Present Status of Collar Rot in Major Chickpea growing State of India

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ABSTRACT: Chickpea is third largest grain legumes after dry beans and dry peas grown across the world. In India Madhya Pradesh is key state for its cultivation and production. Collar rot which cause early stage mortality of plant is becoming a serious disease of chickpea in Central India. Collar rot disease caused by *Sclerotium rolfsii* is a serious threat to chickpea that may cause 55 to 95 % mortality.
An intensive roving field survey was done and the distance from previous to next field was more than 10-15 kilometers was conducted to reveal the status of collar rot in different Chickpea growing areas of Madhya Pradesh during 2018 and 2019 cropping season Incidence of Collar rot was recorded in early stage of crop (30-50 days) with geotagging of the field. The location of the field was taken using GPS camera, and in each field four points were randomly selected using quadrate (1m^2). Number of plants (infected and healthy) were counted thereafter the average percent mortality from all four points was worked out. Collar rot was prevalent in all surveyed agroclimatic zones *viz.,* Central Narmada valley (8.08-17.20%), Kymore Plateau and Satpura hills (9.30-14.80%), Northern Hill region (8.10-11.76%), Satpura plateau (9.30-11.88%) and Vindhyan plateau (12.00-18.20%) of Madhya Pradesh. Highest disease incidence of 18.2 % and lowest 8.08% was recorded at Batiyagarh block of Damoh district and Gotegaon block of Narsinghpur district respectively.
Average minimum percent mortality was observed in the variety Rahila (Local) (12.47 %) and the minimum of (9.60 %) in RVS 201. Present survey provide a vital information of varieties affected as well as sensitive locations to collar rot of chickpea in Madhya Pradesh, which can be utilized for deriving appropriate measures to minimize further incidence of this disease.
This information could be a strong background for effective knowledge for further researchers. With this aim, this experiment also helps to find out whether the susceptibility and resistance for the varieties depends on the virulence of the isolates located in different locations. Even future pathotype analysis of the isolates can be possible with this basic study.

Keywords: Survey, chickpea, collar rot, disease.

INTRODUCTION

Chickpea *(Cicer arietinum* L.), is one of the most important leguminous crops grown all around the world (Knights *et al*., 2007). Initially, it was cultivated in South Eastern areas of the world but now it is distributed in semi-arid regions to (Agarwal *et al.,* 2012). It is a major source of dietary protein for human consumption. It also plays an important role in the management of soil fertility because of having the ability of nitrogen fixation in its root nodules (Hossain *et al.,* 2010). There is a growing demand of chickpea due to its nutritional value. It is the better source of carbohydrates and proteins several vitamins and minerals (Chibbar *et al*., 2010) and also free of cholesterol and provides several vitamins and minerals (Wood and Grusak 2007).

The area under cultivation, production and productivity of chickpea in India comprised 6.63 Mha, 9.38 MT and 974 kg/ha, respectively during 2016-17(Anonymous, 2018). In India the major producing states are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka and Andhra Pradesh together contributing to 90% of the area and 91% of production in the country (Singh, 2010). Madhya Pradesh covers 3.59 M ha area with a production of 4.595 Mt and an average productivity of 1280 kg/ha which is the highest among different pulse crops (PC Annual Report, 2018).

Chickpea can be grown in both tropical and temperate regions. Chickpea is known to be affected by many biotic and abiotic constraints that contributed in reduction of average yield in different regions. Among the biotic constraints more than 50 diseases have been reported. Nearly 172 pathogens have been reported so

far that infect chickpea (*Cicer arietinum* L.) in different parts of the world but only a few of them have the potential to devastate the crop (Nene *et al*., 1996). Collar rot disease caused by *Sclerotium rolfsii* is a serious threat to chickpea that may cause 55 to 95 % mortality (Shrivastava *et al.,* 1984). It has been reported that collar rot is more severe and most frequently at high moistures and high temperatures conditions (Al Askar *et al.,* 2013). Diseases mostly appear in the early growth stage of the crop particularly before pod formation. Affected younger seedlings turn yellow and may collapse, but older seedlings may dry without collapsing. If affected seedlings are uprooted from moist soil in the earlier stages of infection, rapeseed-like sclerotia can be seen. The yellowing of leaves and constriction at the collar region with white mycelial strands of *Sclerotium rolfsii*, attached around the collar region are major characteristic symptoms of disease (Nene *et al.,* 2012).

