessed with the following formula.

$$\text{Per cent Disease Incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

Roots and stem of infected samples were collected from surveyed field. These samples were brought to laboratory for isolation of pathogens.

Results and Discussion

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Comment [h4]: Objectives??

Comment [h5]: Pathogen isolation method(s) should be elaborated!!

Comment [h6]: Discussion part is not satisfactorily written.

To know the prevalence of chickpea wilt complex disease, a survey was conducted during rabi season of 2021-22 and 2022-23 in major chickpea growing areas of Nnorthern Karnataka. The survey revealed that, the wilt incidence was noticed in all the locations surveyed with a range from 6.80 to 54.85 % during 2021-22 and it was 5.28- 55.23 per cent during 2022-23 (Table.1). Among the districts surveyed, the mean maximum incidence (31.69 %) was noticed in Kalburgi district during 2021-22 and minimum disease incidence was observed in Vijayapur district with 20.45 %.

During 2022-23 the mean maximum disease incidence (32.90 %) was noticed in Dharwad district and minimum disease incidence was observed in Haveri district with 19.23 % (Table. 2). During 2021-22 highest incidence was observed in Marewad (54.85 %) village of Dharwad district. During 2022-23 highest incidence (55.23 %) was observed in Narendra of Dharwad district (Fig.1). Hence, these places can be considered as 'hot spots' of chickpea wilt complex disease. Disease incidence varied by location due to cropping patterns, climatic factors, and inoculum buildup. The increased disease incidence might be related to the soil type, environmental conditions, and monocropping strategy, which worsened the disease situation.

Diseased samples were collected from the surveyed areas in both the seasons and subjected to the isolation to observe the major pathogens associated with disease and the results revealed that in both the seasons *Fusarium oxysporum* f.sp. *ciceri* + *Rhizoctonia bataticola* (37.31 %) (Fig.2)was majorly present in all places followed by *Rhizoctonia bataticola* (25.38 %) and *Fusarium oxysporum* f.sp. *ciceri* (24.63 %) and prevalence of *Sclerotium rolfsii* was minimum (2.24%).

The disease severity was very high in areas coming under the black cotton soil and the farmers are growing the chickpea extensively in these areas year after year. This monocropping has led to the buildup of inoculum of the pathogen in the soil over the seasons especially the population of *Fusarium* spp. when there is an optimum soil temperature and moisture and caused more damage to the crop. These observations are in agreement with the earlier descriptions given by Booth (1971). The areas where the disease incidence was higher, we have noticed the association of both *Fusarium* and *Rhizoctonia*. Losses of chickpea from Fusarium wilt have been reported to vary from 10 to15% (Jalali and Chand, 1991; Trapero-Casas and Jimenez-Diaz, 1985).

Comment [h7]: Information(s) are not identical with the information(s) given at Abstract section (L.No. 18-19). Please check!

Comment [h8]: This data had also been taken in 2021-22? Or in subsequent year? Please specify.

Comment [h9]: Appropriate pictures of original experimental procedures should be included.

Comment [h10]: Remove old references & add current references!

Additionally, from the study of disease incidence in different areas it was found that, the disease incidence was most prevalent during the reproductive phase of the crop. Wilt was more prevalent during the reproductive phase of the plant as nutrients flowed to the reproductive area of the crop and due to an imbalance in nutrient availability in the stem and root region (Ravichandran *et al.*, 2015). Disease incidence varies by location due to differences in agroclimatic conditions, cropping pattern, crop stage, and cultural practises used (Nandeesha and Shalini, 2021).

Comment [h11]: Not in concurrence with the data represented in Table 1. It is evident from the data that at 'Pod Filing' stage also the wilt incidence may be more….. Furthermore, this sort of comparative statement could be made only when the data of all considered growth stages of chickpea for all considered regions are given; failing of which can't justify of giving such statement!

Comment [h12]: 'Conclusion', 'Acknowledgement' and 'Funding support' parts are missing.

References

Annual Report. 2020. Directorates of Pulses Development, Bhopal. Government of India.

Anwar F, Sharmila P, Saradhi PP. No more hurdle: In vitro chickpea rooting and cent per cent transplantation. Australian Journal of Basic Applied Science 2009; 3:2491-2496.

Booth C. The genus *Fusarium*. Common wealth Mycological Institute, Kew Surrey, England, 1971. pp. 132.

Grewal JS, Pal M. Fungal diseases of gram and arhar. In Proceedings of 4th Workshop of Pulse Crops 1970 (pp. 169-170).

Jalali BL and Chand H. Chickpea wilt. In: Mukhopadhya AN, Chaube HS, Singh US and Kumar J. (Eds.) Diseases of International Importance. 1991; (1): 7-10.

