The Pharma Innovation Journal 2021; 10(11): 1896-1900

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 1896-1900

www.thepharmajournal.com
Received: 03-09-2021
Accepted: 10-10-2021

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Disease incidence as influenced by different sowing methods and varieties of rice

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Abstract
The effect of weather parameters on different rice cultivars with various sowing methods of direct seeded rice was studied at Agricultural Research Station Farm, Vadgaon Maval, Tal. Maval, Dist. Pune *kharif*, 2017.The field experiment was laid out in split plot design with three replications. There were sixteen treatment combinations comprising of four sowing methods and four varieties. The results revealed that the disease incidence was lower in paddy variety VDN-99-29 (*Phule Samruddhi*) followed VDN-3-51-18 (*Indrayani*) and higher incidence with IET-13549 (*Bhogawati*) and RDN-99-1 (*Phule Radha*). The disease incidence was more with drill sowing at 22.5 cm and lower with sowing on raised bed (15-25×15-25 cm). There was positive correlation between maximum temperature, morning relative humidity, BSS, growing degree day and canopy temperature with incidence of Sheath rot and scald but negative correlation with minimum temperature, evening relative humidity. blast incidence was not observed during the period of investigation. Therefore It would be, suggested to adopt sowing on raised bed (15-25×15-25 cm) to *kharif* direct seeded paddy variety *Phule Samruddhi* for minimum attack of rice disease with high yield production.

Keywords: Rice, sowing methods, varieties, diseases, correlation

Introduction
Rice (*Oryza sativa* L.) is one of the most ancient crops being cultivated in 117 countries, hence called as "Global Grain". Rice belongs to the genus *Oryza* and family *Poaceae*. It has two cultivated and 22 wild species. The cultivated species are *Oryza sativa* and *Oryza glaberrina*. *Oryza sativa* is grown all over the world while *Oryza glaberrina* has been cultivated in West Africa for the last 3500 years.

The production of conventional puddle transplanted rice faces severe constraints because of water and labour scarcity and climatic changes (Pathak *et al*., 2011) [6]. Imminent water crisis, water-demanding nature of traditionally cultivated rice and climbing labour costs ramble the search for alternative management methods to increase water productivity, system sustainability and profitability. Direct seeded rice (DSR) technique is becoming popular nowadays because of its low-input demanding nature. It offers a very exciting opportunity to improve water and environmental sustainability. It is a feasible alternative to conventional puddled transplanted rice with good potential for saving water, mitigating greenhouse gas emissions and adapting to climatic risks; and the yield can be comparable with that of transplanted rice if the crop is properly managed (Kumar and Ladha, 2011) [2]. It involves sowing pre-germinated seeds into a puddle soil surface (wet seeding), standing water (water seeding) or dry seeding into a prepared seedbed (dry seeding). Recently there is trend towards direct seeded rice because of labour and water scarcity (Mallikarjun *et al.*, 2014) [4]. Although the development of suitable varieties and agronomic packages for promoting direct-seeded rice is under way (Pathak *et al.*, 2011) [6], so far no variety has been developed that possess traits specifically needed to high yield under dry direct-seeded conditions, particularly for rainfed systems that may be prone to drought and low fertility. Similarly rice disease has serious negative effects on crop yield, and the correct control of rice diseases is the key to avoid these effects, the disease influence studies also important in this aspect. In view of this, present investigation carried to find out the effect of weather parameters on disease incidence in direct seeded rice with various sowing methods on different cultivars.

Material and Methods
Experimental details
The experiment was conducted at Agricultural Research Station Farm, Vadgaon Maval, Tal.

Maval, Dist. Pune *kharif*, 2017. It was laid out in split plot with sixteen treatment combinations and three replications. There are four sowing methods *viz.,* M_1: Drill sowing at 22.5 cm, M_2: Drill sowing at 30 cm, M_3: Dibbing at 30×10 cm and M_4: Sowing on raised bed (15-25×15-25 cm) as a main plot treatments and four paddy varieties *viz*.V_1: VDN-3-51-18 (*Indrayani*), V_2: VDN-99-29 (*Phule Samruddhi*), V_3: IET-13549 (*Bhogawati*) and V_4: RDN-99-1 (*Phule Radha*) as sub plot treatment. The gross plot size was 3.60 m x 3.60 m and net plot size was different as per treatments. All standard cultural operations were carried out for the experiment. The diseaes observations were taken in proper scale.

