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Pest 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 pest 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). The pest 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 leaf folder and brown plant hopper but negative correlation with minimum temperature, evening relative humidity. Stem borer 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 pest with high yield production.

Key words : Rice, Sowing Methods, Varieties, Pest, Correlation.

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.

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The production of conventional puddle transplanted rice faces severe constraints because of water and labour scarcity and climatic changes (Pathak *et al*., 2011). 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). 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). Although the development of suitable varieties and agronomic packages for promoting direct-seeded rice is under way (Pathak et al., 2011), 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 the pest influence studies also important in this aspect. In view of this, present investigation carried to find out the effect of weather parameters on pest incidence in direct seeded rice with various sowing methods on different cultivars.

Materials 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 x 10 cm and M_4: Sowing on raised bed (15-25 x 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 pest observations were taken in proper scale.

Leaf folder (Cnaphalocrosis medinalis): Larvae consume the leaf tissue except the epidermis, causing typical white streaks. They create a leaf tube during later stages of feeding. Used the following scale on the basis of the percentage of damaged leaves on a 0-9 scale.The observations were recorded a tillering, stem elongation, booting, heading, milk stage and dough stages.

Scale	0	1	3	5	7	9
Damage (%)	No damage	1-10%	11-20%	21-35%	36-50%	51-100%

Stem Borers (Scirpophagain certulas) : The observations for stem borer were recorded at tillering, stem elongation and booting (Dead hearts), and dough stage and grain mature stages (Whiteheads).

Scale for stem borer (Dead hearts):

Scale	0	1	3	5	7	9
Damage (%)	No damage	1-10%	11-20%	21-30%	31-60%	61%-above

Scale for stem borer (White heads):

Scale	0	1	3	5	7	9
Damage (%)	No damage	1-5%	6-10%	11-15%	16-25%	26%-above

Brown plant hopper (Nilaparvata lugens) : Partial to pronounced yellowing of plant with increased severity of stunting. Extreme signs are wilting to death of plants. Infested areas in the field may be patchy. The observations were recorded at tillering, stem elongation, booting, heading, milk stage, dough stage and mature grain stages. The scale for brown plant hopper is

0 - No damage , 1 - Very slight damage , 3 - First and 2nd leaves of most plants partially yellowing, 5 - Pronounced yellowing and stunting or about 10 to 25% of the plants wilting or dead and remaining plants severely stunted or dying, 7- More than half of the plants, 9- All plants dead.

Results and Discusssion

Correlation between weather parameters and incidence of pests

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

On variety Indrayani (V_1)

a) Incidence of Leaf folder : Correlation of incidence of leaf folder with weather parameters in different varieties is presented in Table 1. Correlation of incidence of leaf folder with weather parameters at 28,42,56,70,84 DAS and at harvest revealed significant positive correlation with maximum temperature (r = 0.731*), RH-I(r = 0.544*) and BSS (r = 0.874**) canopy temperature (r = 0.878**), GDD (r = 0.463) indicating increase in maximum temperature, RH-I, canopy temperature, BSS and GDD increased infestation of leaf folder. Significant negative correlation with minimum temperature(r = -0.363) and RH-II (r = -0.332), and indicated increase in T_{min} and RH-II, decreased infestation of leaf folder. Incidence of leaf folder having positive correlation with T_{max}, RH-I, BSS, canopy temperature and GDD and having negative correlation with Tmin and RH-II similar results were observed by Kumar *et al.* (1996).

b) Incidence of brown plant hopper : Correlation of incidence of brown plant hopper with weather parameters at different varieties is presented in Table 1. Correlation of incidence of brown plant hopper with weather parameters at 28,42,56,70,84 DAS and at harvest showed significant positive correlation with maximum temperature (r = 0.461), RH-I (r = 0.382) and BSS (r = 0.336), canopy temperature (r = 0.347) and GDD (r = 0.812**) indicated increase in maximum temperature, RH-I,

Table 1. Correlation between weather parameters and pests of paddy on variety *Indrayani*