Nandeesha KL and Huilgol SN. Survey for the Incidence of Fusarium Wilt of Chickpea in Major Chickpea Growing Districts of Northern Karnataka, India. International Journal of Current Microbiology and Applied Science. 2021; 10(01): 439-443.

Nene YL, Haware MP and Reddy MV. Chickpea diseases: Resistance-screening techniques. Information Bulletin No.10, Patancheru, A.P., India; International Crops Research Institutes for Semi-Arid Tropics, 1981.

Ravichandran S, Hedge YR. Evaluation of fungicides against Fusarium oxysporum ciceri causing chickpea wilt. Chemical Science Review and Letters. 2015; 4:1042-1046.

Singh A, Sirohi A. Status of chickpea diseases in Himachal Pradesh, India. International Chickpea and Pigeonpea Newsletter. 2003;10:29-31.

Trapero-Casas A and Jiménez-Díaz RM. Fungal wilt and root rot diseases of chickpea in southern Spain. Phytopathology. 1985; 75: 1146–1151.

Van Emden HF, Ball SL, Rao MR. Pest, disease and weed problems in pea, lentil, faba bean and chickpea. World crops: Cool season food legumes: A global perspective of the problems and prospects for crop improvement in pea, lentil, faba bean and chickpea. 1988; 519-534.

Table.1 Incidence of wilt complex of chickpea in northern districts of Karnataka during *rabi* 2021-22 and 2022-23

Comment [h13]: The data is not uniform; different stages of growth had been considered to register data!!! Why?

District	Taluk	Village (2021-22)	Stage of crop	Disease incidence %(2021-22)	Village (2022-23)	Stage of crop 2022	Disease incidence % (2022-23)
Bagalkot	Badami	Hoolgeri	Vegetative	20.69	Yankanchi	Flowering	9.28
		Kerur	Vegetative	30.41	Allur	vegetative	16.50
		Adagal	Flowering	20.72	Halkurki	vegetative	48.25
		Allur	Flowering	48.36	Kerur	vegetative	26.36
	Bagalkot	Bhagavathi	Pod filling	30.36	Bhagavathi	Pod filling	35.26
		Hallur	Vegetative	18.71	Hallur	Flowering	15.55
		Bilkerur	Vegetative	30.39	Bilkerur	Flowering	36.12
		Timmapur	Vegetative	17.31	Timmapur	Flowering	19.23
	Jamkhandi	Mygur	Vegetative	6.18	Mygur	Pod filling	22.35
		Aalabal	Flowering	25.27	Aalabal	Pod filling	30.36
		Naganur	Flowering	16.75	Naganur	Flowering	30.39
Belagavi	Bailhongal	Nesargi	Flowering	18.63	Nesargi	Flowering	20.26
		Hogarthi	Flowering	17.25	Kenganur	Flowering	55.73
		Belawadi	Pod filling	27.21	Belawadi	Pod filling	36.85
		Hire bagewadi	Flowering	36.12	Lingadahalli	Pod filling	35.20
	Saundatti	Saundatti	Flowering	35.26	Inamhongala	Flowering	13.60
		Aralakati	Pod filling	29.21	Herenandi	Flowering	28.47
		Rainapur	Vegetative	14.20	Hirehulageri	Pod filling	37.33
	Belagavi	Belagavi	Pod Filling	28.36	Belagavi	Floweing	20.36
		Mutnal	Pod Filling	18.36	Mutnal	Pod filling	25.85
Dharwad	Dharwad	Navluru	Vegetative	30.25	Navluru	Flowering	42.34

