

Influence of Soil and Weather Factors on Progression of Paddy Stem Rot Disease under Natural Condition

Gowdar S.B.^{1*}, Patil M.B.², Gururaj Sunkad³, Pramesh D.⁴, Masthana Reddy B.G.⁴ and Sujay Hurali⁴

¹Department of Plant Pathology, College of Agriculture, Raichur-584104, (Karnataka), India.

²Agricultural Extension Education Centre, Koppal-583231, (Karnataka), India.

³Main Agricultural Research Station, Raichur-584104, (Karnataka), India.

⁴AICRP on Rice, ARS Gangavathi-583227, (Karnataka), India.

(Corresponding author: Gowdar S.B.*)

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ABSTRACT: Rice is a major cereal crop in Karnataka's Tungabhadra Project, Upper Krishna Project and Cauvery command regions. Stem rot has been intermittent in the TBP and UKP command areas of North eastern Karnataka in recent years, but it can become a significant concern. The present investigation was carried out on influence of weather and soil factors on progression of paddy stem rot disease under natural condition in a fixed plot size (10 m × 10 m) at Agricultural Research Station, Gangavathi, UAS Raichur, over the cropping season (*Kharif* 2017-18, *Rabi/summer* 2017-18, and *Kharif* 2018-19). The observations on per cent stem rot incidence were recorded at weekly interval (SMW - Standard Meteorological Weeks) till harvest on paddy cv. BPT-5204. The progression of paddy stem rot disease throughout the entire crop season (*Kharif* 2017-18, *Rabi/summer* 2017-18 and *Kharif* 2018-19) in the susceptible variety BPT-5204 revealed that the disease started (1.60) during the fifth week (40th SMW) after transplanting in the *Kharif* 2017-18 season and reached its peak (42.0%) during the 17th week (52nd SMW) after transplanting. The stem rot incidence was relatively low (0.80%) during 5th SMW of *Rabi/summer* 2017-18 season, and it reached a maximum (36.40%) during the 17th SMW. In the *Kharif* 2018-19 season, the stem rot disease of paddy was detected at 1.20 percent in the fifth week (39th SMW) and 38.40 per cent in the 17th week (51st SMW) after transplanting.

Keywords: Paddy, progression, standard meteorological weeks and stem rot.

INTRODUCTION

Rice is the world's second most significant food crop, next to wheat, mainly cultivated in Asia. Rice is used by 60 per cent of the people in India and China. As a result, increased rice production was prioritized in order to feed the expanding population. Rice output has raised due to high yielding cultivars, chemical fertilizer amendments and expanded irrigation areas. Rice is a major cereal crop in Karnataka's Tungabhadra Project, Upper Krishna Project and Cauvery command regions. Many diseases caused by fungi, bacteria and viruses wreak havoc on the crop. Stem rot has been intermittent in the TBP and UKP command areas of North eastern Karnataka in recent years, but it can become a significant concern. The present investigation was carried out to know the influence of weather and soil factors on progression of paddy stem rot disease under natural condition. Usmani and Ghaffar, (1986) observed that in dry soil

lower temperatures completely inhibit the growth of *Sclerotium*. Palakshappa *et al.*, (1987) reported that *S. rolfsii* causing foot rot in betel vine made maximum saprophytic activity at 0.4 dS/m electrical conductivity (EC) level. Mundhe, (2005) reported that the maximum incidence of root rot disease on finger millet was noticed during the rainy season. It was more progressive after the completion of major rainfall of the season. Shamsi *et al.*, (2011) observed stem rot after the maximum tillering stage. The plants are more susceptible at the internode elongation stage, and the disease is favored by high humidity and high temperature, nitrogenous fertilizer, dense planting and attack of stem borer, node blast, brown plant hopper and jassids (Laha *et al.*, 2017).

