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RESEARCH ARTICLE

Status, distribution and epidemiology of rice diseases in Jabalpur region

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SUMMARY

Status and distribution of diseases was determined in 9 major rice growing areas of the State during *Kharif* 2008. Presence of blast (*Magnaporthae grissea*), brown spot (*Drechlera oryzae* = *Helminthosporium* sp.), bacterial leaf blight (X*anthomonas campestris* pv. *oryzae*), false smut, bunt, and sheath blight was recorded in various proportions. The incidence of disease was observed in 22 rice varieties, 7 hybrids, 14 A lines and 13 new plant type (NPT) developed at JNKVV, Jabalpur. Overall the incidence of the disease was up to 29 per cent. Rice blast was recorded at Waraseoni, Balaghat district. Bacterial disease were not wide spread, however, the sheath blight was predominant. Disease initiation and its corresponding meteorological data reveal that disease by *Rhizoctonia solani was* initiated during 3rd week of September when temperature ranged from 19.9 to 33.2°C with humidity 72.0 to 88 per cent and 13.9 mm rainfall. Maximum disease was noticed up to 4th week of October with average incidence 19 per cent and corresponding temperature was 25°C and relative humidity 67 per cent.

Key Words **:** Rice, Hybrid, Disease, Meteorology factors, Disease incidence, Epidemiology, Status

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Rice (*Oryza sativa* L.) being a stable food crop of India, play significant role in the food security system. The crop is an important integral part of Indian dietary and staple food of more than 60 per cent. Rice is primarily a high energy and high calories food crop that contains about 6-7 per cent protein and 2.25 per cent fat. It occupies a pivotal place in the global food and live hood security. The crop cultivated in an area of 44.62 m ha with annual production of 93.08 mt with productivity of 2.0 t / ha that contributes 44.0 per cent of total food grain production (Koutu and Rao, 2008; Mishra *et al*., 2005).

The largest rice exporting countries are Thailand (26% of world exports), Vietnam (15 %) and the United States (11%) while the largest three importers are Indonesia (14%), Bangladesh (4%) and Brazil (3%). China and India remains the top two largest producers of rice in the world (Rice/*Wikipedia*).

Hybrid rice offers an opportunity to increase rice yields and thereby ensure a steady supply of food (Koutu and Rao, 2008; Virmani and Kumar, 2004) as per projection made for 2025. Hybrid rice is genealogy of rice produced by cross breeding of different kind of rice. It offers a considerable yield advantage over improved varieties. Use of hybrid rice production technology can provide an additional yield of rice up to 1.0 ton per ha over the conventional varieties (Mishra and Rao, 2002). In India, hybrid rice cultivation is becoming more popular in Andhra Pradesh Karnataka, Tamil Nadu, Punjab, Haryana, West Uttar Pradesh and West Bengal (Aldas, 2003).

Epidemiology is the major tool for the study of the development of diseases in a population under a particular set of environment (Neergard, 1997; Singh, 2004). Disease developments, especially for the target disease of the present

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investigation was studied. Development of sheath blight was studied and correlation with weather data was attempted.

MATERIALS AND METHODS

The present studies were under taken to investigate the extent of diseases associated with rice varieties, hybrids, A line and new plant type (NPT) and its istribution. The status of diseases was determined at Jabalpur and other districts in different varieties and hybrids. The investigations were conducted in rice crop grown during *Kharif* 2008 at Jabalpur that lies between $22^0$49' and $20^0$80' North latitude and $78^0$21' and $80^0$58' East longitude at an attitude 411.78 metre above the mean sea level.

Following places were visited during survey of diseases of rice and hybrids grown in farmer field and research fields (Table A).

Table A : Random field survey

Farmer field	Katni, Rewa, Seoni, Balaghat, Badgoan, Chhindwara, Damoh
Fixed field survey	
Research and seed production unit	Jabalpur

Random field survey :

In random survey, farmer's fields were visited at 8 districts/locations including Katni, Rewa, Seoni, Balaghat, Badgoan, Chhindwara, Damoh and Shahdol. Incidences of major diseases were recorded during the visit on randomly selected 100 plants. The diseases were identified on the basis of typical field symptoms. The survey was conducted by Seed Pathologist and information has been provided by him, based upon the observation takes during September- October 2008.