We all know, crop in fields are always exposed to multiple biotic and abiotic stresses where plants exhibit certain physiological and molecular responses that interact and have impact on each other to exert the combined effect of these stresses (Choi *et al.,* 2013; Padaria *et al.,* 2015; Pandey *et al.*, 2015). These stress interactions in plants may either have direct or indirect effect on pathogens through other community interactions (Sharma and Ghosh 2017) leading to either positive or negative effects on plant responses (Ramegowda *et al.*, 2013).

The on-going changes in climatic conditions such as increase in CO_2 emissions, unpredicted rainfall patterns, temperature rise, decrease/increase in relative humidity, and low soil moisture stress (Zhao and Running 2010) are likely to influence the plant diseases establishment, its distribution and epidemiology (Graham and Vance 2003).

It is being noticed that Collar rot incidence seems to be increased recent time. Looking to the facts, an intensive survey was carried out to know the present status of Collar rot of chickpea with respect to different agro climatic zones of Madhya Pradesh.

MATERIALS AND METHODS

A. Survey for disease incidence
During Rabi 2018 and 2019, an intensive survey covering 15 districts under 5 agroclimatic zones was carried out to assess the occurrence of collar rot of chickpea (Table 1). The survey was conducted using the GPS location point. In each field 1 m2 area was randomly selected at the 4 different location in the field and average percent mortality was calculated. Percent disease incidence was calculated by using the following formula:

$$\text{Percent disease incidence(PDI)} = \frac{\text{Number of plants infected}}{\text{Total number of plants}} \times 100$$

Isolation and confirmation of Pathogencity of Isolates. During Rabi 2018 - 2019 collar rot infected chickpea plant samples were collected and washed in distilled water. The fungus was isolated by tissue segment method (Rangaswamy and Mahadevan 1998) under aseptic conditions. The infected tissues were cut into small pieces of 1-2 mm size and surface sterilized with 1% sodium hypochlorite solution for one minute

and wash repeatedly thrice in sterile distilled water. These pieces were transferred to blotting paper to remove water adhered to sample and place in Petri plates containing sterilized PDA and incubated at 28 ± 2°C Based on typical cultural cultural characteristic and sclerotial formation pattern, the pathogen is identified as *Sclerotium rolfsii.* (Barnett and Hunter 1972).

Table 1: List of Districts wise Survey of incidence of Collar rot of Chickpea in different Agro Climatic Zone of Madhya Pradesh.

Agro climatic zones of M.P. (05)	Districts (15)
Northern Hill Region	Mandla, Dindori
Kymore Plateau & Satpura Hills	Jabalpur, Katni, Satna, Rewa, Sidhi, Panna and Seoni
Vindhyan Plateau	Sagar and Damoh
Central Narmada Valley	Narsinghpur, Hoshangabad, Harda
Satpura Plateau	Chhindwara

RESULT AND DISCUSSION

The results obtained from the present investigation are summarized below:
Survey for disease incidence. Survey during Rabi 2018 and 2019 revealed that incidence ranged from 11.11% to 10.13%. Plants were assessed for disease based on their visual symptoms on plant and white mycelial growth at collar region (Plate 2) along with Sclerotia (mustard like) were also observed. Collar rot was prevalent in all surveyed agroclimatic zones are presented in Table 3 to 8.
Identification of pathogen. The pathogen isolated from typical infected plants was produced white colony on PDA (Plate1). The growing pathogenic fungus was

fast as it covered 90 mm petridish within 5 days of inoculation. The growing pattern of colony was submerged and fluffy. Sclerotial formation started after 8-10 days of inoculation. Initially it appeared as white dots and later with in 5-10 it matured. The colony of sclerotia was brown with irregular and round shape. Till 21 days of inoculation numerous sclerotia was formed in the culture plate. This kind of cultural and sclerotial characteristics was observed in *Sclerotium rolfsii* and several researchers have been reported such kind of standard characteristic of *Sclerotium rolfsii* (Sarma *et al.,* 2002; Adandonon *et al.,* 2005; Palaiah and Adiver 2006; Okereke and Wokocha, 2007; Akram *et al*., 2008; Rakholiya and Jadeja 2011; Sharma *et al*., 2013).

