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Prevalence of chickpea (*Cicer arietinum* L.) wilt caused by *Fusarium oxysporum* f. sp. *Ciceris* in Bhopal district of Madhya Pradesh

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Abstract

Chickpea (*Cicer arietinum* L.) is one of the important rabi pulse crop grown in Vindhya region of Madhya Pradesh. Among vascular wilt caused by *Fusarium oxysporum* f. sp. *ciceris* is major devastated disease of chickpea causing losses to the tune of 100 per cent in severe condition. The present study was conducted in Bhopal district of Madhya Pradesh during rabi seasons of 2022-23 and 2023-24 to survey the losses in chickpea due to wilt in three tehsils Huzur, Berasia and Kolar of Bhopal district. Results across both years revealed that the average incidence of wilt in the three tehsils surveyed ranged from 11.80 (Kolar) to 16.24 (Berasia) percent. However, it was found that the chickpea crop cultivated in the Berasia tehsil suffered more, with a wilt incidence of 16.24 percent compared to an average wilt incidence of 13.26%. The Huzur tehsil had the second-highest average wilt incidence of 14.55 percent, followed by Kolar (11.80%). Effect of root exudates of variety JG-12 on mycelial growth of pathogenic fungus was most effective while root exudates of variety JG-74 was found least effective.

Keywords: Chickpea, *Fusarium oxysporum*, Survey, Wilt incidence, Bhopal, M.P.

Introduction

Chickpea (*Cicer arietinum* L.) is an important legume crop cultivated in the Mediterranean region and globally (Saxena, 1990) [5]. It ranks as the third most important pulse crop worldwide, following dry bean (*Phaseolus vulgaris* L.) and dry pea (*Pisum sativum* L.) (Nikam *et al.*, 2007) [4]. Belonging to the sub-family *Papilionaceae* and the family *Leguminaceae*, chickpea originated in the Middle East and has since spread to over 45 countries with arid, semi-arid, and subtropical climates and also referred as bengal gram, channa, or garbanzo bean. In India Punjab, Haryana, Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, Maharashtra, West Bengal, Andhra Pradesh and Karnataka are the major producers of chickpea. Among pulses, chickpea is the most flexible crop in terms of acreage and yield. (Anonymous, 2009). Chickpea is highly valued for its nutritious seeds, which are rich in protein (20.5 g), fat (6.05 g) and carbs (63 g) per 100 g seed, making it an increasingly popular substitute for animal protein (Hossain *et al.*, 2010). Chickpeas are also a rich source of minerals like calcium, phosphorus, magnesium, iron, potassium, and β -carotene. Compared to other legumes, chickpeas contain higher levels of manganese, zinc, and phosphorus (Wang *et al.*, 2010). Additionally, chickpeas provide Thiamine (0.30 mg/100 g), Riboflavin (0.51 mg/100 g), Biotin (10 μ g/100 g), Folic acid (125 μ g/100 g), and Nicotinic acid (2.1 mg/100 g). (The Nutritive value of Indian Foods and the Planning Satisfactory Diet, ICMR). Chickpeas are cultivated across India, chickpeas are grown on 10.91 million hectares, producing 130.75 million tonnes (Anonymous, 2021-22). In Madhya Pradesh (M.P.) over an area of 26.60 lakh hectares, yielding 19.88 lakh tonnes. Northern India contributes approximately 90 percent of the chickpea-growing area and 95 percent of the total production. In Madhya Pradesh, chickpeas are widely cultivated, particularly in districts such as Bhopal, Vidisha, Sehore, Khargone, Khandwa, Gwalior, Bhind, Morena, Shivpuri, Guna, Jabalpur, Narsinghpur, Sagar, Raipur, Bilaspur, and Chhindwara. The average yield in M.P. is about 908 kg/ha, which is relatively low. Several factors contribute

to this low yield, including the tendency of farmers to grow pulses, an energy-rich crop, on poor and eroded soils, and a lack of attention to plant protection measures against diseases and pests. Chickpeas are susceptible to numerous diseases and insect pests, with significant yield losses often occurring from pre-emergence to crop maturity. Many of these diseases are caused by fungi associated with seeds and present in the soil. Singh *et al.* (1986) [6] reported that wilt incidence can range from 10 to 100% in various parts of India and 10 to 20% incidence observed in the Vindhyan Plateau's farmers' fields.

