Disease Incidence of Paddy Seedlings in Relation to Environmental Factors under Temperate Agroclimatic Conditions of Kashmir Valley

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ABSTRACT

Present study was undertaken to understand the relationship of environmental factors in disease occurrence in paddy seedlings under temperate agroclimatic conditions of Kashmir .Paddy is the staple food and is the main Kharief crop of the valley of Kashmir. This crop is being subjected to temperature fluctuations ranging from 5^{o} C to 35^{o} C and even sometimes snowfall occurs during seedling stage. Besides erratic rainfall , heavy dozes of nitrogen and high seed rates adopted by the farmers result in disease occurrence in paddy crop right at the seedling stage. The results revealed that the incidence of the blast disease of rice was greatly effected by the rate and frequency of dosage of nitrogen in nursery conditions. Though increased dose of nitrogen showed slight increase of sheath blight but brown spot disease revealed decreasing percentage of incidence. In general high temperature and high relative humidity favoured all the diseases under study. There was a significant increase in the incidence percentage of all the diseases with the increase seed rates due to overlapping of sprouted seeds resulting in rotting and weakening in seedling vigour. These studies have a direct effects on the farming community so that they could adopt the correct doze of nutrients, seed rate and also adopt strategies to save the seedlings from temperature fluctuations which are most prevalent under Kashmir ecology.

Key words: Disease incidence, paddy seedlings, paddy blast, sheath blight

INTRODUCTION

The current global population of 6.4 billion is expected to reach 7.5 billions by 2020 and 9 billions by 2050AD. Most of this population increase will occur in developing countries of Asia and Africa, where rice is the staple food. Globally it is cultivated now in 154 million hectares with annual production of around 600 million tones and average productivity of 3.9 t/ha. More than 90% of rice is produced and consumed in Asian countries and provides 23% of global human per capita energy and 16% per capita protein. It is estimated that by 2020 at least 115-120 million tones of milled rice is to be produced in India to maintain the present level of self sufficiency (Viraktamath, 2007). Rice is staple food of the state and is the main *Kharief* crop of Kashmir and Jammu plains.

The weather and soil conditions like temperature, soil moisture, soil nutrients, light, air humidity, soil pollutants, soil pH etc. influence the seasonal development and geographical distribution of plant diseases (Jones, 1924). Blast disease of rice (*Pyricularia grisea*) is the major disease of rice and losses due to blast range up to 90% depending upon the part of plant infected. Bacterial leaf blight of paddy (*Xanthomonas oryzae*) has become one of the most serious problems of rice cultivation in India and field losses estimated to vary from 6- 60%. Brown spot of paddy (*Helminthosporium oryzae*) is prevalent in all rice growing areas of the country especially in heavy monsoon areas of West Bengal, where major epidemic in 1942 resulted in yield loss up to 90% . Sheath blight of rice (*Rhizoctonia solani*) was reported for first time in India by Paracer and chahal (1963) from Punjab. The reduction in the grain yield has been reported up to 80% in India by Lakhpale *et. al.* (1996). The present study was undertaken with the following objectives:

i) Study the occurrence of different major diseases in rice seedling which cause a huge damage in rice nursery under Kashmir conditions viz Blast, Sheath blight and Brown spot diseases.
ii) To study the relationship of temperatures and growth of disease pathogens under in-vivo studies.
iii) To isolate pathogen of most prevalent diseases in nursery of rice.

MATERIALS AND METHODS

The study was carried out at the Research Farm of Rice Research & Regional Station Khudwani of S. K. University of Agricultural Sciences & Technology of Kashmir during 2007. The following general procedure was followed in different experiments to fulfill the objectives :

Preparation of Nursery:

Healthy and stout paddy seeds free from the diseases were kept into fresh cotton bags and soaked in fresh water for 24 hours. After 24 hours the seed bags were brought out and kept under the temperature of 20 – 30^{o}C. After 4-6 days the sprouts emerged and were sown in nursery area comprising of 1/10 of total cultivated land with different seed rates and with various doses of urea.

Incidence of disease:

Direct methods measure disease as incidence or severity.

$$\text{Disease incidence (I)} = \frac{\text{No. of infected plant units}}{\text{Total No. of units assessed}} \times 100$$

Descriptive scale used for estimating disease intensity:

The grades developed by British Mycological Society (1947) are as: -

0	=	Not seen in field
0.1	=	A few spots (1 or 2 spots) in 10.8m radius. A few plants affected.
1%	=	Up to ten spots per plant, or general light spotting
5%	=	About 50 spot per plant, or up to one leaflet in ten attacked.
25%	=	nearly every plant with lesions, plant still remaining normal form. Fields may smell of blight but look green although every plant is infected.
50%	=	Every plant affected and about half of the leaf area destroyed by blight. Field looks green flecked with brown.
75%	=	About three quarters of the leaf area destroyed by blight. Field looks neither predominantly brown nor green.
95%	=	Only a few leaves left green, but stems green.

100% = All leaves dead, stem dead or dying

Isolation of pathogen from diseased plant tissues of rice seedlings: -

Preparation of Potato Dextrose Agar Medium:-

Initially 200g potato peeled slices were boiled for ½ hours in sterilized distilled water then strained through cheese cloth. Then added 20 grams of dextrose and agar powder each and filled the water to complete 1 liter quantity. Then poured in conical flasks of 500ml quantity were plugged and autoclaved up to 15 square inch pressure for 1 hour to get rid with all the possible contamination in medium for further studies.