MATERIAL AND METHODS

To know the crop stage for initiation and progress of stem rot during the entire crop season on susceptible

variety BPT-5204, the study was carried out in fixed plot (10 m × 10 m) at ARS, Gangavathi. The crop was transplanted on 06.09.2017, 04.01.2018 and 27.08.2018 during *Kharif* 2017-18, *Rabi*/Summer 2017-18 and *Kharif* 2018-19, respectively and all recommended agronomic practices were followed. This plot was kept free from any fungicidal application. The observations of stem rot initiation and its development was recorded, starting from transplanting to the harvesting of the crop. The observations were recorded at weekly interval (SMW - Standard Meteorological Weeks) till harvest on paddy *cv.* BPT-5204. For recording the stem rot incidence in the plot, five sites (1m×1m) were selected randomly the total numbers of plants present and number of plants showing wilting symptoms due to *Sclerotium* at each spot was counted and recorded in each plot. The disease incidence (%) was calculated by using the following formula.

Stem rot incidence (%) =

$$\frac{\text{No. of infected hills}}{\text{Total no. of hills or plants observed}} \times 100$$

RESULTS AND DISCUSSION

The host, pathogen and suitable soil and weather all have a role in disease progression and have been investigated in present study. A fixed plot size (10 m × 10 m) experiment was carried out at ARS, Gangavathi, to identify the crop stage for genesis and progression of stem rot disease of paddy over the cropping season (*Kharif* 2017-18, *Rabi*/summer 2017-18, and *Kharif* 2018-19) on susceptible variety

BPT-5204.

In the *Kharif* 2017-18 season, stem rot progress begun during the 5th week after transplanting. The incidence of stem rot was initially low (1.60 per cent), but it increased to 42.0 per cent during the 17th week stem rot incidence in the plot stem rot incidence in the plot after transplanting (Table 1). According to the Standard Meteorological weeks, the soil temperature ranged from 23.67 to 24.92°C at the time of paddy transplanting (36th SMW). Similarly, several weather variables such as soil moisture (26.49%), soil pH (7.68) and soil electrical conductivity (0.52), as well as rainfall (70.4mm) and rainy days (05) were prevailed.

Paddy stem rot was initiated at the fifth week (40th SMW) of transplanting, with the incidence of 1.6 per cent. The weather variables such as maximum temperature of 25.02°C noticed, soil moisture of 27.01 per cent, soil pH was 7.80 and rainfall (9.4mm) and rainy days (02) were prevailed. During *Kharif* 2017-18, the overall rainfall and the number of rainy days may have aided the pathogen in establishing the disease. Similarly, progress and development of diseases was entirely dependent on rainfall and the number of wet days and from the 10th week (45th SMW) onwards, the disease severity has progressively increased from 12.80 to 42.0 per cent on the 17th week (52nd SMW). It is apparent from the Table that during *Kharif* 2017-18, soil temperature, soil moisture, soil PH, number of rainy days and total rainfall all favoured the pathogen colonization and disease development (Table 2 and Fig. 1).

Table 1: Progress of paddy stem rot under natural condition at ARS Gangavathi during *kharif* 2017-18, *rabi*/summer 2017-18 and *kharif* 2018-19.