Material and Methods

A roving field survey was conducted during the *Rabi* 2022-23 and 2023-24 season in the chickpea growing three tehsils of Bhopal district to assess wilt disease incidence. The field visits were undertaken during seedling to pod formation stages of the crop. Samples of farmers' fields of chickpea crop exhibiting symptom of wilt were collected from different locations of three tehsils (Huzur, Berasia and Kolar) of Bhopal district of Madhya Pradesh. During survey following observations were recorded, total number of chickpea plants/two rows was counted, of which wilt suspected plants were counted separately to calculate percent wilt incidence. Based on numerical data obtained in respect of total number of chickpea plants and wilted plants per field surveyed, percent wilt incidence was calculated.

$$\text{Disease incidence} = \frac{\text{Total number of wilted plants}}{\text{plants observed}} \times 100$$

Chickpea seeds of different varieties (JG-24, Vijay, Jaki-9218, JG-36, JG-18, JG-52, JG12, JG-315, JG-62 and JG-74) will be collected from JNKVV Jabalpur (MP). The seeds were air dried and kept in paper bags and stored at room temperature. Seeds were placed on a floating polystyrene platform, in such a way that the protruding chickpea radical projected down through a hole in the platform into beaker containing 100 ml of sterilized water. The seeds of different cultivars of chickpea which varied in their resistance were sterilized in 2% hypochlorite solution and germinated on filter paper soaked in sterilized water, after 48 hr. The germinated platform floated on the surface

of the water and incubated at 25 °C under 1-2-hrs light dark regime (Haware and Nene 1984) [3].

After seven days the polystyrene platform and chickpea seedling was removed and the resulting exudates solution filtered through sterilized Nalgene filters (0.45 µm) under reduced pressure. The roots from each beaker were weighed so that the exudates from each cultivar can be diluted or concentrated to make exudates equivalent to 1 g root tissue per 10 ml of water. Sterilized root exudates of different cultivars were tested for their effect on mycelia growth. (Hale *et al.* 2020) [1] Pure culture of *F. oxysporum* f. sp. *ciceris* isolates were represented different races/pathotypes transferred to PDA to study the effect of root exudates on the mycelia growth. Fifty ml of root exudates were added to 50 ml of PDA at round 500 C and mixed thoroughly. This was poured in Petri dishes @ 15 ml per plate. PDA without root exudates served as control. Seven-day old culture of *F. oxysporum* f. sp. *ciceris* were representing different races grow on PDA used for inoculation. Three plates were kept for each treatment and incubated at 25 °C for 10 days. Colony diameter was recorded on 5th, 7th and 9th day.

Results and Discussion

Survey of chickpea wilt in Bhopal district: Based on the (Table 1), The average incidence of wilt in the three tehsils surveyed during *Rabi* 2022-23 and 2023-24 ranged from 11.26 (Kolar) to 16.24 (Berasia) percent. However, it was found that the chickpea crop cultivated in the Berasia tehsil suffered more, with a wilt incidence of 16.24 percent compared to an average wilt incidence of 13.26%. The Huzur tehsil had the second-highest average wilt incidence of 14.55 percent, followed by Kolar (11.80%). In the Kolar tehsil a minimum average wilt incidence of 11.80 percent was found. Similarly, Shrivastava *et al.* (2021) [7] reported that wilt incidence in chickpeas was generally higher in the *Rabi* season of 2018-2019 compared to 2019-2020. Their survey across six districts in the Vindhyan Plateau zone revealed that the disease was widespread and consistently present, with moderate to severe levels. The highest average incidence was in Sehore (17.87%), followed by Rajgarh (17.00%) and Bhopal (15.20%) for both years. Overall, the average wilt incidence was greater in 2018-2019 (15.63%) than in 2019-2020 (14.99%).

Table 1: Average wilt incidence (%) of chickpea in Bhopal district of Madhya Pradesh during *Rabi* 2022-23 and 2023-24

Sr. No.	Tehsil	Variety	Village	<i>Rabi</i> 2022-23 Percent Wilt incidence (%)	<i>Rabi</i> 2023-24 Percent Wilt incidence (%)	Average percent Wilt incidence (%)
1	Huzur	JG-12	Toomda	13.4	14.6	14.55
		Vijay	Patniya	15.4	14.8	
2	Berasia	JG-74	Jamusar Kalan	18.15	17.2	16.24
		Desi	Lalariya	13.22	16.4	
3	Kolar	Local	Amravat	13.3	12.5	11.80
		Vijay	Gol	10.2	11.2	

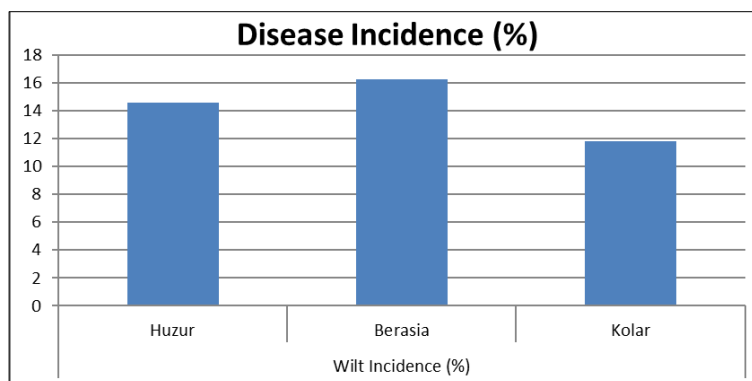


Fig 1: Average wilt incidence (%) of chickpea in Bhopal district of Madhya Pradesh during Rabi 2022-23 and 2023-24