Particular Weather parameter	Leaf folder						Brown plant hopper					
	Days after sowing (DAS)											
	28	42	56	70	84	At harvest	28	42	56	70	84	At harvest
T_{max}	0.731*	0.832**	0.492	0.788**	0.654*	0.564*	0.461	0.896**	0.332	0.932**	0.753**	0.796**
T_{min}	-0.363	-0.374	-0.367	-0.849**	-0.443	-0.486	-0.543*	-0.441	-0.386	-0.243	-0.546*	-0.439
RH-I	0.544*	0.380	0.123	0.346	0.438	0.261	0.382	0.671*	0.492	0.356	0.541**	0.484
RH-II	-0.332	-0.246	-0.676*	-0.412	-0.849**	-0.548*	-0.649*	-0.242	-0.361	-0.347	-0.766*	-0.324
BSS	0.874**	0.476	0.572*	0.398	0.374	0.469	0.336	0.362	0.354	0.584*	0.148	0.836**
Canopy temp	0.878**	0.541*	0.542*	0.491	0.434	0.534*	0.347	0.491	0.636*	0.325	0.593*	0.466
GDD	0.463	0.541*	0.596	0.645**	0.541*	0.873**	0.812**	0.468	0.636*	0.589*	0.778*	0.516*

canopy temperature, BSS and GDD increased in infestation of brown plant hopper. On the other hand significant negative correlation was observed with minimum temperature (r = -0.543*) and RH-II (r = -0.649*) indicated increase in these meteorological element decreased infestation of brown plant hopper.

Incidence of BHP having positive correlation with Tmax, RH-I, BSS, canopy temperature and GDD while having negative correlation with T_{min} and RH-II similar results was observed by Heong *et al*. (1995).

On variety Phule Samruddhi

a) Incidence of leaf folder : Correlation of incidence of leaf folder with weather parameters at different varieties is presented in Table 1. Correlation of incidence of leaf folder with weather parameters at 28,42,56,70,84 DAS and at harvest revealed significant positive correlation with T_{max} (r = 0.863**), RH-I (r = 0.564*), BSS (r = 0.392), canopy temperature (r = 0.482) and GDD (r = 0.646*) indicated increase in T_{max}, RH-I, canopy temperature, BSS and GDD increased infestation of leaf folder. On the other hand significant negative correlation was noticed with, T_{min} (r = -0.464) and RH-II (r = -0.539*) indicated increase in these parameters resulted in decreased infestation of leaf folder.

Incidence of leaf folder having positive correlation with Tmax, RH-I, BSS, canopy temperature and GDD was highest at grain filling stage and having negative correlation with Tmin and RH-II similar results were observed by Sakia and Parameswaran (1999).

c) Incidence of brown plant hopper : Correlation of incidence of brown plant hopper with weather parameters at different varieties is presented in Table 2. Correlation analysis of incidence of brown plant hopper with weather parameters at 28,42,56,70,84 DAS and at harvest revealed significant positive correlation with T_{max} (r = 0.561*), RH-I (r = 0.569*), BSS (r = 0.463), canopy temperature (r = 0.193) and GDD (r = 0.803**) indicated increase in T max, RH-I, canopy temperature, BSS and GDD increased infestation of brown plant hopper and significant negative correlation with T_{min} (r = -0.398) and RH-II (r = -0.801**) indicated increase in T_{min} and RH-II decreased infestation of brown plant hopper.

Incidence of BHP having positive correlation with T_{max}, RH-I, BSS, canopy temperature and GDD while having negative correlation with T_{min} and RH-II.