Fixed field survey :

The fixed field survey was conducted at Rice Research Experimental Field, Seed Production Unit, JNKVV, Jabalpur, in the crop grown during *Kharif* 2008 on pre-selected 100 plants. These included different varieties, hybrid, A line and NPT entries.

The symptoms, of target diseases were noticed under field conditions. Target diseases included the sheath blight, false smut, and kernel smut. Those have been chosen on the basis of previous experience of plant pathologist and rice breeder.

RESULTS AND DISCUSSION

The results revealed that the development of diseases was studied on pre-selected plants under fixed plot method using rice varieties and hybrids.

Status of rice diseases :

The crop, rice is suffered due to number of microflora that includes bacteria, fungi, nematode, virus and mycoplasma. Many of three diseases are seed associated, vector borne and transmitted through various agencies (Sharma, 2006).

World wide distribution :

The world wide distribution of the rice disease is reported in Table 1. The crop is essentially a staple food of large section of Asian countries. In several part of the Asian region, more than one crop is being taken, in some country and some part of India, three crops are being harvested. The monoculture, extensive and continuous cultivation of rice crop has resulted in the development of biotic stresses. The increasing pressure of biotic factor has resulted in decreasing productivity and production. Numbers of disease have been observed that are creating a problem and serving as a limiting factor for profitable cultivation (Anonymous, 1976; Ou, 1985). Globally, rice blast (*Magnaporthae grissea* = *Pyricularia oryzae*), sheath blight (*Rhizoctonia solani*), brown spot (*Drechslera oryzae* = *Helminthosporium*), stem base rot disease (*Sclerotium oryzae*), seedling diseases (*Sclerotium rolfsii*) caused by fungal pathogen have been reported. Many bacterial and viral pathogens have been encountered attacking the crop in various countries. A good deal of research work on various aspects of rice diseases is being conducted in Asia. Comprehensive account on the disease is available at International Rice Research Institute Manila, Philippines (www.irri.com).

Rice diseases in India :

Very impressive work on of rice is being conducted at Directorate of Rice Research (DRR-ICAR), Rajendra Nagar, Hyderabad, Andhra Pradesh and Rice Research Institute,

Table 1 : Varieties, hybrids, A line were observed for the association of the diseases under Jabalpur conditions

Varieties (25)	Pratiksha, Kavya, Varlu, Surekha, JR 201, Sugandha 5, Suganha 3, Mahamaya, Karma Masuri, Chandra Hasini, Pusa Basmati, P 1460, P 1401, MTU 1010, WGL 14, WGL 21, WGL 32100, WGL 32183, JGL 3844, Erramallelu, MR 219, Pusa 1121, IR 64, Kranti, IR 36
Hybrids (07)	JRH 4, JRH 5, JRH 8, JRH 10, JRH 11, JRH 13, JRH 14
A line (14)	25 A, 97 A, 36 A, 56 A, 32 A, 99 A, 6 A, 29 A, 69 A, 17 A, 22 A, 31 A, 36 A, 3 A
NPT	NPT 19(S), NPT(S), NPT 22, NPT(S)4-1, NPT 20, NPT 26, NPT 10-1, NPT 24, NPT(S)7-1, NPT 16, NPT 17, NPT 18, NPT 70

Cuttak, Orissa; under the agencies of ICAR, New Delhi. Commendable work on different aspects of rice disease management is also being taken by ICAR funded All India Coordinated Improvement Project at various State Agricultural University (SAUs).

Several research review and text book contains the present status of the diseases of rice in India, as well in different states. However, there is no systematic information is available on hybrid rice diseases, especially under the conditions of Madhya Pradesh. Therefore, the present investigation seems to have tremendous significance.