Table 2: Block wise incidence of collar rot of chickpea in Central Narmada valley agro climatic zone during 2018.

Districts	Blocks	Number of field surveyed	Varieties	Per cent incidence
Narsinghpur	Narsinghpur	04	Surya 10, JG 36, JG 12, JG 315	10.79
	Gadarwara	04	JG 63, RVS 202, RVS 203, JG 36	17.20
	Gotegaon	04	JG 12, JG 315, JG 63,RVS 202	8.08
	Tendukheda	04	JG 12, JG 63,JG 315,RVS 202	9.56
	Kareli	05	JG 12, JG 315, JG 63, RVS 202	8.70
Hoshangabad	Babai	06	JG 14, JG 12, JG 36, JG 16, JG 11	10.19
	Itarsi	05	JG 14, JG 12, JG 36	11.28
	Pipariya	05	JG 14, JG 16, JG 36	10.14
	SeoniMalwa	05	JG 14, JG 16, Local	11.97
	Sohagpur	04	JG 14, JG 12, Local	10.90
	Bankhedi	05	JG 14, JG 12, Local	8.90
	Dolariya	04	JG 16, JG 12, Local	11.38
Harda	Handiya	05	JAKI 9218, Vishal, JG 130	10.26
	Sirali	04	JG 11, JG 12, RVG 201, JG 130	10.58
	Timarni	04	JG 11, JG 12, RVG 201	10.93
	Khirkiya	05	JAKI 9218, Vishal, JG 130, RVG 201	8.80
	Rehatgaon	05	JG 130, RVG 201, JG 11, JG 130	9.63
Average				**10.54**

Survey in the Central Narmada valley agro climatic zone during 2018 revealed that collar rot incidence ranged from 8.08 to 17.20 percent (Table 2). Highest incidence of 17.20 percent was recorded in the Gadarwara block of Narsinghpur district in the varieties viz. JG 63, RVS 202, RVS 203, JG 36 and the lowest incidence of 8.08 percent was observed in the Gotegaon block of Narsinghpur district in the varieties JG 12, JG 315, JG 63, RVS 202. In Central Narmada valley agro climatic zone during 2018 average incidence of collar rot of chickpea was 10.54 percent. During survey of major Chickpea growing districts of Madhya Pradesh collar rot appeared at 15 - 45 days old crop and it ranged from 5 - 30 percent (Gupta and Mishra 2009). In the Kymore Plateau and Satpura Hills agro climatic zone during 2018 collar rot incidence ranged from 9.30 to 14.80 percent (Table 3). Highest incidence of 14.80 percent in the Rampur Naikin block of Sidhi district in the varieties *viz.,* JG 11, JG 12, JG 130, JG 14, JG 315 and the lowest incidence of 9.30 percent was seen in the Kundam block of Jabalpur district in the varieties JG 315, JG 130. Average incidence of collar rot of chickpea recorded was 12.25 percent in Kymore Plateau and Satpura Hills agro climatic zone during 2018. During survey of major Chickpea growing districts of Madhya Pradesh collar rot appeared at 15 - 45 days old crop and it ranged from 5-30 percent (Gupta and Mishra 2009). The survey in Kymore Plateau and Satpura Hills agro climatic zone during 2019 collar rot revealed incidence ranged from 13.00 to 16.66 percent (Table 4). Highest incidence of 16.66 percent in the Raipura block of Panna district in the varieties viz. JG 11, JG 14 and the lowest incidence of 13.00 percent in the varieties JG 11, JG 130, JG 14 was observed in the Panna block of Panna district. In Kymore Plateau and Satpura Hills agro climatic zone during 2018 average incidence of collar rot of chickpea recorded was 14.41 percent.

