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Survey to Know the Status of *Sclerotium rolfsii Sacc.* causing Foot Rot in Irrigated Finger Millet of Southern Karnataka

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ABSTRACT: Finger millet (*Eleusine coracana* (L.) Gaertn) is one of the important nutri millet crop of India. It is one of the staple food crop grown by subsistence farmers in the semi-arid tropics of South Asia and Africa. Due to its greater tolerance to biotic and abiotic stresses, better suitability for different cropping systems and contingent crop plans; it is cultivated on varied soil and climatic conditions compared to other cereals. Among these diseases, foot rot is one of the important emerging diseases of Finger Millete specially under irrigated and high rainfall situations. To know the foot rot disease occurrence and incidence of *S. rolfsii* a roving survey was undertaken during 2018-19 in southern districts of Karnataka *viz.*, Mysuru, Mandya, Ramanagara, Chamarajanagara, Hassan and Tumkuru. The survey data revealed that; mean foot rot disease incidence varied from 4.45 to 19.19 per cent in different locations. The highest mean per cent disease incidence was recorded in the Mandya district (19.19%) followed by Mysuru (12.62%). while lowest disease incidence was recorded in the Hassan district (4.45%). The highest per cent disease incidence was recorded in the regions of Mandya district V. C. Farm (31.70%) followed by Hatana (28.60%) and Honnenahally (28.40%) with canal irrigated condition was identified as the hotspots for foot rot of finger millet. Among the different locations, canal irrigation with alternative wet and drying condition was most suitable for pathogen survival and establishment compare to borewell and low rain fall irrigation ecosystem. Survey of the disease over a period of time gives the intensity with which it affects the yield in addition to the most susceptible stage of the crop. And also it helps to locate the hotspot of the disease in finger millet.

Keywords: Finger millet, *Sclerotium rolfsii*, foot rot, Hotspot, Incidence.

INTRODUCTION

Finger millet (*Eleusine coracana* (L.) Gaertn)is one of the important millet crop of India.In different regions of the country finger milletcalled as bird's foot, *madua*, *mandua*, *maruva*, *nachni*, *nagli*, *ragi* etc.,which is commonly referred as the "nutri-millet" and "poor man's food" because finger millet grains are nutritionally superior to many cereals providing fair amount of proteins, minerals, calcium, iron andvitamins in abundance .It is one of the staple food crop grown by subsistence farmers in the semi-arid tropics of South Asia and Africa. Due to its greater tolerance to biotic and abiotic stresses, better suitability for different cropping systems and contingent crop plans; it is cultivated on varied soil and climatic conditions compared to other cereals.

This cropis known to be one of the hardiest crops, it is albeit, attacked by many diseases *viz*., blast, blight, foot rot, smut, downy mildew, mosaic and mottling owing to cultivation of many high yielding varieties (Govindu and Shivanandappa, 1967). Among these diseases, foot rot is one of the important emerging diseases of Finger Millet especially under irrigated and high rainfall situations. It is caused by the fungus *Sclerotium rolfsii* (Sacc.). In recent years, due to continuous monoculture, cultural practices and use of high yielding varietiesby farmers in the irrigated ecosystem has led to outbreak of soil borne diseases like foot rot caused by *Sclerotium rolfsii*. This disease was first observed by Coleman, (1920) from the princely state of Mysuru. Subsequently, Mc Rae (1929) recorded the occurrence of foot rot in Vishakhapatnam, later in 1933 Sundararaman reported *Sclerotium rolfsii* from wilted ragi in the former Madras presidency. Narain, (1972) recorded this disease from Odisha and recently Kumar and Prasad (2010) recorded this disease in Uttarakhand.

S. rolfsii causing foot rot disease is a soil inhabitant, polyphagus and a facultative parasite. A loss up to 50 per cent was recorded in Rampur, Nepal (Batsa and Tamang, 1983). Sujatha, (1991) reported that disease incidence in Bengaluru ranged from 19-22 per cent. It occurs in diverse agro-climatic regions of tropical and subtropical continents and it is one of the most destructive soil inhabiting pathogens causing heavy loss to the crops both during Kharif as well as Rabi and summer seasons. This pathogen causes a variety of symptoms like collar rot, southern blight, foot rot, leaf spot etc., on different hosts. Due to its wide host range, prolific growth and ability to produce persistent sclerotia contribute to the large economic losses associated with this pathogen.Foot rot was most frequently occurring disease especially in irrigated and heavy rainfall area Nagaraja and Reddy (2009).To know the incidence and intensity of disease which affect the growth and yield of crop in addition to this, most susceptible stage of the crop to develop the location specific management practices is important.Survey of the disease over a period of time gives the intensity with which it affects the yield in addition to the most susceptible stage of the crop. Hence, the survey was conducted to know the severity and distribution of the disease.