SMW	Dates <i>Kharif</i> 2017-18	Stem rot incidence (%)	SMW	Dates <i>Rabi</i> /summer 2018-19	Stem rot incidence (%)	SMW	Dates <i>Kharif</i> 2018-19	Stem rot incidence (%)
36	03 Sep – 09 Sep	-	1	01 Jan – 07 Jan	-	35	27 Aug – 02 Sep	-
37	10 Sep – 16 Sep	-	2	08 Jan – 14 Jan	-	36	03 Sep – 09 Sep	-
38	17 Sep – 23 Sep	-	3	15 Jan – 21 Jan	-	37	10 Sep – 16 Sep	-
39	24 Sep – 30 Sep	-	4	22 Jan – 28 Jan	-	38	17 Sep – 23 Sep	-
40	01 Oct – 07 Oct	01.60	5	29 Jan – 04 Feb	00.80	39	24 Sep – 30 Sep	01.20
41	08 Oct – 14 Oct	03.20	6	05 Feb – 11 Feb	02.00	40	01 Oct – 07 Oct	02.80
42	15 Oct – 21 Oct	04.00	7	12 Feb – 18 Feb	04.40	41	08 Oct – 14 Oct	04.00
43	22 Oct – 28 Oct	08.40	8	19 Feb – 25 Feb	06.00	42	15 Oct – 21 Oct	07.20
44	29 Oct – 04 Nov	09.20	9*	26 Feb – 04 Mar	08.80	43	22 Oct – 28 Oct	09.20
45	05 Nov – 11 Nov	12.80	10	05 Mar – 11 Mar	12.00	44	29 Oct – 04 Nov	12.00
46	12 Nov – 18 Nov	15.60	11	12 Mar – 18 Mar	15.60	45	05 Nov – 11 Nov	15.20
47	19 Nov – 25 Nov	18.00	12	19 Mar – 25 Mar	18.80	46	12 Nov – 18 Nov	18.00
48	26 Nov – 02 Dec	24.00	13	26 Mar – 01 Apr	22.00	47	19 Nov – 25 Nov	21.60
49	03 Dec – 09 Dec	28.00	14	02 Apr – 08 Apr	25.20	48	26 Nov – 02 Dec	25.20
50	10 Dec – 16 Dec	32.40	15	09 Apr – 15 Apr	28.00	49	03 Dec – 09 Dec	29.60
51	17 Dec – 23 Dec	37.60	16	16 Apr – 22 Apr	32.00	50	10 Dec – 16 Dec	34.80
52**	24 Dec – 31 Dec	42.00	17	23 Apr – 29 Apr	36.40	51	17 Dec – 23 Dec	38.40

SMW : Standard Meteorological Week
Date of sowing : 08.08.2017
Date of transplanting : 06.09.2017
Date of harvesting : 22.12.2017

SMW : Standard Meteorological Week
Date of sowing : 03.12.2017
Date of transplanting : 04.01.2018
Date of harvesting : 28.04.2018

SMW : Standard Meteorological Week
Date of sowing : 25.07.2018
Date of transplanting : 27.08.2018
Date of harvesting : 21.12.2018

Table 2: Influence of weather and soil factors on progress of stem rot of paddy at ARS Gangavathi during Kharif 2017-18.

SMW	Dates	Soil temperature (°C)		Soil Moisture (%)	Soil pH	Soil EC	Rain fall (mm)	Rainy days /week	Stem rot incidence (%)
		Minimum	Maximum						
36	03 Sep – 09 Sep	23.67	24.92	26.49	7.68	0.52	70.4	05	-
37	10 Sep – 16 Sep	24.20	24.98	26.67	7.83	0.53	45.7	03	-
38	17 Sep – 23 Sep	23.56	24.89	27.35	7.84	0.55	16.2	01	-
39	24 Sep – 30 Sep	23.29	25.04	28.25	7.65	0.52	48.6	03	-
40	01 Oct – 07 Oct	23.12	25.02	27.01	7.80	0.53	9.4	02	01.60
41	08 Oct – 14 Oct	23.36	25.33	26.77	7.82	0.54	60.2	02	03.20
42	15 Oct – 21 Oct	23.52	25.55	26.75	7.75	0.51	-	-	04.00
43	22 Oct – 28 Oct	22.75	25.26	26.88	7.81	0.53	4.8	01	08.40
44	29 Oct – 04 Nov	22.89	25.61	27.95	7.74	0.50	-	-	09.20
45	05 Nov – 11 Nov	24.30	25.49	29.01	8.05	0.61	-	-	12.80
46	12 Nov – 18 Nov	23.50	24.55	27.07	7.74	0.55	-	-	15.60
47	19 Nov – 25 Nov	24.47	25.84	27.00	7.78	0.53	-	-	18.00
48	26 Nov – 02 Dec	21.87	25.50	28.75	7.94	0.59	-	-	24.00
49	03 Dec – 09 Dec	21.89	26.69	27.81	7.84	0.54	-	-	28.00
50	10 Dec – 16 Dec	21.17	27.91	27.91	7.92	0.58	-	-	32.40
51	17 Dec – 23 Dec	20.49	29.15	27.89	7.86	0.56	-	-	37.60
52**	24 Dec – 31 Dec	22.15	28.27	27.09	7.79	0.51	-	-	42.00

