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Effect of different sowing dates on the development and spread of sheath blight disease in rice

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ABSTRACT

An experiment was conducted to find out the effective sowing dates to avoid the economically important disease like sheath blight of rice caused by Rhizoctonia solani. Maximum disease severity (39.85%) as well as disease incidence (35.36%) and rate of spread (r = 0.224) was recorded in the variety MTU 7029 when the crop was sown on 30th June (early sowing). Minimum disease was obtained when the crop was sown on 15th July (normal sowing) which can be recommended to escape the disease.

***Keywords*:** Disease severity, rice sheath blight, sowing date

Sheath blight of rice caused by the fungus *Rhizoctonia solani* Kuhn [Teleomorph –*Thanatephorus cucumeris* (A.B. Frank) Donk], has become one of the most devastating diseases of rice (*Oryza sativa* L.) worldwide. In India, the disease has been reported to cause severe damage to plants in many parts of the country. The disease affects leaf sheaths, leaf blades, stems and sometimes panicles. An estimation of losses due to sheath blight disease alone in India has been upto 54.3% (Rajan, 1987; Roy, 1993). In spite of advances in disease management strategies the philosophy of farmers in disease management is mainly restricted to the fungicidal application or chemical sprayings. The conventional chemical method of disease management most of the time leave harmful residues both in soil and crop itself. Therefore, management of sheath blight disease has been directed towards the integration of cultural practices with chemical control (Chin and Bhandhufalck, 1990; Damicone *et al.*, 1993). Among different cultural practices, adjustment of sowing dates plays an important role in development and spread of any disease. Knowledge about this factor is very much necessary to work out strategies for disease management. In view to this, the present study was carried out to find out the most appropriate sowing date to escape the onset of the disease and ultimately to avoid the crop loss due to the disease.

MATERIALS AND METHODS

Field trial was taken up in the research fields of All India Coordinated Rice Improvement Project, Regional Research and Technology Transfer Station, OUAT, Chiplima during *kharif* season of two consecutive years 2013 and 2014. Two most popular varieties of western Odisha, MTU 7029 and MTU 1001 were selected for the study. Uniform plant population was maintained for each plot with a plot size of 50 m^2 and 20 x 15 cm spacing with three replications. All the recommended agronomic practices were followed to raise the crop. The crop was directly sown at 15 days interval as early (30th June), mid (15th July) and late (30th July) sowing following raised bed technique. Natural infection of the disease was permitted. The plants were constantly examined for disease progress or decline starting from the initial appearance of the disease. Both disease severity percentage and disease incidence percentage was recorded at weekly interval till the terminal disease severity/ incidence. Three sampling units of one m^2 area were fixed in each plot at random for observation of both disease severity and incidence. Ten plants at random in each sampling unit were selected and observations on the severity and incidence of sheath blight in each plot were recorded.

The disease severity of the two varieties was compared by calculating the AUDPC values following the formula proposed by Wilcoxon *et al*. (1975)

$$= \sum_{i-1}^{k} \frac{1}{2}(S_i + S_{i-1}) \times d$$

Where Si= disease severity at the end of the week i, k = no. of successive evaluation of the disease, d= interval between two evaluations.

Disease incidence percentage was recorded by using the following formula (Anon., 2002):

$$\% \text{ Disease Incidence} = \frac{\text{No. of plants infected}}{\text{Total no of plants observed}} \times 100$$

The rate of spread (r) of the disease both in case of disease severity and disease incidence was also calculated for each sowing in case of MTU 7029 as per the formula proposed by Vanderplank (1963)

$$r = \frac{2.3}{(t_2 - t_1)}\left(\log \frac{x_2}{1-x^2} - \log \frac{x_1}{1-x^1}\right)$$

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Where (t_2 - t_1) = time interval between two observations, X_1= % disease severity/ incidence at t_1 and X_2= % disease severity/incidence at t_2.

RESULTS AND DISCUSSION

The investigation was taken up to have information on the effect of time of sowing on disease severity and incidence. Data at weekly interval was recorded in relation to different time of sowing during both the years of experiment and pooled data was also worked out. It was found that both disease severity and disease incidence were significantly influenced by date of sowing.