Scale	0	1	3	5	7	9
Damage (%)	No incidence	Less than 1%	1-5%	6-25%	26-50%	51-100%

Scale for Sheath rot

The disease is caused by *Sarocladium oryzae.* Oblong or irregular brown to grey lesions on the leaf sheath near panicle. The lesions sometimes coalescing to prevent emergence of panicle. Used the following scale on the basis of the percentage of damaged leaves on a 0-9 scale. The observations were recorded at milk stage, dough stage and mature grain stages.

Scale for Leaf scald

Leaf scald of paddy is caused by *Microdochium oryzae.* The lesions occurs mostly near leaf tips, but sometimes starts at the margin of the blade and develops into large ellipsoid areas encircled by dark-brown, narrow bands accompanied by a light-brown halo. The disease observations were recorded at booting, heading, milk stage and dough stages.

Scale	0	1	3	5	7	9
Damage (%)	No incidence	Less than 1%	1-5%	6-25%	26-50%	51-100%

Results and Discussion

Correlation between weather parameters and incidence of disease

Correlation analysis of weather parameters and incidence of disease on paddy is given as follows:

On variety *Indrayani* (V_1)

Incidence of sheath rot

Correlation analysis of incidence of sheath rot with weather parameter with different varieties is presented in Table 1.Correlation of incidence of sheath rot with weather parameters at 56, 70, 84 DAS and at harvest revealed the significant positive correlation with T max (r = 0.754**), RH-I(r = 0.307), BSS (r =0.434), GDD(r = 0.798**) and canopy temperature (r = 0.432) indicated increase in infestation of sheath rot. Further, significant negative correlation was noticed with Tmin (r = -0.851**) and RH-II (r = -0.307) indicated increase in Tmin and RH-II decreased infestation of sheath rot, similar results are observed by Reddy *et al.* (2001) [7].

Incidence of scald

Correlation at 42 56,70,84 DAS and at harvest revealed the significant positive correlation between leaf scald incidence and T max (r = 0.875**), RH-I (r = 0.530*), BSS (r= 0.565*), canopy temperature (r = 0.636*) and GDD (r = 0.623*) indicated that increase in their levels showed increase in infestation of scald. Thereafter, significant negative correlation was noticed with Tmin(r = -0.351), RH-II (r = -0.623*) indicating increase in Tmin and RH-II decreased infestation of scald.

on variety *Phule Samruddhi*(V_2)

Incidence of sheath rot

Correlation analysis of incidence of sheath rot with weather parameter with different varieties is presented in Table 2.Correlation of incidence of sheath rot with weather parameters at 56,70,84 DAS and at harvest revealed significant positive correlation with Tmax(r = 0.617*), GDD (r= 0.563*) canopy temperature (r = 0.546*) and BSS (r =0.312) indicating increase in these weather element increased infestation of sheath rot. Further, significant negative correlation was noticed with Tmin (r = -0.384),RH-I(r = -0.474) and RH-II (r = -0.576*)indicated increase in RH-II, RH-I and Tmin decreased infestation of sheath rot. Incidence of sheath rot having positive correlation with T_{max}, RH-I, BSS and Canopy temperature while showing negative correlation with T_{min} and RH-II similar results are observed by Amin *et al.* (1974) [1]

Incidence of scald

Correlation analysis of incidence of scald with weather parameter with different varieties presented in table 2. Correlation 42,56,70,84 DAS and at harvest revealed significant positive correlation between leaf scald incidence and T max (r= 0.834**), RH-I (r= 0.486), BSS (r= 0.539*), canopy temperature (r=0.965**) and GDD (r= 0.466) indicated that increase in T max, RH-I, canopy temperature, GDD and BSS levels showed increase in infestation of scald. Thereafter, significant negative correlation was noticed with Tmin (r = 0.632*) and RH-II (r = -0.235) indicated increase in Tmin and RH-II decreased infestation of scald.