On variety Bhogawati

a) Incidence of leaf folder : Correlation

Table 2. Correlation between weather parameters and pests of paddy on variety *Phule Samruddhi*

Particular Weather parameter	Leaf folder						Brown plant hopper					
	Days after sowing (DAS)											
	28	42	56	70	84	At harvest	28	42	56	70	84	At harvest
T_{max}	0.863**	0.894**	0.549*	0.692*	0.832**	0.867**	0.561*	0.898**	0.371	0.534*	0.642*	0.742**
T_{min}	-0.464	-0.416	-0.546*	-0.363	-0.432	-0.398	-0.398	-0.944**	-0.545*	-0.613*	-0.134	-0.278
RH-I	0.564*	0.566*	0.410	0.523*	0.464	0.569*	0.569*	0.776**	0.424	0.548*	0.348	0.489
RH-II	-0.539*	-0.548	-0.203	-0.356	-0.816**	-0.461	-0.801**	-0.489	-0.223	-0.891**	-0.371	-0.691*
BSS	0.392	0.344	0.884**	0.462	0.336	0.353	0.463	0.366	0.434	0.492	0.657*	0.833**
Canopy temp.	0.482	0.734**	0.489	0.832**	0.362	0.491	0.193	0.464	0.493	0.442	0.438	0.866**
GDD	0.646*	0.537*	0.403	0.505*	0.800**	0.503*	0.803**	0.337	0.429	0.518*	0.856**	0.240

of incidence of leaf folder with weather parameters at different varieties is presented in Table 3. Correlation of incidence of leaf folder with weather parameters at 28,42,56,70,84 DAS and at harvest revealed significant positive correlation with T_{max} (r = 0.840**), RH-I (r = 0.374), BSS (r = 0.345), canopy temperature (r = 0.782*) and GDD (r = 0.567*) indicated increase in T_{max}, RH-I, canopy temperature, BSS and GDD increased infestation of leaf folder. However, significant negative correlation of leaf folder incidence was noticed with Tmin (r = -0.544*) and RH-II (r = -0.388) indicated increase in these parameters decreased infestation of leaf folder.

Incidence of leaf folder having positive correlation with Tmax, RH-I, BSS, canopy temperature and GDD and having negative correlation with Tmin and RH-II

c) Incidence of brown plant hopper : Correlation analysis of incidence of brown plant hopper with weather parameters at different varieties is presented in Table 3. Correlation of incidence of brown plant hopper with weather parameters at 28,42,56,70,84 DAS and at harvest revealed significant positive correlation with T max (r = 0.328), RH-I (r = 0.444), BSS (r = 0.693*), canopy temperature (r = 0.422) and GDD (r = 0.433) indicated increase in T_{max}, RH-I, canopy temperature, BSS and GDD increased infestation of brown plant hopper. Further, significant negative correlation was observed with Tmin (r = -0.501*) and RH-II (r = -0.165) indicated increase in Tmin and RH-II decreased infestation of brown plant hopper.

Incidence of BHP having positive correlation with Tmax, RH-I, BSS, canopy temperature and GDD while having negative correlation with Tmin and RH-II similar results were as observed by Ashrith *et al*. (2016).

On variety Phule Radha

a) Incidence of leaf folder : Correlation analysis of incidence of leaf folder with weather parameters at different varieties is presented in Table 4. Correlation of incidence of leaf folder with weather parameters at 28,42,56,70,84 DAS and at harvest revealed significant positive correlation with T_{max} (r = 0.984**), RH-I (r = 0.884**), BSS (r = 0.530*), canopy temperature (r=0.558*) and GDD (r = 0.605*) indicated increase in T_{max}, RH-I, BSS, canopy temperature and GDD increased infestation of leaf folder. However, significant negative correlation was noticed with T_{min} (r = -0.545*) and RH-II (r = -0.348) indicated increase in these parameters decreased infestation of leaf folder.