SMW: Standard Meteorological Week; Date of sowing: 08.08.2017; Date of transplanting: 06.09.2017; Date of harvesting: 22.12.2017

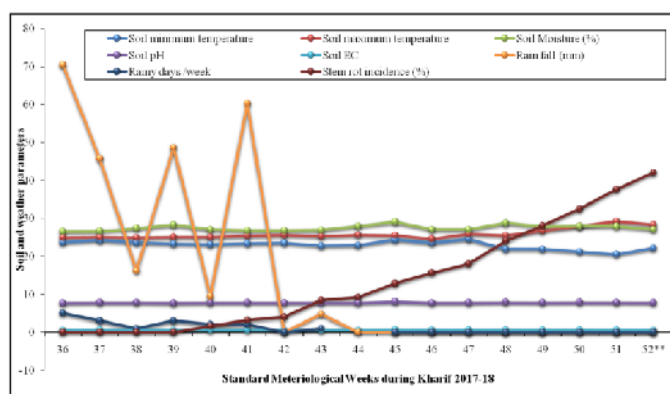


Fig. 1. Influence of soil and weather parameters on stem rot of rice at ARS Gangavathi during Kharif 2017-18.

Similarly, during the Rabi/ summer 2017-18 season, the natural progression of paddy stem rot commenced on the 5th SMW. The stem rot incidence was initially relatively low (0.80 per cent) and surged at 36.40 per cent during the 17th SMW of plant growth (Table 3 and Fig. 2). During this period the temperature was ranged

from 19.37 to 38.13 °C and there was no much variation in remaining weather factors except rainfall pattern. The disease incidence progress and level was relatively low during Rabi/summer 2017-18 compare to Kharif 2017-18 may be due to increase of temperature compare to previous season.

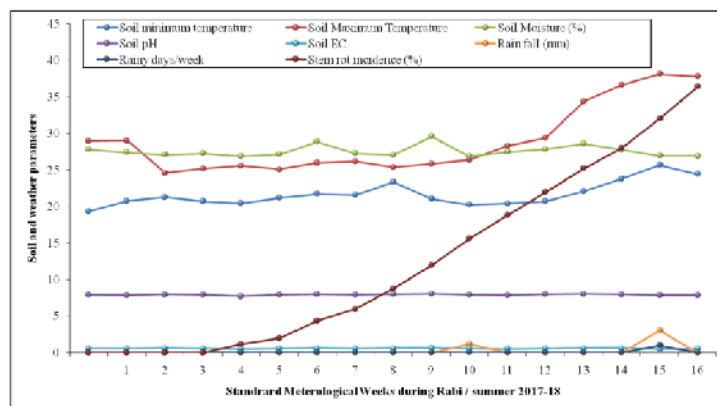


Fig. 2. Influence of soil and weather parameters on stem rot of rice at ARS Gangavathi during Rabi/summer 2017-18.

Table 3: Influence of weather and soil factors on progress of stem rot of paddy at ARS Gangavathi during Rabi/summer 2017-18.

MSW	Dates	Soil temperature (°C)		Soil Moisture (%)	Soil pH	Soil EC	Rain fall (mm)	Rainy days/week	Stem rot incidence (%)
		Minimum	Maximum						
1	01 Jan – 07 Jan	19.37	28.97	27.81	7.92	0.58	-	-	-
2	08 Jan – 14 Jan	20.75	29.02	27.42	7.84	0.55	-	-	-
3	15 Jan – 21 Jan	21.29	24.57	27.11	7.95	0.59	-	-	-
4	22 Jan – 28 Jan	20.73	25.17	27.26	7.89	0.57	-	-	-
5	29 Jan – 04 Feb	20.44	25.54	26.88	7.73	0.51	-	-	01.20
6	05 Feb – 11 Feb	21.17	25.07	27.13	7.89	0.56	-	-	02.00
7	12 Feb – 18 Feb	21.72	25.95	28.86	7.99	0.59	-	-	04.40
8	19 Feb – 25 Feb	21.58	26.17	27.29	7.91	0.58	-	-	06.00
9*	26 Feb – 04 Mar	23.37	25.36	27.05	7.98	0.59	-	-	08.80
10	05 Mar – 11 Mar	21.06	25.84	29.59	8.04	0.61	-	-	12.00
11	12 Mar – 18 Mar	20.26	26.35	26.90	7.94	0.55	1.2	-	15.60
12	19 Mar – 25 Mar	20.42	28.28	27.49	7.87	0.53	-	-	18.80
13	26 Mar – 01 Apr	20.70	29.34	27.84	7.96	0.58	-	-	22.00
14	02 Apr – 08 Apr	22.07	34.39	28.59	8.01	0.59	-	-	25.20
15	09 Apr – 15 Apr	23.8	36.65	27.78	7.95	0.59	-	-	28.00
16	16 Apr – 22 Apr	25.68	38.13	26.95	7.85	0.52	3	1	32.00
17	23 Apr – 29 Apr	24.42	37.80	26.92	7.85	0.53	-	-	36.40