Incidence of scald having positive correlation with T_{max}, RH-I, BSS and GDD and having negative correlation with T_{min} and RH-II similar results was observed by Peregrine *et al.* (2009) [5].

On variety *Bhogawati* (V_3)

Incidence of sheath rot

Correlation analysis of incidence of sheath rot with weather parameter with different varieties is presented in Table 3. Correlation of incidence of sheath rot with weather parameters at 56,70,84 DAS and at harvest revealed significant positive correlation with T max (r = 0.685*), RH-I (r = 0.384), canopy temperature (r = 0.723**) and GDD (r= 0.854**) indicated increase in these weather elements increased infestation of sheath rot. Further, significant negative correlation was noticed with Tmin (r = -0.598*), RH-II (r = -0.486), BSS (r = -0.455) indicated increase in Tmin, RH-II and BSS decreased infestation of sheath rot.

Incidence of sheath rot having positive correlation with T_{max}, RH-I, BSS and Canopy temperature while showing negative correlation with T_{min} and RH-II similar results are observed by Reddy *et al.* (2001) [7]

Incidence of scald

Correlation at 42,56.70,84 DAS and at harvest revealed significant positive correlation between leaf scald incidence and Tmax (r= 0.698**), RH-I (r=0.724**), BSS (r= 0.447), canopy temperature (r=0.576*) and GDD (r= 0.554*) indicated that increase in Tmax, RH-I, canopy temperature, BSS and GDD levels showed increase in infestation of scald.

Thereafter, significant negative correlation was noticed with Tmin (r = -0.458) and RH-II (r = -0.458) indicated increase in Tmin and RH-II decreased infestation of scald.
Incidence of scald having positive correlation with T_{max}, RH-I, BSS and GDD and having negative correlation with T_{min} and RH-II similar results was observed by Lamey and Williams (1972) [3].

On variety *Phule Radha*(V_4)
Incidence of sheath rot
Correlation analysis of incidence of sheath rots with weather parameter at different varieties is presented in Table 4
Correlation of incidence of sheath rot with weather parameters at 56,70,84 DAS and at harvest revealed significant positive correlation with Tmax (r = 0.865**), BSS (r= 0.434), canopy temperature (r = 0.267) and GDD (r= 0.498) indicated increase in these weather elements increased infestation of sheath rot. Further, significant negative correlation was noticed with Tmin (r = -0.556*), RH-I (r = -0.468) and RH-II (r = -0.586*) indicated increase in Tmin, RH-I and RH-II decreased infestation of sheath rot.
Incidence of sheath rot having positive correlation with T_{max}, RH-I, BSS and Canopy temperature while showing negative correlation with T_{min} and RH-II similar results are observed by Amin *et al.* (1974) [1].

b) Incidence of scald
Correlation at 42,56,70,84 DAS and at harvest revealed significant positive correlation between leaf scald incidence and Tmax (r= 0.594*), BSS (r= 0.779*) and canopy temperature (r=0.675*) and GDD (r= -0.631*) indicated that increase in Tmax, BSS, canopy temperature and GDD levels showed increase in infestation of scald. Thereafter, significant negative correlation was noticed with Tmin (r = -0.468), RH-I (r = -0.382) and RH-II (r= -0.463) indicated increase in Tmin, RH-I and RH-II decreased infestation of scald.
Incidence of scald having positive correlation with T_{max}, RH-I, BSS and GDD and having negative correlation with T_{min} and RH-II similar results was observed by Peregrine*et al.* (2009) [5].