Effect of root exudates of chickpea cultivars on mycelial growth of *Fusarium oxysporum* f.sp. *ciceris*

Effect of root exudates of ten chickpea cultivars on the growth of *F. oxysprum* f. sp. *ciceris* were studied and presented in table 2. In order to study the effect of root exudates on fungal growth of *F. oxysprum* f. sp. *ciceris* on PDA medium containing root exudates of all the ten chickpea cultivars along with check was done by measuring the colony diameter after 5th, 7th and 9th days after incubation (DAI)

The data presented in below table revealed that the effect of root exudates of ten chickpea cultivars on the growth of *F. oxysprum* f. sp. *ciceris*. The colony diameter ranged from 17 mm to 77.53 mm on 9th DAI. Lowest colony diameter was recorded in the *F. oxysprum* f. sp. *ciceris* by the root exudates of the variety JG-12 was 17 mm on 9th DAI followed by JG 315 (20.22 mm), JG-24(26.58 mm), JG-18(28.42 mm), JAKI-9560(30 mm), Vijay (41.2 mm), JG-36 (42.98 mm), JG-52 (47.05 mm), JG-62 (55.10 mm) and JG -74 (58.16 mm) on 9th DAI. Highest colony diameter was recorded in the root exudates by variety JG-74 was 58.16 mm on 9th DAI which was followed by the colony diameter in the root exudates of variety JG-62 was 55.10 mm.

Among all the varieties highest per cent growth inhibition found in JG-12 which was 78.07% followed by JG-315(73.92%), JG-24(65.72%), JG-18 (63.34%), JAKI-9560 (61.31%), Vijay (46.86%), JG-36 (44.56%), JG-52

(39.31%), JG-62 (28.93%) and JG -74 (24.98%) on 9th DAI. Similarly, Hale *et al.* (2020) conducted an experiment at V.N.M.V.V., Parbhani (M.S.) to study the effect of root exudates from eleven chickpea cultivars on spore germination and hyphal growth of *Fusarium oxysporum* f. sp. *ciceris*. The root exudates of the susceptible cultivar JG 62 showed the highest colony diameter, 85.13 mm, followed by the cultivar Vijay, which showed a colony diameter of 50.46 mm.

Table 2: Effect of root exudates of ten chickpea cultivars on mycelial growth of *Fusarium oxysprum* f. sp. *ciceris*

Varieties	Colony diameter in (mm)			Per cent Growth Inhibition (%)
	5th day	7th day	9th day	
JG-315	8.36	12.85	20.22	73.92
JG-62	32.4	42.05	55.10	28.93
JG-24	17.24	21.42	26.58	65.72
JG-36	30.2	38.22	42.98	44.56
Vijay	23.65	31.44	41.2	46.86
JG-18	19.54	23	28.42	63.34
Jaki 9560	21.30	25.60	30	61.31
JG-52	27.15	36.12	47.05	39.31
JG-12	7.25	10.80	17	78.07
JG-74	31.24	47.96	58.16	24.98
Control	49.35	63.74	77.53	0
CD	1.24	1.49	0.98	1.18
Sc(m)	0.42	0.51	0.33	0.40

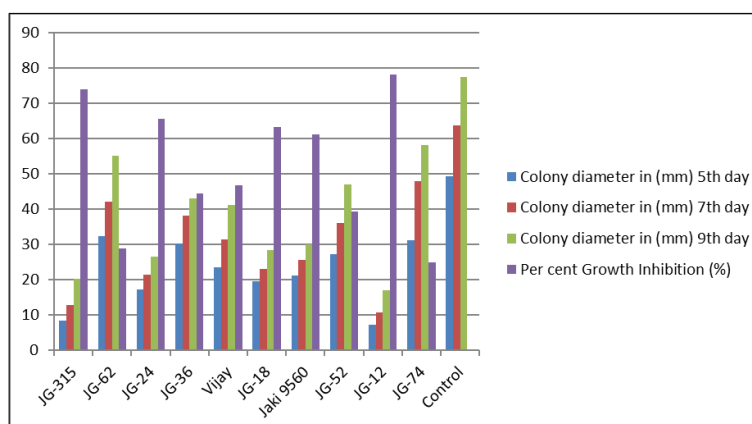


Fig 2: Effect of root exudates of ten chickpea cultivars on mycelial growth of *Fusarium oxysporum* f. sp. *ciceris*

Conclusion

The study revealed that in Bhopal district the mean incidence of chickpea wilt were found maximum in Berasia tehsil (16.24%), followed by Huzur (14.55%) and Kolar (11.80%) respectively. Present study showed that chickpea

wilt is highly distributed in all the surveyed areas of Bhopal district of Madhya Pradesh. The smallest colony diameter was observed with the root exudates of variety JG-12 with 78.07% growth inhibition while the largest colony diameter

was recorded with the root exudates of JG-74 with 24.98% growth inhibition.

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