SMW: Meteorological Standard Week; Date of sowing: 03.12.2017; Date of transplanting: 04.01.2018; Date of harvesting: 28.04.2018

In the *Kharif* 2018-19, stem rot disease paddy appeared in the fifth week (39th SMW) after transplanting accounting for 1.20 per cent incidence. The most significant frequency of paddy stem rot was reported in the 17th week after transplanting with incidence of 38.40 per cent (Table 4 and Fig. 3). In this season it was observed that, there was slight increase in rate of stem rot development from 29.60 to 34.80 per cent

between 49th and 50th SMW may be due to the drop in minimum temperature from 24.75 to 22.55°C and remaining weather variables remain same might have supported the acceleration of the disease. The progress and growth of paddy stem rot may be seen starting from the fifth week and culminating in the 17th week in all seasons.

Table 4: Influence of weather and soil factors on progress of stem rot of paddy at ARS Gangavathi during Kharif 2018-19.

SMW	Dates	Soil temperature (°C)		Soil Moisture (%)	Soil pH	Soil EC	Rain fall (mm)	Rainy days/week	Stem rot incidence (%)
		Minimum	Maximum						
35	27 Aug – 02 Sep	23.73	28.89	27.09	8.01	0.60	15.2	02	-
36	03 Sep – 09 Sep	23.87	29.34	26.82	7.88	0.53	3.8	01	-
37	10 Sep – 16 Sep	24.75	30.19	27.78	7.94	0.55	-	-	-
38	17 Sep – 23 Sep	24.65	31.03	27.53	7.89	0.53	22.1	04	-
39	24 Sep – 30 Sep	24.16	32.00	28.09	7.81	0.51	9.8	02	01.20
40	01 Oct – 07 Oct	25.63	30.31	27.12	7.88	0.53	-	-	02.80
41	08 Oct – 14 Oct	26.30	33.01	28.17	7.97	0.59	-	-	04.00
42	15 Oct – 21 Oct	26.06	34.84	27.54	7.87	0.52	42.4	02	07.20
43	22 Oct – 28 Oct	25.55	34.00	27.46	7.97	0.58	-	-	09.20
44	29 Oct – 04 Nov	25.32	36.28	28.12	7.98	0.59	-	-	12.00
45	05 Nov – 11 Nov	24.61	35.24	29.57	8.11	0.63	-	-	15.20
46	12 Nov – 18 Nov	24.09	34.07	28.10	7.96	0.57	-	-	18.00
47	19 Nov – 25 Nov	24.14	33.49	29.55	8.03	0.61	-	-	21.60
48	26 Nov – 02 Dec	23.91	31.04	28.53	7.95	0.58	-	-	25.20
49	03 Dec – 09 Dec	24.75	30.97	27.66	7.94	0.53	-	-	29.60
50	10 Dec – 16 Dec	22.55	31.42	27.34	7.86	0.52	-	-	34.80
51	17 Dec – 23 Dec	21.58	31.19	27.92	7.60	0.50	-	-	38.40

SMW: Standard Meteorological Week; Date of sowing: 25.07.2018; Date of transplanting: 27.08.2018; Date of harvesting: 21.12.2018

The progression of incidence of stem rot was studied using epidemiological factors such as soil temperature, rainfall, number of rainy days, soil moisture, soil pH, electrical conductivity and soil moisture. These parameters play an essential role in development of stem rot of paddy and help in disease severity as well as pathogenicity. According to Krishnaveni and Laha (2009), changes in agricultural

practices, high relative humidity (>80%), high temperature (30 to 35°C), and waterlogged conditions have indeed contributed to an alarming increase in stem rot disease. Hussain and Ghaffar, (1998) conducted experiments to investigate the influence of soil solarization and reported no change in surface and deep conditions in non-mulched conditions and sclerotial viability was not lost.