In Vindhyan Plateau agro climatic zone climatic zone during 2019 survey revealed collar rot incidence ranged from 12.00 to 18.20 percent (Table 5). Highest incidence of 18.20 percent was observed in the Batiyagarh block of Damoh district in the varieties viz. JG 12, Khajwa (Local), JG 16, JG 36. Lowest incidence of 12.00 percent was observed in the Khurai block of Sagar district in the varieties JG 16, JG 322 JG 315, RVS 202. In Vindhyan Plateau agro climatic zone agro climatic zone during 2019 average incidence of collar rot of chickpea recorded was 16.41 percent. During survey of major Chickpea growing districts of Madhya Pradesh collar rot appeared at 15 - 45 days old crop and it ranged from 5 - 30 percent (Gupta and Mishra, 2009). In Northern Hill Region agro climatic climatic zone during 2019 survey, revealed collar rot incidence ranged from 11.76 to 8.10 percent (Table 6). Highest incidence of 11.76 percent was observed in the Dindori block of Dindori district in the varieties viz. JG 315, JG 322, Local. Lowest incidence of 8.10 percent was observed in the Nainpur block of Mandla district in the varieties JAKI 9218, Vijay, JG 130, JG 14. In Northern Hill Region agro climatic zone agro climatic zone during 2019 average incidence of collar rot of chickpea recorded was 10.65 percent. During survey of major Chickpea growing districts of Madhya Pradesh collar rot appeared at 15 - 45 days old crop and it ranged from 5 - 30 percent (Gupta and Mishra 2009). In Satpura Plateau agro climatic zone during 2019, survey revealed collar rot incidence ranged from 11.88 to 9.30 percent (Table 7). Highest incidence of 11.88 percent was observed in the Parasia block of Chhindwara district in the varieties viz. JG 11, JG 12, JG 63 and JG 36. Lowest incidence of 9.30 percent was observed in the Amarwara block of Chhindwara district in the varieties JG 11, JG 130, JG 12, JG 63 and JG 36.

Table 3: Block wise incidence of collar rot of chickpea in Kymore Plateau and Satpura Hills agro climatic zone during 2018.

Districts	Blocks	Number of field surveyed	Varieties	Per cent incidence
Jabalpur	Jabalpur	12	JG 11, JG 130, JG 74, JG 16, JG 24, JG 36, JG 16	10.39
	Kundam	10	JG 74, JG, 16, Local, JG 130	11.73
	Majholi	10	JG 315, JG 130	9.30
	Panagar	10	JG 130, JG 11, JG 16	10.67
	Shahpura	07	JG 24, JG 12, JG 130	9.36
	Patan	08	JG 315, JG 74, JG 130	9.99
	Sihora	10	JG 74, JG, 16, Local, JG 130, JG 11	12.68
Katni	Badwara	05	JG 74, JG, 16,JG 63, Local	12.59
	Murwara	05	JG 14, JG 14, Khajwa (Local),JG 322, JG 74	12.69
	Bahoriband	04	Khajwa (Local), JG 315, JG 322	14.77
	Rithi	05	Khajwa (Local), JG 74, JG 16	10.97
	Barhi	05	Khajwa (Local), JG 74, JG 16	13.65
	Vijayraghavgarh	05	Khajwa (Local), JG 130, JG 16, JG 74, JG 11	12.48
	Dhimarkheda	05	Khajwa (Local), JG 315, JG 322, JG 14, JG 16	10.63
Satna	Amarpatan	06	JG 14, JG 11, JG 74, JG 12, JG 16,Rahila (Local)	11.52
	Majhgawan	05	JG 14, JG 11, JG 16, JG 315, Rahila (Local)	12.86
	Rampur Baghelan	04	Rahila (Local), JG 14	13.29
	Birsinghpur	05	Rahila (Local), JG 74, JG 130, JG 315, JG 16	13.51
	Nagod	04	Rahila (Local), JG 74, JG 315, JG 16	11.57
	Unchahara	06	Rahila (Local), JG 74, JG 315, JG 16, JG 11	10.47
	Kotar	06	Rahila (Local),JG 315, JG 11	13.73
	Raghurajnagar	06	Rahila (Local), JG 315, JG 74,JG 130	14.12
	Maihar	06	Rahila (Local), JG 315	14.35
	Ramnagar	04	Rahila (Local), JG 315, JG 74	9.32
Rewa	Gurh	06	Rahila (Local), JG 315, JG 74,JG 16, JG 63, JG 11	11.13
	Mangawan	05	Rahila (Local), JG 315, JG 14, JG 11	12.01
	Semaria	05	Rahila (Local), JG 315, JG 74, JG 12, JG 11	12.06
	Hanumana	05	Rahila (Local), JG 130, JG 63, JG 11, JG 315	12.44
	Mauganj	04	Rahila (Local), JG 16, JG 63, JG 14	11.88
	Sirmour	04	Rahila (Local), JG 315, JG 14, JG 11	12.53
	Huzur	05	Rahila (Local), JG 315, JG 11	14.18
	Naigarhi	05	Rahila (Local), JG 315, JG 74	9.87
	Teonthar	05	Rahila (Local), JG 315, JG 74	12.83
	Raipur Karchuliyan	05	Rahila (Local), JG 315, JG 130	12.49
	Jawa	04	Rahila (Local), JG 315, JG 74, JG 63, JG 74	12.77
Sidhi	Churhat	05	JG 11, JG 130, JG 14, JG 315	13.80
	Kusmi	04	JG 12, JG 130, JG 14, JG 315	14.25
	Majhauli	05	JG 11, JG 130, JG 14, JG 12	14.4
	Rampur Naikin	05	JG 11, JG 12, JG 130, JG 14, JG 315	14.8
	Average			**12.25**