		Narendra	Flowering	50.23	RRC	Vegetative	30.36
		Marewad	Vegetative	54.85	Amminbhavi	Vegetative	30.41
		Govinkoppa	Flowering	24.36	Somapur	Vegetative	20.84
		RRC	Flowering	32.36	Narendra	Flowering	55.23
		Somapur	Vegetative	14.85	Somapur	Flowering	25.65
		Yettinaudda	Flowering	33.85	Yadwad	Flowering	22.73
		Shivalli	Flowering	22.81	Shivalli	Pod Filling	26.41
	Navalgund	Aratti	Flowering	21.23	Annigeri	Vegetative	43.22
		Thirlapur	Pod filling	25.36	Betageri	Flowering	40.38
		Karewada	Flowering	30.31	Karewada	Flowering	28.51
		Kadadhahalli	Flowering	27.25	Kadadhahalli	Flowering	35.41
		Aarekuratti	Pod filling	48.21	Aarekuratti	Flowering	30.78
	Hubballi	Chabbi	Vegetative	8.52	Chabbi	Flowering	26.44
		Thadsa	Flowering	18.21	Ingalahalli	Pod filling	32.11
		Byahatti	Vegetative	30.55	Kusugal	Pod filling	35.36
Gadag	Gadag	Belehoda	Flowering	25.26	Hulakote	Vegetative	15.38
		Magadi	Pod filling	28.36	Konnur	Vegetative	7.42
		Asundi	Pod filling	23.54	Mulagund	Flowering	25.45
		Belehoda	Pod filling	27.81	Belehoda	Flowering	26.19
		Chik handigalur	Flowering	29.85	Neelagund	Flowering	7.28
		Gojanur	Flowering	33.12	Gojanur	Pod filling	33.41
		Hulakote	Flowering	9.12	Hulakote	Pod filling	25.36
	Nargund	Kurligeri	Flowering	19.21	Kurligeri	Pod filling	26.38
		Banahatti	Pod filling	26.77	Banahatti	Pod filling	30.24
	Ron	Ron	Pod filling	20.85	Ron	Flowering	22.36
		Naregal	Flowering	25.87	Naregal	Flowering	27.01
Haveri	Ranibennur	Karimalapura	Vegetative	20.36	Honnati	Flowering	18.36
		Guddada anveri	Vegetative	9.39	Karimallapura	Flowering	5.28
		Honnati	Vegetative	39.77	Guddada Anveri	Flowering	17.36
	Shiratti	Balehosur	Flowering	28.14	Doddur	Flowering	22.11
		Basapur	Flowering	30.23	Basapur	Vegetative	27.48
Vijayapur	Vijayapur	Rampur	Flowering	11.23	Hadagali	Vegetative	15.36
		Vijayapur	vegetative	23.36	Vijayapur	Flowering	22.68
		Honnutagi	Pod filling	30.62	Kumatagi Tanda	Flowering	25.66
		Bommanjogi	Pod filling	36.36	Uppaladinni	Flowering	15.48
		Shivanagi	Pod filling	25.36	Shivanagi	Pod filling	7.36
		Kavalgi	Flowering	19.23	Kavalgi	Pod filling	18.41
	Sindagi	Kudagi	Flowering	23.30	Aheri	Pod filling	35.57
		Guthargi	Pod filling	11.54	Bisnal	Pod filling	25.85
		Padaganur	Flowering	16.74	Guthargi	Vegetative	17.62
		Aheri	Pod filling	14.59	Moratagi	Vegetative	6.85
Kalaburgi	Kalaburgi	Sannur	Flowering	26.55	Aurad	Vegetative	15.61

		Kalaner	Flowering	28.36	Belakot	Vegetative	25.92
		Nadisinnur	Flowering	30.88	Farathabad	Vegetative	38.64
	Sedam	Bategeri	Flowering	24.33	Biranahalli	Floweing	38.36
		Kodla	Pod filling	45.22	Samkhed tanda	Vegetative	20.25

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Table.2 Mean per cent disease incidence of wilt complex of chickpea in different district and taluka during *rabi* 2021-22 and 2022-23

District	Taluk	Disease incidence (2021-22)	Disease incidence 2022-23	Mean
Bagalkot	Badami	30.05	25.10	27.58
	Bagalkot	24.19	26.54	25.37
	Jamkhandi	16.07	27.70	21.89
	Mean	23.44	26.45	24.94
Belagavi	Bailhongal	24.80	37.01	30.91
	Savdatthi	26.22	26.47	26.35
	Belagavi	23.36	23.11	23.24
	Mean	24.79	28.86	26.83
Dharwad	Dharwad	32.95	31.75	32.35
	Navalgund	30.47	35.66	33.07
	Hubballi	19.09	31.30	25.20
	Mean	27.50	32.90	30.20
Gadag	Gadag	25.29	20.07	22.68
	Nargund	22.99	28.31	25.65
	Ron	23.36	24.68	24.02
	Mean	23.88	24.35	24.12
Haveri	Ranebennur	23.17	13.66	18.42
	Shiratti	29.19	24.80	26.99
	Mean	26.18	19.23	22.70
Vijayapura	Vijayapura	24.36	17.49	20.93
	Sindagi	16.54	21.47	19.01
	Mean	20.45	19.48	19.97
Kalburgi	Kalburgi	28.60	26.72	27.66
	Sedam	34.78	29.31	32.05
	Mean	31.69	28.02	29.85

Fig. 1 Incidence of chickpea wilt during survey of northern Karnataka

a. Narendra (Dharwad)

b. Karimallapur (Haveri)

Fig. 2 Prevalence of the pathogens associated with wilt complex of chickpea