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Effect of different dates of sowing on the occurrence and severity of sheath rot disease in rice

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Abstract
Avoidance or escape is one of the safest principles of plant disease management. Field experiment was conducted to find out the best sowing time to avoid sheath rot disease, one of the emerging diseases of rice crop. Rice variety MTU 1001 was sown three times during kharif season at 15 days interval as early, mid and late sown crop. It was found that the disease appeared late in early sown crop and consequently the disease severity in terms of Percent Disease Index (PDI) was also lowest (36.4 %) as compared to mid and late sown crops recording 41.95 % and 47.22 % PDI respectively. So, early sowing i.e. sowing within the last week of June is found to be the best sowing time to escape sheath rot disease. This will render less damage to the crop ultimately increasing the yield level of the crop.

Keywords: rice, sheath rot, date of sowing

Introduction
Sheath rot disease of rice caused by *Sarocladium oryzae* was reported first in Taiwan almost a century ago. The disease was mainly characterized by rotting and discolouration of sheath leading to chaffiness and sterility of grains. Various other organisms like *Fusarium* sp and *Pseudomonas* sp can also cause similar symptoms like sheath rot and all of them including sheath rot are seed transmitted and constitute a disease complex. Crop intensification practices like increased plant density, high dose of nitrogenous fertilizer, use of semi dwarf and photo period insensitive cultivars made the rice plants susceptible to many diseases and sheath rot complex is one of them (Vincent *et al*., 2015) [9]. According to Mew *et al*. (2004) [4] new photo period insensitive cultivars have lost the capacity of avoiding flowering under conditions of high humidity and temperature, thus making the rice plants conducive to effective disease attacks. Moreover, international exchange of planting material may have contributed to the spread of the disease. The disease was considered as a geographically limited disease for many years but recently it is getting momentum and considered as an important disease occurring in almost all rice growing areas of the country and as an emerging rice production threat. The disease is an emerging problem in rice belt of Odisha. It can lead to variable yield losses which can be as high as 85 % (Sakthivel, 2001) [8]. Moderately resistant varieties or genotypes can be used in breeding programme for sheath rot management (Pal *et al.* 2011) [6]. A number of fungicides are available in the market to control the disease but over reliance on pesticides is increasing the environmental pollution day by day. So producing food in a sustainable way adopting environment friendly plant protection measures is the need of the hour. Taking all these factors into account, the present experiment was carried out to have an idea on the occurrence of sheath rot disease at three different dates of sowing. The aim is to study the progress and severity of the disease at different sowing dates and find out the most suitable one to avoid or escape the disease. This will help to minimize the extent of damage caused by the disease by adjusting the sowing date.

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 2016 and 2017.

The station is located at 20^0 21'N latitude and 80^0 55'E longitude with an elevation of 178.8 m above mean sea level in the Sambalpur district of Odisha. Sheath rot susceptible variety MTU 1001 was selected for the study. Uniform plant population was maintained for each plot with a plot size of 25 m^2 and 20 x 15 cm spacing with four 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. The disease severity percentage was recorded at weekly interval till the terminal disease severity. Three sampling units of one m^2 area were fixed in each plot at random for observation of disease severity. Ten plants at random in each sampling unit were selected and observation on the disease severity was recorded following SES Scale (Anonymous, 2002) [1]. The Per cent disease index was calculated using the following formulae:

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of all numerical ratings}}{\text{No.of observations X Maxmimum rating}} \text{ X } 100$$

Results and Discussion

It is very clear from the result that the first symptom of the disease was visible during flowering and grain filling stages and after that the disease severity went on increasing and continued till the ripening and maturity stage of the crop. In the month of November, when the minimum temperature came down below 20 ^{0}C and evening relative humidity was nearly 60-70%, the disease was found to be more in the field especially during the grain filling stage of the crop. This was common in both the years of study. Pearce *et al.* (2001) [7] found the causal fungus most destructive after booting stage. Grewal and Kang (1990a) [2] in a study with the sheath rot disease incidence observed that cool and dry condition favoured the survival of the fungus in plants even up to 11 months. Sakthivel (2001) [8] reported that a temperature of 20-30 ^{0}C and relative humidity in the range of 65-85% favour sheath rot development.

During 2016, disease severity reached 42.23% in case of early sown crop (Table 1). It was higher in case of mid sown crop recording 46.11% (Table 2) and highest in late sown crop i.e. 51.11% (Table 3) disease severity. Similar trend was noticed in 2017 though the disease was a little less severe as compared to 2016 which may be attributed to varied weather conditions during both the years of experiment. In 2017, the disease severity reached to 30.56% (Table 1) in early sown crop and 37.78% and 43.33% severity were recorded in mid and late sown crop (Table 2 & 3) respectively. During both the years of study, disease severity was highest in late sown crop and it was lowest in early sown crop of rice. This finding is in conformity with the finding of Grewal and Kang (1990 b) [3] who observed that the increase in disease incidence was co-related with delay in transplanting.

Table 1: Percent Disease Index (PDI) of Sheath rot disease in early sown crop of rice

Observations (at weekly interval)	Crop Stage	Percent Disease Index (PDI)		
		2016	2017	Pooled
1st (114 DAS)	Grain filling	13.89*	15.00	14.45
2nd week	Grain filling	16.67	17.23	16.95
3rd week	Grain filling	22.78	23.33	23.06
4th week	Grain filling	31.67	28.89	30.28
5th week	Ripening	37.22	30.00	33.61
6th week	Maturity	42.23	30.56	36.40

*average of four replications

Table 2: Percent Disease Index (PDI) of Sheath rot disease in mid sown crop of rice

Observations (at weekly interval)	Crop Stage	Percent Disease Index (PDI)		
		2016	2017	Pooled
1st (95 DAS)	Grain filling	14.45*	11.11	12.78
2nd week	Grain filling	17.23	16.67	16.95
3rd week	Grain filling	23.89	25.56	24.73
4th week	Grain filling	33.89	32.78	33.34
5th week	Ripening	40.00	36.67	38.34
6th week	Maturity	46.11	37.78	41.95

*average of four replications

Table 3: Percent Disease Index (PDI) of Sheath rot disease in late sown crop of rice

Observations (at weekly interval)	Crop Stage	Percent Disease Index (PDI)		
		2016	2017	Pooled
1st (87 DAS)	Flowering	16.11*	10.56	13.34
2nd week	Grain filling	21.67	19.45	20.56
3rd week	Grain filling	26.67	28.89	27.78
4th week	Grain filling	35.00	36.12	35.56
5th week	Grain filling	45.56	40.00	42.78
6th week	Ripening	51.11	43.33	47.22

*average of four replications

The disease appeared late in early sown crop as compared to mid and late sown crop. In early sown crop, it appeared at about 114 days after sowing (DAS), in mid sown crop about 95 DAS and in late sown crop the disease was noticed 87 DAS. Therefore, the early sown crop suffered less due to the disease and consequently the pooled disease severity was also

lowest i,e., 36.40% (Table 1) disease severity as compared to mid and late sown crop. In late sown crop, the disease appeared much earlier and the crop experienced maximum infection recording a highest pooled PDI of 47.22% (Table 3). The disease severity of mid sown crop was intermediate in between the two and the pooled PDI was recorded 41.95% (Table 2). Mukherjee & Yadav (1989) [5] also reported that early medium duration cultivars when sown in June escaped the disease and had little infection whereas July sown crop had shown more incidence. So, it can be concluded from the present study that early sowing of rice crop preferably during the later parts of June is better than mid and late sowing or July sowing to escape the sheath rot disease and to lower the extent of damage caused by the disease.

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