Data presented in table 1 indicated that, percent disease severity (PDS) reached the highest in case of early sown crop of MTU 7029 with a pooled PDS of 33.95 and lowest in mid sown crop recording 26.48 pooled PDS. In case of MTU 1001 also (Table 2) the highest pooled PDS of 13.57 was recorded from early sown crop and the lowest from the mid sown crop with a pooled PDS of 10.35. So, the crop sown on 30th June as early crop showed maximum disease severity during both the years. In case of both the varieties the disease progressed with time and reached its maximum level nearing maturity. The disease severity percentage was low at early growth stages but the severity increased rapidly at either flowering or grain filling stages and reached the peak nearing maturity. The PDS at early growth stages differed significantly from the severity at later stages of plant growth during both the years of experiment. Same trend was noticed in case of both the varieties though the disease severity was much more in MTU 7029 than in MTU 1001 during both the years of experiment. Sheath blight is usually severe on cultivars that are short, highly tillering, more erect and responsive to high fertilizer in comparison to tall cultivars with fewer tillers and some cultivars may be resistant or susceptible at both seedling and adult stages while others may be resistant at seedling stage but become susceptible later and *vice* versa (Anon.,1973). Vanitha *et al.,* (1996) reported that plants are more susceptible to infection at booting and flowering and the average percentage of infected tillers and average disease severity are increased as plant age increases. Munshi and Singh (2000) also recorded flowering stage as the most susceptible stage as compared to seedling and tillering stages. The maximum disease severity observed at the time of grain filling or maturity may be attributed to the prevalence of optimum temperature and humidity for favourable development of the disease during that time as compared to earlier months.

Table 1: Sheath blight disease severity percentage in MTU 7029 during three dates of sowing

Crop stage	Early sowing			Mid sowing			Late sowing		
	2013	**2014**	**Pooled**	**2013**	**2014**	**Pooled**	**2013**	**2014**	**Pooled**
1st (Tillering)	2.71	2.19	2.45	2.24	3.40	2.82	3.37	3.66	3.52
	(9.46)	(8.49)	(8.99)	(8.54)	(2.02)	(1.95)	(10.54)	(2.14)	(2.12)
2nd (Tillering)	4.92	9.50	7.21	3.89	4.59	4.24	5.74	6.10	5.92
	(12.77)	(17.86)	(15.55)	(11.33)	(2.36)	(2.29)	(13.72)	(2.65)	(2.63)
3rd (P.I.)	7.75	14.05	10.90	7.24	6.95	7.10	8.58	8.55	8.57
	(16.13)	(21.98)	(19.25)	(15.54)	(2.82)	(2.85)	(16.92)	(3.06)	(3.09)
4th (P.I.)	15.34	16.35	15.85	12.75	9.45	11.10	16.73	12.75	14.74
	(22.99)	(23.82)	(23.44)	(20.88)	(3.23)	(3.48)	(24.06)	(3.68)	(3.94)
5th (Flowering)	32.65	19.55	26.10	20.60	13.65	17.13	24.90	15.50	20.20
	(34.82)	(26.17)	(30.70)	(26.90)	(3.82)	(4.26)	(29.86)	(4.03)	(4.59)
6th (G.F.)	37.27	21.75	29.51	28.11	16.65	22.33	27.27	17.80	22.53
	(37.60)	(27.68)	(32.86)	(31.92)	(4.19)	(4.83)	(31.44)	(4.32)	(4.84)
7th (G.F.)	37.83	26.95	32.39	30.05	19.30	24.68	31.56	20.05	25.81
	(37.93)	(31.21)	(34.65)	(33.20)	(4.50)	(5.07)	(34.16)	(4.58)	(5.18)
8th (Maturity)	39.85	28.05	33.95	31.25	21.70	26.48	35.42	22.50	28.96
	(39.13)	(31.94)	(35.62)	(33.95)	(4.76)	(5.24)	(36.50)	(4.84)	(5.47)
SEm (±)	**0.84**	**1.37**	**0.81**	**1.20**	**0.16**	**0.08**	**1.16**	**0.10**	**0.12**
LSD(0.05)	**2.58**	**4.20**	**2.48**	**3.66**	**0.48**	**0.25**	**3.56**	**0.30**	**0.36**

Note: P.I. - Panicle initiation, G.F. - Grain filling. Figures in the parentheses are the transformed data.