Table 1: Correlation between weather parameters and diseases of paddy on variety *Indrayani*

Weather parameter	Sheath rot				Scald				
	Days after sowing (DAS)								
	56	70	84	At harvest	42	56	70	84	At harvest
Tmax	0.754**	0.407	0.321	0.663*	0.875**	0.434	0.331	0.745**	0.534*
Tmin	-0.851**	-0.554*	-0.563*	-0.467	-0.351	-0.300	-0.444	-0.411	-0.523*
RH-I	0.307	0.315	0.223	0.378	0.530*	0.435	0.772**	0.299	0.434
RH-II	-0.482	-0.234	-0.447	-0.513*	-0.673*	-0.341	-0.562	-0.359	-0.641*
BSS	0.434	0.420	0.545*	0.439	0.565*	-0.584*	0.430	-0.324	0.426
Canopy temp.	0.432	0.440	0.363	0.436	0.636*	0.934**	0.452	0.364	0.528*
GDD	0.798**	0.660*	0.625*	0.474	0.623*	0.701**	0.654*	0.532*	0.433

Table 2: Correlation between weather parameters and diseases of paddy on variety *Phule Samruddhi*

Weather Parameter	Sheath rot				Scald				
	Days after sowing (DAS)								
	56	70	84	At harvest	42	56	70	84	At harvest
Tmax	0.617*	0.357	0.624*	0.723**	0.834**	0.964**	0.546*	0.895**	0.698*
Tmin	-0.384	-0.375	-0.687*	-0.369	-0.632*	-0.344	-0.358	-0.375	-0.665*
RH-I	-0.474	0.387	0.524*	0.562*	0.486	0.443	0.345	0.466	-0.365
RH-II	-0.576*	-0.246	-0.107	-0.335	-0.235	-0.160	-0.315	-0.265	-0.546*
BSS	0.312	0.682*	0.196	0.449	0.539*	0.496	0.675*	-0.432	0.349
Canopy Temp.	0.546*	0.343	0.346	0.140	0.965**	0.669*	0.544	0.562*	0.266
GDD	0.563*	0.452	0. 331	0.654*	0.466	0.645*	0.333	0.446	0.789**

Table 3: Correlation between weather parameters and diseases of paddy on variety *Bhogawati*

Weather Parameters	Sheath rot				Scald				
	Days after sowing (DAS)								
	56	70	84	At harvest	42	56	70	84	At harvest
Tmax	0.685*	0.544*	0.745**	0.725**	0.698*	0.978**	0.714**	0.675*	0.761*
Tmin	-0.598*	-0.447	0.765**	-0.641*	-0.458	0.435	-0.489	-0.469	-0.589*
RH-I	0.384	0.253	-0.469	0.446	0.724**	0.553*	0.569*	0.569*	-0.449
RH-II	-0.486	-0.166	-0.412	-0.766*	-0.458	-0.261	-0.779**	-0.493	-0.378
BSS	-0.455	0.549*	0.245	0.996**	0.447	0.723**	0.454	-0.432	0.589*
Canopy temp.	0.723**	0.474	0.436	0.447	0.576*	0.445	0.607*	0.279	0.645**
GDD	0.854**	0.925**	0.499	0.843**	0.554*	0.844**	0.322	0.832**	0.328

Table 4: Correlation between weather parameters and diseases of paddy on variety *Phule Radha*

Weather parameter	Sheath rot				Scald				
	Days after sowing (DAS)								
	56	70	84	At harvest	42	56	70	84	At harvest
Tmax	0.865**	-0.618*	0.564*	0.793**	0.594*	-0.849**	0.945**	0.643*	0.869**
Tmin	-0.556*	-0.578*	-0.469	-0.635*	-0.468	-0.435	-0.565*	-0.758**	-0.497
RH-I	-0.468	0.656*	0.399	0.444	-0.382	0.594*	0.475	0.546*	0.623*
RH-II	-0.586*	-0.469	-0.789**	-0.234	-0.463	-0.316	-0.368	-0.412	-0.423

BSS	0.434	0.364	0.348	-0.263	0.675*	0.374	0.462	-0.456	0.395
Canopy temp.	0.267	0.538*	0.265	0.252	0.619*	0.574*	0.744**	0.536*	0.366
GDD	0.498	0.465	0.496	0.641*	0.631*	0.944**	0.441	0.371	0.594*