Table 4: Block wise incidence of collar rot of chickpea in Kymore Plateau and Satpura Hills agro climatic zone during 2019.

Panna	Amanganj	05	JG 11, JG 12, JG 130, JG 14	15.6
	Ajaigarh	05	JG 11, JG 130, JG 14,	14.4
	Raipura	03	JG 11, JG 14	16.66
	Shahnagar	05	JG 11, JG 63, JG 130, JG 14	13.6
	Panna	04	JG 11, JG 130, JG 14	13.00
Seoni	Barghat	06	JG 11, JG 130, JG 14, JG 315	13.50
	Chhapara	06	JG 11, JG 63, JG 14, JG 130	15.83
	Ghansaur	06	JG 11, JG 63, JG 14, JG 130	13.5
	Lakhnadon	05	JG 11, JG 14	13.6
	Average			**14.41**

Table 5: Block wise incidence of collar rot of chickpea in Vindhyan Plateau agro climatic zone during 2019.

Districts	Blocks	Number of field surveyed	Varieties	Per cent incidence
Sagar	Rehli	05	JG 12, JG 16, JG 315, RVS 202, RVS 203	16.40
	Bina	05	JG 14, JG 16, JG 322 JG 315, Khajwa (Local)	17.20
	Khurai	05	JG 16, JG 322 JG 315, RVS 202	12.00
	Garhakota	05	JG 14, JG 16, JG 315, Khajwa (Local)	16.80
	Shahgarh	05	JG 322, Khajwa (Local), RVS 202	18.00
	Rahatgarh	05	JG 322, Khajwa (Local), RVS 202, JG 315	15.80
Damoh	Batiyagarh	05	JG 12, Khajwa (Local) , JG 16, JG 36	18.20
	Patera	05	JG 16, Khajwa (Local) , JG 315, JG 36	17.40
	Damoh	05	JG 12, JG 315, JG 36	15.80
	Patharia	04	JG 12, JG 315, JG 36	15.00
	Hatta	05	JG 12, Khajwa (Local), JG 36	16.60
	Tendukheda	05	JG 12, Khajwa (Local), JG 315, JG 36	16.80
	Jabera	05	JG 16, Khajwa (Local), JG 315, JG 36	17.40
Average				**16.41**

Table 6: Block wise incidence of collar rot of chickpea in Northern Hill Region agro climatic zone during 2019.

Districts	Blocks	Number of field surveyed	Varieties	Per cent incidence
Mandla	Bichhiya	05	JAKI 9218,Vijay, JG 130, JG 14	10.77
	Mandla	04	Vijay, JG 130, JG 315	10.73
	Ghughari	05	Local, JG 315, Vijay	11.46
	Narayanganj	04	JG 14, JG 130	10.06
	Nainpur	05	JAKI 9218, Vijay, JG 130, JG 14	8.10
	Niwas	05	JG 14, Local	11.68
Dindori	Dindori	10	JG 315, JG 322, Local	11.76
Average				**10.65**

Table 7: Block wise incidence of collar rot of chickpea in Satpura Plateau agro climatic zone during 2019.