While considering the data on disease incidence percentage in MTU 7029 (Table 3) a highest pooled incidence of 34 per cent was recorded from early sown crop and a lowest pooled value of 20.91 per cent was reported from the mid sown crop. The disease incidence percentage at early growth stages differed significantly from the later growth stages and same result was observed during both the years irrespective of sowing time. The disease incidence percentage was very low in MTU 1001 during both the years of experiment and hence the data was not included in the result.

In general, disease severity was more during 2013 than 2014 which may be attributed to variations in weather conditions. While considering the AUDPC values in variety MTU 7029 (Table 4) the highest values of 1099.35 and 862.89 were found during 2013 and 2014 respectively in early sown crop while the lowest values of 835.67 and 581.98 were found in mid sown crop during 2013 and 2014 respectively. Same trend was observed in MTU 1001 also though the AUDPC values were lower than MTU 7029. This may be due to variations in resistance level of the two varieties.

Table 2: Sheath blight disease severity percentage in MTU 1001 during three dates of sowing

Crop stage	Early sowing			Mid sowing			Late sowing		
	2013	**2014**	**Pooled**	**2013**	**2014**	**Pooled**	**2013**	**2014**	**Pooled**
1st (Tillering)	3.23	2.57	2.90	2.58	1.80	2.19	3.49	2.82	3.16
	(2.03)	(1.87)	(1.97)	(1.89)	(1.66)	(1.78)	(2.10)	(1.94)	(2.03)
2nd (Tillering)	5.85	5.50	5.68	4.96	3.07	4.02	5.12	3.97	4.55
	(2.62)	(2.53)	(2.58)	(2.43)	(2.01)	(2.24)	(2.47)	(2.23)	(2.35)
3rd (P.I.)	8.45	6.82	7.64	5.57	4.95	5.26	7.70	5.65	6.68
	(3.05)	(2.80)	(2.94)	(2.55)	(2.44)	(2.50)	(2.95)	(2.58)	(2.77)
4th (P.I.)	11.70	7.85	9.78	7.42	5.60	6.51	8.89	7.72	8.31
	(3.56)	(2.97)	(3.28)	(2.90)	(2.56)	(2.74)	(3.14)	(2.94)	(3.05)
5th (Flowering)	12.43	9.30	10.87	8.99	6.14	7.57	10.50	8.15	9.33
	(3.66)	(3.20)	(3.45)	(3.15)	(2.67)	(2.92)	(3.39)	(3.02)	(3.21)
6th (G.F.)	15.22	9.76	12.49	10.17	6.83	8.50	12.79	9.90	11.35
	(4.02)	(3.28)	(3.67)	(3.33)	(2.80)	(3.08)	(3.71)	(3.29)	(3.51)
7th (G.F.)	16.13	10.02	13.08	12.74	7.25	10.0	13.40	10.48	11.94
	(4.13)	(3.31)	(3.75)	(3.70)	(2.87)	(3.32)	(3.79)	(3.38)	(3.59)
8th (Maturity)	16.88	10.25	13.57	12.90	7.80	10.35	14.76	11.05	12.91
	(4.22)	(3.35)	(3.82)	(3.72)	(2.96)	(3.37)	(3.97)	(3.47)	(3.73)
SEm (±)	**0.12**	**0.13**	**0.07**	**0.11**	**0.05**	**0.07**	**0.11**	**0.09**	**0.07**
LSD (0.05)	**0.37**	**0.39**	**0.21**	**0.35**	**0.15**	**0.20**	**0.33**	**0.28**	**0.20**

Note: P.I. - Panicle initiation, G.F. - Grain filling. Figures in the parentheses are the transformed data.