MATERIAL AND METHODS

To know the incidence and intensity of foot rot disease occurrence and incidence of *S. rolfsii* a roving survey was undertaken during 2018-19 in southern districts of Karnataka viz., Mysuru, Mandya, Ramanagara, Chamarajanagara, Hassan, and Tumkuru.

Details of places surveyed are presented in Table 1. For assessing the disease incidence, minimum of four to five fields were selected in one location and three to four plots of one square meter area were selected randomly in each field. In selected plots, total number of plants present and number of plants showing symptoms due to infection of *S. rolfsii* was recorded and per cent disease incidence (PDI) was calculated by using the following formula.

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected plants observed}}{\text{Total number of plants observed}} \times 100$$

RESULTS AND DISCUSSION

To get precise information on the occurrence, distribution and severity of the *S. rolfsii* in finger millet an intensive roving survey was undertaken in southern districts of Karnataka viz., Mysuru, Mandya, Ramanagara, Chamarajanagara, Hassan, and Tumkuru (Table 1, Plate 1 & 2 and Fig. 1). Incidence of foot rot on finger millet were reported by various workers from Coimbatore (Anon., 1954), Uttarakhand (Kumar and Prasad, 2010) and Gujarat (Waghunde *et al.*, 2011).

Table 1: Details of locations selected for surveying of foot rot in finger millet.

Sr. No.	District	Taluk	Locations
1.	Mysuru	HDKote	Lakpatna
2.			Shettahally
3.		K.R Nagara	Hampapura
4.		Hunsur	Bilikere
5.			Gowdally
6.			Mulluru
7.		Nanjanagud	Hosaveedu
8.			Madavinahally
9.	Mandya	Pandavapura	Bydarahally
10.			Chikkade
11.			T.S.Chatra
12.		Srirangapatna	Garudaukkada
13.			Shanthikoppalu
14.			Doddapalya
15.		Mandya	Hatna
16.			Mudagundur
17.			V.C.Farm
18.			Honnenahally
19.			G.Malligere
20.			B.Hosuru
21.			Bevukallu
22.		Maddur	Kestur
23.			Nidasale
24.			Nidagatta
25.			Besgarahally
26.		Malavally	Nanjarayanapura
27.			Kadukottanahally
28.		Nagamangala	Harakadahally
29.			Muttegere
30.	Ramanagara	Kanakapura	Hosally
31.			Hosadoddi
32.			Kodihally
33.		Magadi	Kodigehally
34.			Mudrahally
35.	Chamarajanagara	Chamarajanagara	Kuntikudicolony
36.			Kagalawadi
37.			Haradanahally
38.		Gundlupete	Palya
39.			Raghavapuru
40.			Kotekere
41.	Hassan	Hassan	Dudda
42.			Karekere
43.			Moslehosally
44.		Channarayanapatna	Kikkeri
45.	Tumkur	Tumkur	Gulur
46.			Mallasandra
47.		Kunigal	Hebbur
48.			Yediyur

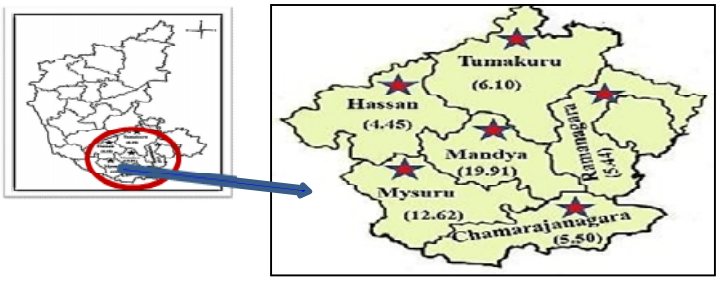

Plate 1: Incidence of foot rot in finger millet growing districts of South Karnataka.

Plate 2: Field view of survey for occurrence of foot rot disease in finger millet during *Kharif*-2018-19.

The mean per cent disease incidence (PDI) of foot rot was ranging from 4.45 to19.91 with an average of 9.00 per cent across surveyed locations on different varieties. Similar result is shown by Reddy *et al.*,(1971) in that he carried out survey during 1969-70 in Karnataka and found that, losses due to foot rot in wheat crop were about five per cent.Among the districts, the highest mean foot rot incidence (19.91%) was observed in Mandya followed by Mysuru (12.62%), Tumakuru (6.10%), Chamarajanagara (5.50%) and Ramanagara (5.44%). However, the lowest mean foot rot incidence was recorded in Hassan (4.45%). Per cent disease incidence in different districts can be classified as less (0 to 5.00 per cent), moderate (5.1 to 15.00 per cent) and high (>15.10 per cent). Hassan (4.45%) had less incidence, Ramanagara (5.44%), Tumakuru (6.10%) and Mysuru (12.62%) had moderate incidence whereas Mandya (19.91%) had high incidence of foot rot (Fig. 1).