Districts	Blocks	Number of field surveyed	Varieties	Per cent incidence
Chhindwara	Amarwara	05	JG 11, JG 130, JG 12, JG 63, JG 36	9.30
	Harrai	04	JG 11, JG 12, JG 130, JG 63	10.36
	Parasia	05	JG 11, JG 12, JG 63, JG 36	11.88
	Bichhua	04	JG 12, JG 130, JG 63, JG 36	10.25
	Sausar	04	JG 12, JG 63, JG 36, JG 11	10.18
	Chaurai	04	JG 12, JG 63, JG 11	9.90
	Mohkhed	05	JG 12, JG 63, JG 36, JG 11	8.45
	Tamia	05	JG 63, JG 36, JG 11	9.37
	Pandhurna	03	JG 63, JG 36, JG 11	10.62
	Chhindwara	05	JG 12, JG 36, JG 11	11.54
Average				**10.18**

Table 8: Variety wise average incidence of collar rot of chickpea in Madhya Pradesh.

Varieties	Number of field surveyed	Per cent incidence
JAKI 9218	06	11.05
JG 11	52	10.94
JG 12	45	11.01
JG 130	52	10.96
JG 14	47	11.08
JG 16	36	10.96
JG 24	06	10.57
JG 315 (max)	75	10.93
JG 322	13	11.26
JG 36	23	10.93
JG 63	26	10.97
JG 74	25	11.86
JG 14	02	12.42
Khajwa (Local)	20	11.36
Local	15	11.90
Rahila (Local)	33	12.47
RVS 201	05	9.60
RVS 202	08	10.69
RVS 203	03	10.82
Surya 10	01	10.83
Vijay	06	10.60
Vishal	02	10.94

In Satpura Plateau agro climatic zone average incidence of collar rot of chickpea recorded was 10.65 percent. During survey of major Chickpea growing districts of Madhya Pradesh collar rot appeared at 15 - 45 days old crop and it ranged from 5 - 30 percent (Gupta and Mishra 2009).

Variety wise incidence of collar rot of chickpea observed in different districts. Survey results were also categorized among variety incidence of Collar rot in Madhya Pradesh (Table 8). The chickpea varieties found during the survey of the 15 districts in the 5 agroclimatic zones were JAKI 9218, JG 11, JG 12, JG 130, JG 14, JG 16, JG 24, JG 315, JG 322, JG 36, JG 63, JG 74, JG 14, Khajwa (Local), Rahila (Local), RVS 201, RVS 202, RVS 203, Surya 10, Vijay, Vishal. The highest percent mortality was observed in the variety was observed in Rahila (Local) 12.47 % and the minimum of 9.60 % in the variety RVS 201. During survey of major Chickpea growing districts of Madhya Pradesh collar rot appeared at 15 - 45 days old crop and it ranged from 5 - 30 percent (Gupta and Mishra 2009).

Plate 1: Pure culture of *Sclerotium rolfsii* isolates.

Plate 2: Collar rot affected chickpea plant showing whitish mycelia growth.
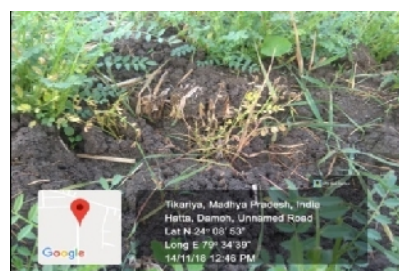
| (A) | (B) |

| (C) | (D) |

Plate 3: Geotagged Field view of collar rot affected chickpea fields at different locations.

CONCLUSION

Average minimum percent mortality was observed in the variety Rahila (Local) (12.47 %) and the minimum of (9.60 %) in RVS 201. Present survey provide a vital information of varieties affected as well as sensitive locations to collar rot of chickpea in Madhya Pradesh, which can be utilized for deriving appropriate measures to minimize further incidence of this disease.

Conflict of Interest. None.

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