Table 5: Incidence of blast, sheath rot and scald diseases in different treatments during *kharif* season

Treatment		Per cent incidence				
		Days after sowing (DAS)				
	Disease	42	56	70	84	At harvest
M_1V_1	Blast	0	0	0	0	0
	Sheath rot	0	4.7	7.4	10	13.8
	Scald	4.1	8.7	10.2	14.8	18.4
M_1V_2	Blast	0	0	0	0	0
	Sheath rot	0	3.3	5.05	9.7	13.3
	Scald	3.5	6.6	9.8	13.4	16.4
M_1V_3	Blast	0	0	0	0	0
	Sheath rot	0	6.6	8.3	10.1	14.5
	Scald	4.5	9	12.1	15.7	20.7
M_1V_4	Blast	0	0	0	0	0
	Sheath rot	0	7.9	8.3	11.1	18.2
	Scald	4.7	9.6	12.8	16.3	21.7
M_2V_1	Blast	0	0	0	0	0
	Sheath rot	0	6.1	6.8	10.1	14.8
	Scald	4	8.1	10	14.1	18
M_1V_2	Blast	0	0	0	0	0
	Sheath rot	0	3.7	4.7	9.4	12.5
	Scald	3.1	6.3	9.4	12.9	16.1
M_1V_3	Blast	0	0	0	0	0
	Sheath rot	0	6.9	7.1	10.3	14.8
	Scald	4.2	8.9	11.7	14.8	19.9
M_1V_4	Blast	0	0	0	0	0
	Sheath rot	0	7.9	9.4	13.6	17.7
	Scald	4.5	9.2	12.4	15.7	20.8

Table 5: Continued…

Treatment		Per cent incidence				
		Days after sowing (DAS)				
	Disease	42	56	70	84	At harvest
M_3V_1	Blast	0	0	0	0	0
	Sheath rot	0	5.05	6.6	10	13.7
	Scald	3.9	7.8	9.7	13.7	17.4
M_3V_2	Blast	0	0	0	0	0
	Sheath rot	0	3.3	5.9	9.4	12.9
	Scald	2.6	5.9	8.9	12.1	15.6
M_3V_3	Blast	0	0	0	0	0
	Sheath rot	0	6.1	7.9	11.1	16.6
	Scald	4.1	8.5	11.2	14.2	19.1
M_3V_4	Blast	0	0	0	0	0
	Sheath rot	0	6.1	9.5	12.1	17.7
	Scald	4.3	8.8	12	15.2	20
M_4V_1	Blast	0	0	0	0	0
	Sheath rot	0	4.7	6.6	10	14.8
	Scald	3.5	7.5	9.3	12	16.9
M_4V_2	Blast	0	0	0	0	0
	Sheath rot	0	3.3	3.8	9.2	14.1
	Scald	2.1	5.2	8.2	11.4	14.9
M_4V_3	Blast	0	0	0	0	0
	Sheath rot	0	6.4	8.3	11.1	15
	Scald	3.9	8.1	10.8	13.4	18.6
M_4V_4	Blast	0	0	0	0	0
	Sheath rot	0	6.9	9.2	13.1	16.3
	Scald	4	8.5	11.7	14.1	19.1

Conclusion

From the data it can be said that the disease population was lower in paddy variety VDN-99-29 (*Phule Samruddhi*) followed VDN-3-51-18 (*Indrayani*) and higher incidence with IET-13549 (*Bhogawati*) and RDN-99-1 (*Phule Radha*).Disease Incidence was more with drill sowing at 22.5 cm and lower with sowing on raised bed (15-25×15-25 cm). There was positive correlation between maximum temperature, morning relative humidity, BSS, growing degree day and canopy temperature with incidence of Sheath rot and

scald but negative correlation with minimum temperature, evening relative humidity. Blast incidence was not observed during the period of investigation. Therefore It would be, suggested to adopt sowing on raised bed (15-25×15-25 cm) to *kharif* direct seeded paddy variety *Phule Samruddhi* for minimum attack of rice disease with high yield production.

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