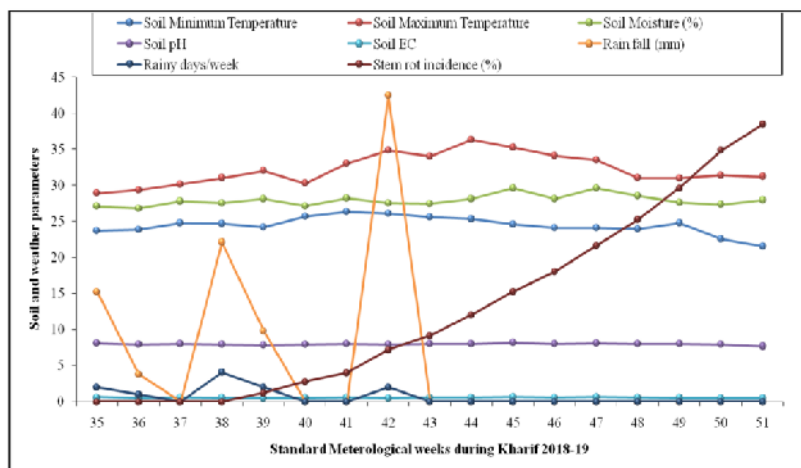


Fig. 3. Influence of soil and weather parameters on stem rot of rice at ARS Gangavathi during *Kharif* 2018-19.

Cintas and Webster, (2001) confirmed how *S. oryzae* inoculum was affected by winter floods and different residue management techniques. An increase in EC levels dramatically decreased colonization and germination of *S. rolfsii* Sacc. sclerotia. The temperatures of 25-30°C, 30 per cent soil moisture and pH of 5.5 to 9.0 were ideal for pathogen growth (Kulkarni, 2007). The foot rot infection in finger millet caused by *S. rolfsii* commenced in the second fortnight of August and culminated after the 36th MSW, when heavy rainfall had completed. The disease progressed more quickly in the 36th and 38th MSWs, when soil temperatures ranged from 28 to 29°C, rainfall ranged from 2.70 to 26.10 mm and soil moisture ranged from 19.64-26.82 per cent (Pawar, 2013). The researchers focused on developing soil borne diseases in chickpea correlated with crop growth stage and meteorological data, concluded that the 52nd SMW, i.e. the 5th week of December 28th had the highest collar rot (28.2%). Temperatures varied from 7.40 to 24.90°C, with relative humidity ranging from 24 to 89 per cent throughout that time. Contrary to this, the highest per cent mortality due to dry root rot was observed in the 10th SMW, i.e. the second week of March 2012, when the temperature ranged from 11.6-30.8°C coupled with 18 to 76 per cent relative humidity. However, the disease was initiated when the temperature was >27°C with a low relative humidity (Akhilesh Jagre *et al.*, 2014).

CONCLUSION

The progression of paddy stem rot disease throughout the entire crop season (*Kharif* 2017-18, *Rabi/summer* 2017-18 and *Kharif* 2018-19) in the susceptible variety BPT-5204 revealed that the disease started (1.60) during the fifth week after transplanting in the *Kharif* 2017-18 season and reached its peak (42.0%) during the 17th week after transplanting. The stem rot incidence was relatively low (0.80%) throughout the *Rabi/summer* 2017-18

season, and it reached a maximum (36.40%) during the 17th week. In the *Kharif* 2018-19 season, the stem rot disease of paddy was detected at 1.20 percent in the fifth week and 38.40 per cent in the 17th week.

Conflicts of Interest. None.

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