Studies conducted in Andhra Pradesh, Tamil Nadu,

Table 2: Distribution of the rice diseases in the world

Diseases	Causal organism	Distribution
Diseases caused by fungi		
Blast	*Magnaporthe grissea = (Pyricularia oryzae)*	China, California, India, Indonesia, Japan, Korea, Thailand
Sheath blight	*Rhizoctonia solani*	Thailand, China, Brazil, India
Kernel smut	*Neovossia horrida (Tillelia barclayana)*	China, Germany, Italy, India, USA, Japan, Philippines
False smut	*Ustilaginoidea virens*	China, Japan, Mexico, India
Brown spot	*Drechslera oryzae*	India, Australia ,Brazil
Stem rot	*Sclerotium oryzae*	Japan, Korea, Thailand
Bakanae disease	*Fusarium moniliformae*	Japan, Korea, China, India, Bagladesh
Narrow brown leaf spot	*Cercospora oryzae*	India, Sri-Lanka, Australia, Japan
Leaf smut	*Ectostroma oryzae*	China, Italy, Philippines, India
Seedling blight	*Sclerotium rolfsii*	Thailand, Australia, USA, Malaysia, India
Diseases caused by bacteria		
Bacterial leaf blight	*Xanthomonas campestris* pv. *Oryzae*	India, USA, Philippines, Indonesia
Bacterial leaf streak	*Xanthomonas translucens* pv. *Oryzae*	China, Japan, Bangladesh, India
Diseases caused by nematode		
White tip of paddy	*Aphlenchoides besseyi*	India, USA, Ezypt, Kenya, Sri- Lanka
Diseases caused by virus		
Tungro	Complex	Philippines, Malaysia, Indonesia, Thailand, India

Table 3: Distribution of the rice diseases in the India

Diseases	Causal organism	Distribution
Diseases caused by fungi		
Blast	*Magnaporthe grissea*	Andhra Pradesh, Karnataka, Assam, Tamil Nadu
Sheath blight	*Rhizoctonia solani*	Punjab, Haryana, Andhra Pradesh, West Bengal
Kernel smut (Rice bunt)	*Neovossia horrida*	Punjab, Haryana, Uttar Pradesh, West Bengal
False smut	*Ustilaginoidae virens*	Punjab, Haryana, Andhra Pradesh, West Bengal, Uttar Pradesh
Brown spot	*Drechslera oryzae = (Helminthosporium oryzae)*	Bihar, Gujarat, Punjab, Uttar Pradesh
Stem rot	*Sclerotium oryzae*	Karnataka, Punjab, Haryana, Uttar Pradesh
Bakanae disease	*Fusarium moniliformae*	Punjab, Haryana, Uttar Pradesh, West Bengal
Narrow brown leaf spot	*Cercospora oryzae*	Punjab, Haryana, Andhra Pradesh, West Bengal
Leaf smut	*Ectostroma oryzae*	Punjab, Haryana, Andhra Pradesh, West Bengal
Seedling blight	*Sclerotium rolfsii*	Punjab, Haryana, Uttar Pradesh, West Bengal
Diseases caused by bacteria		
Bacterial leaf blight	*Xanthomonas campestris* pv. *Oryzae*	Punjab, Haryana, Andhra Pradesh, West Bengal, Karnataka
Bacterial leaf streak	*Xanthomonas translucens* pv. *Oryzae*	Assam, Bihar, Orrisa, Tamil Nadu, Maharastra
Diseases caused by nematode		
White tip	*Aphlenchoides besseyi*	Madhya pradesh, Assam, Kerela, Orissa
Diseases caused by virus		
Tungro	Complex	Bangladesh, West Bengal

Punjab, Uttar Pradesh, Orissa and Karnataka reveal the presence of rice blast (*Magnaporthae grissea*), sheath blight (*Rhizoctonia solani*), brown spot (*Drechslera oryzae*) , false smut (*Ustilaginoidea virens*) and stem base rot (*Fusarium moniliformae* and *Sclerotium rolfsii*) as a major problem (Anonymous, 2006). Wide spread distribution of bacterialpathogen (*Xathomonas campestris* pv. *oryzae*) and association of nematode (*Aphlenchoides besseyi*) can not be ignored (Anonymous, 2007).