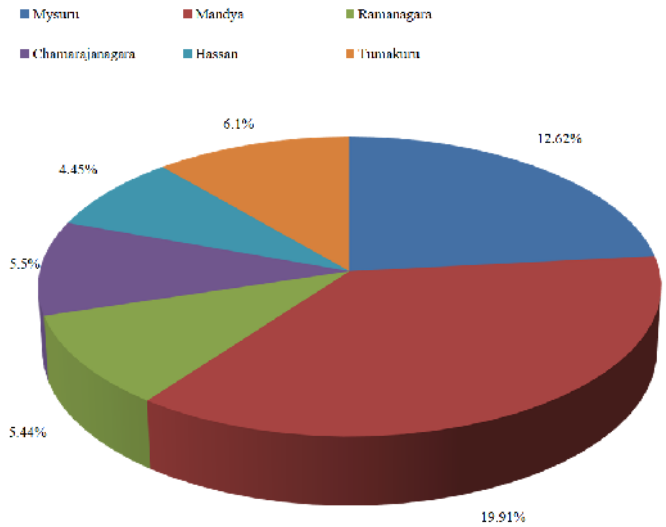

Fig. 1. Incidence of foot rot in southern districts of Karnataka.

Among the district different taluks were selected for survey to strengthen the studies. In Mysuru district, H.D.Kote, K.R.Nagara, Hunsur and Nanjanagud taluks were selected, out of which, the highest mean foot rot incidence was recorded in Nanjanagud (16.75 %) followed by K. R. Nagara taluk (15.50%), H. D. Kote (11.40%) and Hunasuru taluks (9.73%). Among the villages, the Madavinahally village of Nanjanagud taluk recorded the highest incidence (17.50%) followed by Hosaveedu (16.00%) under alternative canal irrigation system. The least incidence was recorded in Mulluru village (6.40%) of Hunsurtaluk under rainfed condition. Similarly, in six taluks of Mandya district, highest mean foot rot disease incidence in Srirangapatna taluk (24.93%) followed by Mandya taluk (21.32 %). The least mean foot rot disease incidence was noticed in Maddur taluk (11.73 %). Among the villages, the highest incidence was recorded in V. C. Farm (31.70 %) of Mandya taluk under alternative canal irrigation followed by Shantikoppalu (30.70 %) and Hatna (28.60%) villages of Srirangaptana and Mandya taluk under alternative canal irrigation system. The lowest mean incidence was recorded in the Nidagatta (9.10%) village of Maddur taluk under alternative canal irrigation condition (Table 2).

Table 2: Prevalence of foot rot in finger millet growing areas of South Karnataka.

Sr. No.	District	Taluk	Locations	Irrigationtype	Per cent Foot rot incidence	Taluk Mean
1.	Mysuru	HDKote	Lakpatna	Protective	12.50	11.40
2.			Shettahally	Protective	10.30	
3.		K.RNagara	Hampapura	Protective	15.50	15.50
4.		Hunsur	Bilikere	Rainfed	14.20	9.73
5.			Gowdally	Rainfed	8.60	
6.			Mulluru	Rainfed	6.40	
7.		Nanjanagud	Hosaveedu	Canal	16.00	16.75
8.			Madavinahally	Canal	17.50	
Mean					**12.62**	
9.	Mandya	Pandavapura	Bydarahally	Canal	13.80	13.56
10.			Chikkade	Canal	11.20	
11.			T.S.Chatra	Canal	15.70	
12.		Srirangapatna	Garudaukkada	Canal	18.90	24.93
13.			Shanthikoppalu	Canal	30.70	
14.			Doddapalya	Canal	25.20	
15.		Mandya	Hatna	Canal	28.60	21.32
16.			Mudagundur	Canal	15.70	
16.			V.C.Farm	Canal	31.70	
17.			Honnenahally	Canal	28.40	
18.			G.Malligere	Canal	24.10	
19.			B.Hosuru	Canal	26.50	
20.			Bevukallu	Canal	18.40	
21.		Maddur	Kestur	Canal	14.80	11.73
22.			Nidasale	Canal	12.40	
23.			Nidagatta	Canal	9.10	
24.			Besgarahally	Canal	10.60	
25.		Malavally	Nanjarayanapura	Protective	14.80	17.15
26.			Kadukottanahally	Protective	19.50	
27.		Nagamangala	Harakadahally	Protective	15.40	14.10
28.			Muttegere	Protective	12.80	
Mean					**19.91**	
29.	Ramanagara	Kanakapura	Hosally	Rainfed	5.40	3.87
30.			Hosadoddi	Protective	3.80	
31.			Kodihally	Protective	2.40	
32.		Magadi	Kodigehally	Rainfed	7.10	11.35
33.			Mudrahally	Protective	8.50	
Mean					**5.44**	
34.	Chamarajanagara	Chamarajanagara	Kuntikudicolony	Rainfed	3.50	3.3
35.			Kagalawadi	Rainfed	2.90	
36.			Haradanahally	Rainfed	3.50	
37.		Gundlupet	Palya	Rainfed	6.90	16.10
38.			Raghavapuru	Rainfed	5.70	
39.			Kotekere	Protective	10.50	
Mean					**5.50**	
40.	Hassan	Hassan	Dudda	Rainfed	5.30	3.90
41.			Karekere	Protective	3.60	
42.			Moslehosally	Rainfed	2.80	
43.		Channarayapatna	Kikkeri	Protective	6.10	6.10
Mean					**4.45**	
44.	Tumakuru	Tumakuru	Gulur	Rainfed	5.30	5.2
45.			Mallasandra	Rainfed	5.10	
46.		Kunigal	Hebbur	Protective	7.80	7
47.			Yediyur	Protective	6.20	
Mean					**6.10**	
Mean foot rot					**9.00**	