Table 3. Correlation between weather parameters and pests of paddy on variety *Bhogawati*

Particular Weather parameter	Leaf folder						Brown plant hopper					
	Days after sowing (DAS)											
	28	42	56	70	84	At harvest	28	42	56	70	84	At harvest
T_{max}	0.840**	0.488	0.644*	0.588*	0.473	0.784**	0.328	0.808**	0.912**	0.771**	0.693*	0.634*
T_{min}	-0.544*	-0.532	-0.505*	-0.865**	-0.345	-0.949**	-0.501*	-0.245	-0.417	-0.346	-0.457	-0.425
RH-I	0.374	0.192	0.567	0.383	0.664*	0.518	0.444	0.918**	0.335	0.611*	0.860**	0.405
RH-II	-0.388	-0.463	-0.223	-0.463	-0.503	-0.214	-0.165	-0.468	-0.397	-0.478	-0.363	-0.470
BSS	0.845**	0.446	0.346	0.372	0.398	0.566*	0.693*	0.593*	0.735**	0.365	0.423	0.315
Canopy temp.	0.382	0.434	0.368	0.592*	0.627*	0.772**	0.422	0.445	0.656*	0.465	0.436	0.805**
GDD	0.567*	0.234	0.589*	0.489	0.453	0.797**	0.433	0.664*	0.858**	0.523*	0.753**	0.564*

Table 4. Correlation between weather parameters and pests of paddy on variety *Phule Radha*

Particular Weather parameter	Leaf folder						Brown plant hopper					
	Days after sowing (DAS)											
	28	42	56	70	84	At harvest	28	42	56	70	84	At harvest
T_{max}	0.884**	0.513*	0.476	0.824**	0.365	0.631*	0.462	0.758**	0.634*	0.449	0.734**	0.836**
T_{min}	-0.545*	-0.366	-0.395	-0.215	-0.342	-0.629*	-0.703*	-0.208	-0.370	-0.491	-0.476	-0.539*
RH-I	0.364	0.442	0.489	0.515*	0.410	0.602*	0.564*	0.801**	0.231	0.340	0.468	0.624*
RH-II	-0.348	-0.619*	-0.609*	-0.403	-0.426	-0.421	-0.342	-0.503*	-0.507*	-0.488	-0.586*	-0.834**
BSS	0.530*	0.310	0.545*	0.553*	0.446	0.640*	0.834**	0.482	0.558*	0.444	0.353	0.844**
Canopy temp.	0.558*	0.885**	0.569*	0.453	0.579*	0.445	0.467	0.351	0.256	0.495	0.873**	0.564*
GDD	0.605*	0.417	0.781**	0.474	0.368	0.607*	0.501*	0.630*	0.346	0.733*	0.635*	0.826**

** Significant at 5% level, * Significant at 1% level

Incidence of leaf folder having positive correlation with T_{max}, RH-I, BSS, canopy temperature and GDD and having negative correlation with Tmin and RH-II .

b) Incidence of brown plant hopper : Correlation analysis of incidence of brown plant hopper with weather parameters at different varieties presented in Table: 4. Correlation of incidence of brown plant hopper with weather parameters at 28,42,56,70,84 DAS and at harvest revealed significant positive correlation with T_{max} (r = 0.462), RH-I (r = 0.564), BSS (r = 0.834**), canopy temperature (r = 0.467) and GDD (r = 0.501*) indicated increase in Tmax, RH-I, BSS, canopy temperature and GDD increased infestation of brown plant hopper. Further, significant negative correlation was observed with T_{min} (r = -0.703**) and RH-II (r = -0.342), and indicated increase in T_{min} and RH-II decreased infestation of brown plant hopper.Incidence of BHP having positive correlation with Tmax, RH-I, BSS, canopy temperature and GDD while having negative correlation with T_{min} and RH-II similar results was observed by Nair *et al*. (1980).

Conclusion

From the data it can be said that the pest 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).Pest Incidence was more with drill sowing at 22.5 cm and lower with sowing on raised bed (15-25 x 15-25 cm). There was positive correlation between maximum temperature, morning relative humidity, BSS, growing degree day and canopy temperature with incidence of leaf folder and brown plant hopper but negative correlation with minimum temperature, evening relative humidity. Stem borer incidence was not observed during the period of investigation. Therefore It would be, suggested to adopt sowing on raised bed (15-25 x 15-25 cm) to kharif direct seeded paddy variety Phule Samruddhi for minimum attack of rice pest with high yield production.

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