Observation taken at standard week interval indicate that the disease by *Rhizoctonia solani* was initiated during 3rd week (24-30 Sept.) when temperature ranged from 19.9 to 33.2^0 C with humidity 72.0 to 86 per cent and 13.9 mm rainfall in variety IR 36. In variety Kranti, the disease symptoms were initiated during first week of October (temp. 20.6 - 31.4^{0}C; relative humidity 54-86 %). Maximum disease incidence was noticed up to 4th week of October (22-28 Oct.) with incidence 19 per cent. The average temperature was 25^{0}C and relative humidity 67 per cent. The development of sheath blight was also recorded in rice hybrids JRH4, JRH5 and JRH10. The disease was initiated by the first week of October (1-7 Oct.). The disease incidence increased up to 29 per cent in hybrids. Increased from 11 to 26 in JRH4, 17-35 in JRH5 and 03-10 in JRH10 during 2nd and 3rd week of October, when the average temperature was 25.2^{0}C and relative humidity 67 per cent. Reddy *et al*. (2001) observed more disease in *Kharif* as compared to *Rabi*. Relative humidity was positively correlated with index whereas, temperature and sunshine was negatively correlated.Disease development was observed at 50 per cent maximum RH, it was rapid at above 80 per cent and slow between 60-80 per cent. Epidemiology of sheath blight disease has also been studied by Kabir *et al*. (2006); Nair and Gokulpalam (1990), Lanoiselet *et al*. (2007); Araujo *et al*. (2006), Singh and Dohan (1995) and Reddy *et al*. (2001).

The progressive development of false smut was studied under the same set of environment and variety (IR 36, Kranti) and hybrid (JRH 4, JRH 5 and JRH 10) with the pre-selected another 100 plants at Jabalpur during *Kharif* 2008. The disease incidence in IR 36 was initiated from 3rd week of September (17-23 Sept.) when the average temperature was 26.5^{0}C (minimum 21.2 and maximum 32^{0}C) with corresponding average relative humidity 78 per cent (88% minimum-maximum 90%). The rainfall during previous week enhanced the temperature and humidity combination. The incidence in IR 36 3 per cent in 3rd week of September that rose up to 12 per cent in the week of October with corresponding average temperature 27.35^{0}C (minimum 20.6 and maximum 34.1^{0}C) and humidity 70 per cent (minimum 54.0 and maximum 86%). The incidence remained 12 per cent till last week of October. In hybrid rice, incidence was recorded during 4th week of September (24-30 Sept.) when the average temperature was 26.5^{0}C (minimum 19.9^{0}C and maximum 32.2^{0}C) with average corresponding

Table 4: Progressive development of sheath blight in rice varieties at Jabalpur

Month / Week	% disease incidence		Temp. (°C)		Relative humidity (%)		Rainfall (mm)
	IR 36	Kranti	Min.	Max.	Min.	Max.	
03-09 Sept.	00	00	22.3	32.6	67	90	005.06
10-16 Sept.	00	00	22.1	30.6	59	90	078.00
17-23 Sept.	00	00	21.1	32.0	66	90	000.00
24-30 Sept.	03	00	19.9	33.2	70	88	013.04
01-07 Oct.	08	02	20.6	34.1	54	86	000.00
08-14 Oct.	11	13	18.2	32.3	56	83	000.00
15-21 Oct.	24	15	14.1	31.0	44	88	000.00
22-28 Oct.	24	19	11.1	32.2	32	89	000.00

Table 5: Progressive development of sheath blight in rice hybrids at Jabalpur

Month / Week	% disease incidence			Temp. (°C)		Relative humidity (%)		Rainfall (mm)
	JRH 4	JRH 5	JRH 10	Min.	Max.	Min.	Max.	
03-09 Sept.	00	00	00	22.3	32.6	67	90	005.06
10-16 Sept.	00	00	00	22.1	30.6	59	90	078.00
17-23 Sept.	00	00	00	21.1	32.0	66	90	000.00
24-30 Sept.	00	00	00	19.9	33.2	70	88	013.04
01-07 Oct.	02	04	01	20.6	34.1	54	86	000.00
08-14 Oct.	11	17	03	18.2	32.3	56	83	000.00
15-21 Oct.	26	35	10	14.1	31.0	44	88	000.00
22-28 Oct.	29	41	11	11.1	32.2	32	89	000.00

relative humidity 79 per cent (minimum 70 % and maximum 88%) with 13.4 mm rainfall. The disease development has been studied by Devi and Singh (2007); Biswas (2001). Devi and Singh (2007) studied the development through aerobiology under Manipur, North East Indian conditions. The disease was correlated with spore concentration in the air, growth phase of the crop and meteorological parameters. Highest spore catch (41.661/m^3) was recorded on 3 November that coincided with optimum temperature (maximum 29.0^{0}C and minimum 13.0^{0}C) and relative humidity (89%) and no rains. Epidemiological studies have also been conducted in rice bunt disease by Chahal (2001), Singh (1975) and Reddy and Reddy (1992).

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