5.44% of mean foot rot incidence was recorded in Kanakapura and Magadi taluks of Ramanagara district. Among the taluks Magadi taluk recorded highest mean foot rot incidence of 11.35% and Kanakapura taluk recorded least foot rot incidence of 3.87%. Among the villages, under protective irrigation system Mudrahally recorded highest mean foot rot incidence of 8.50 % and least foot rot incidence of 2.40% was observed in Kodihally village.

In Chamarajanagara district, the highest mean per cent incidence was recorded at Gundlupet taluk (16.10%) followed by the Chamarajanagara taluk (3.30%) respectively. Among the villages, Kotekere village of Gundlupet taluk under protective irrigation recorded the highest incidence (10.50%) and least foot rot incidence of 2.90% was observed in Kagalavadi village under rainfed condition.

Hassan and Channarayapattana talukwas surveyed in Hassan district recorded the mean foot rot incidence of 4.45 %. Channarayapattana taluk (6.10) recorded the highest incidence under protective irrigation. Among the villages, Kikkeri (6.10 %) recorded the highest incidence under protective irrigation and least foot rot incidence of 2.80% was observed in Moslehosally village under rainfed condition.

Similarly, in the Kunigal areas of Tumakuru taluk in Tumkur district the mean per cent incidence of 6.10% was recorded and among the different villages, Hebburu village (7.80%) recorded the highest incidence under protected condition whereas the least was recorded in Mallasandra (5.10 %) under similar conditions.

The mean per cent disease incidence (PDI) of foot rot was ranging from 4.45 to 19.91with an average of 9.00 per cent across surveyed locations on different varieties. Among the districts, the highest mean foot rot incidence (19.91%) was observed in Mandya followed by Mysuru (12.62%), Tumakuru (6.10%), Chamarajanagara (5.50%) and Ramanagara (5.44%). However, the lowest mean foot rot incidence was recorded in Hassan (4.45%). Per cent disease incidence in different districts can be classified as less (0 to 5.00 per cent), moderate (5.1 to 15.00 per cent) and high (>15.10 per cent). Hassan (4.45%) had less incidence, Ramanagara (5.44%), Tumakuru (6.10%) and Mysuru (12.62%) had moderate incidence whereas Mandya (19.91%) had high incidence of foot rot (Fig. 1).

The disease incidence varied from locality to locality, which may be attributed to the varied agro-climatic situations, cropping pattern, varieties grown and cultural practices adopted by the farmers; and possibly due to existence of pathogenic variability.

Varied levels of foot rot incidence in finger millet were reported by various workers from Coimbatore (Anon., 1954), Uttarakhand (Kumar and Prasad, 2010), Gujarat (Waghunde *et al*., 2011) and Karnataka (Nagamma and Nagaraja, 2015).

It is evident from the table that the foot rot incidence was high under canal irrigation than under protective and raifed conditions. Nagaraja and Reddy (2009) also reported foot rot as a problem in heavy rainfall areas and irrigated ragi.

CONCLUSION

Survey of the disease over a period of time gives the intensity with which it affects the yield in addition to the most susceptible stage of the crop. And also it helps to locate the hotspot of the disease in finger millet. The disease incidence varied from locality to locality, which may be attributed to the varied agro-climatic situations, cropping pattern, varieties grown and cultural practices adopted by the farmers; and possibly due to existence of pathogenic variability. The foot rot incidence was high under canal irrigation than under protective and raifed conditions. In this survey, highest per cent disease incidence was recorded in the regions of Mandya district (V. C. Farm (31.70%) followed by Hatana (28.60%) and Honnenahally (28.40%) with canal irrigated condition was identified as the hotspots for foot rot of finger millet.

Conflict of Interest. There is no conflict of interest.

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