Table 3: Sheath blight disease incidence percentage in MTU 7029 during three dates of sowing

Crop stage	Early sowing			Mid sowing			Late sowing		
	2013	**2014**	**Pooled**	**2013**	**2014**	**Pooled**	**2013**	**2014**	**Pooled**
1st (Tillering)	3.50	6.87	5.19	4.50	4.15	4.33	5.45	2.20	3.83
	(10.66)	(15.16)	(13.16)	(2.33)	(2.33)	(2.29)	(2.51)	(1.78)	(2.19)
2nd (Tillering)	7.79	14.38	11.09	7.20	6.09	6.65	8.42	3.34	5.88
	(16.12)	(22.19)	(19.42)	(2.83)	(2.65)	(2.75)	(3.05)	(2.07)	(2.62)
3rd (P.I.)	13.65	17.52	15.59	10.46	6.82	8.64	12.91	5.40	9.15
	(21.66)	(24.62)	(23.23)	(3.36)	(2.79)	(3.10)	(3.72)	(2.52)	(3.19)
4th (P.I.)	20.23	20.95	20.59	13.59	10.15	11.87	14.67	10.75	12.71
	(26.71)	(27.22)	(26.97)	(3.81)	(3.33)	(3.59)	(3.95)	(3.42)	(3.69)
5th (Flowering)	30.94	27.50	29.22	16.62	14.22	15.42	18.85	13.28	16.07
	(33.77)	(31.57)	(32.70)	(4.18)	(3.90)	(4.05)	(4.45)	(3.75)	(4.13)
6th (G.F.)	32.71	27.88	30.30	19.75	14.63	17.19	21.50	16.70	19.10
	(34.86)	(31.80)	(33.38)	(4.55)	(3.94)	(4.26)	(4.74)	(4.18)	(4.48)
7th (G.F.)	35.30	30.45	32.88	22.26	18.25	20.26	24.00	20.11	22.06
	(36.43)	(33.44)	(34.97)	(4.82)	(4.39)	(4.61)	(5.0)	(4.59)	(4.80)
8th (Maturity)	35.36	32.64	34.0	22.84	18.97	20.91	24.70	21.65	23.18
	(36.47)	(34.82)	(35.65)	(4.88)	(4.47)	(4.68)	(5.07)	(4.76)	(4.92)
SEm (±)	**0.72**	**1.14**	**0.48**	**0.21**	**0.17**	**0.15**	**0.14**	**0.14**	**0.12**
LSD (0.05)	**2.21**	**3.51**	**1.46**	**0.65**	**0.51**	**0.45**	**0.44**	**0.43**	**0.37**

Note: P.I. - Panicle initiation, G.F. - Grain filling. Figures in the parentheses are the transformed data.

Table 4: Sheath blight disease severity (AUDPC) of MTU 7029 and MTU 1001

Time of sowing	2013		2014	
	Disease severity (AUDPC)		Disease severity (AUDPC)	
	MTU 7029	MTU 1001	MTU 7029	MTU 1001
Early	1099.35	558.85	862.89	389.62
Mid	835.67	403.13	581.98	270.48
Late	939.23	472.68	656.81	369.64

Rate of spread (r) of sheath blight disease in terms of both disease severity and incidence was also compared in case of cultivar MTU 7029 (Table 5). It was found that, vertical spread was more as compared to horizontal spread of the disease. Considering the disease severity, maximum r values of 0.142 and 0.224 during 2013 and 2014 respectively were recorded in case of early sown crop and in case of disease incidence also, maximum rate was again found in case of early sown crop (r = 0.122 and 0.119 during 2013 and 2014 respectively).

Table 5: Maximum rate of spread of sheath blight disease severity and incidence in MTU 7029

Time of sowing	2013		2014	
	Max. rate of spread (r)		Max. rate of spread (r)	
	Disease severity	Disease incidence	Disease severity	Disease incidence
Early	0.142	0.122	0.224	0.119
Mid	0.090	0.073	0.063	0.062
Late	0.109	0.068	0.076	0.106

So, it is clear from the result that, highest disease severity and incidence as well as their rate of spread, all were maximum in case of early sown crop and minimum in mid sown crop. Therefore in areas which are prone to sheath blight infection early sowing of rice crop should be avoided and mid sowing i.e. sowing during mid July (preferably at 15th July) is recommended to escape the disease.

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