Isolation of Pathogen:

Pieces of diseased tissues were washed and placed in a beaker. Squares of tissues approximately 0.5cm across were cut from the advancing margins of lesions & placed in calcium hypochlorite solution for 3 to 5 minutes. Transferred small pieces of tissues onto hardened agar medium with alcohol – flamed forceps. Agar medium with diseased tissue were surface sterilized to avoid contamination .

Recording growth of mycelia

The radial growth and mycelial growth of the fungi were carried out in solid and liquid medium. Seven temperature levels (5, 10, 15, 20, 25, 30 and 35^{o}C) were studied in PDA medium. Each treatment was replicated thrice. They were sterilized at 120kg/cm^{2} pressure for 10 minutes. In solid medium tests, a 5mm mycelial disc was cut from the margin of a 14 days old culture and place asceptically. The centre of the petridish containing 20ml media and incubated at different temperatures for 14 days. Dry mycelial weight and radial growth of the each fungus was recorded. Results were analyzed statistically.

Recording of weather data

Weather data for the months of April to July was collected from the Meteorological Department of S.K. Univ. of Agri. Sci. & Technology Shalimar ,Srinagar (Table1).

Table 1: Weather data from April to July ,2007

Weather Parameters	April.	May	June	July
Rainfall(mm)	0.4	2.8	0.4	8.5
Max. temp.^{o}C	30.79	20.8	28.9	28.9
Min. temp.^{o}C	6.87	8.4	12.4	16.6
Sunshine hours	9.21	5.4	9.3	6.5

RESULTS AND DISCUSSION

Studies conducted at Rice Research and Regional Station, SKUAST-K Khudwani, Anantnag on the effect of temperature (Table 2) revealed that there was a significant increase in dry weight of mycelia from 35.5 mg to 150.7 mg with an increase of temperature from 5^{o}C to 30^{o}C in case of rice blast (*pyricularia grisea*). At 35^{o}C, there was a significant decrease of mycelial growth from 150.7 mg at 30^{o}C to 94.5 mg at 35^{o}C.

Table 2: Effect of temperature on the growth of *Pyricularia risea, Helminthosporium oryzae and Rihzoctonia solani.*

Temperature	Dry mycelial weight (mg)			Mean colony diameter (mm) on solid media		
	P. grisea	***H. oryzae***	***R. solani***	***P. grisea***	***H. oryzae***	***R. solani***
5^{o}C	35.50	41.50	15.50	7.50	14.60	8.60
10^{o}C	70.00	75.80	25.70	15.00	22.50	15.70
15^{o}C	87.00	95.00	40.00	21.00	28.70	21.00
20^{o}C	105.50	115.70	48.70	35.60	45.00	30.70
25^{o}C	135.00	150.00	56.70	41.50	50.50	36.50
30^{o}C	150.70	170.00	70.50	50.70	60.30	43.50
35^{o}C	94.50	181.80	78.70	60.00	70.50	50.70
C. D. at 1%	**7.61**	**9.51**	**6.42**	**3.42**	**5.14**	**3.15**

In case of sheath blight & brown spot, there was significant increase of dry mycelial weight from 41.5 mg to 181.20mg and 15.5 mg to 78.70 mg respectively. The results on the mean colony diameter (mm) revealed that there was a significant increase

in the diameter from 7.5 mm to 60mm in case of *P. grisea,* 14.6 mm to 70.5 mm in case of brown spot (*Helminthosporium oryzae)* and 8.6mm to 50.7 mm in case of sheath blight (*Rhizoctonia solani)* The effect of temperature on the infection and development of blast disease of rice has been studied by many workers (Suzuki,1975,Agarwal et al.,1989). It is now well established that low night temperature during the growth of rice plants is the most critical of environmental factors that predispose the host to infection by *P. grisea* (Suryanarayanan, 1996). At the Central Rice Research Institute, Cuttack, India, it has been found that an out break of blast can be expected at a minimum night temperature of 20 – 24^{o}C and relative humidity above 90% during the early morning period for 2 – 4 days.

Brown spot

Pathogen: *Helminthosporium oryzae*:

Sheath Blight

Pathogen: *Rhizoctonia solani*

Studies on the different doses of nitrogen(Table 3) on the disease incidence revealed that there was significant increase in the leaf blast from 3% in control (no nitrogen) to 20% with 120 kg N/ha with 567% over the control. Sakamoto (1948) demonstrated that resistance to rice blast decreased with increased nitrogen levels due to injurious effects of ammonium, accumulation in the cells of plants. However brown spot disease showed a decrease in trend with increase in the levels of nitrogen from 50% (control) to 20% with 120kgN/ha with 60% decrease over the control. Sheath blight showed initial decrease in the incidence percentage from 5% to 4.5% with

increase of 20 kg N/ha over control but later on there was increase in percentage of disease occurrence to 4% and later on there was again decrease to 0% at 60 kg N/ha. From 60kgN/ha onwards there was significant increase from 20% with 80kgN/ha to 46% with 120kgN/ha. The connection between nutrition and susceptibility to parasitic and non parasitic diseases in plants has been studied by Karl Boning (1976).

The results on different seed rates (Table 4) on the occurrence of disease in paddy nursery revealed that leaf blast showed initially slight increase but with higher seed rates viz 100kg/ha & onwards, there was a significant increase from 4% to 20.5%.The incidence percentage on the brown spot revealed significant increase from 5% to 40.00% with an increase of seed rate from 60 – 160 kg / ha. Sheath blight also revealed increase in trend with increase in the seed rate. However, there was a non-significant difference between 60 & 80 kg/ha, 140 & 160 kg/ha. Also maximum seed rate also influences the seedlings due to overlapping of sprouted seeds resulting rotting & weakening in seedling vigour.

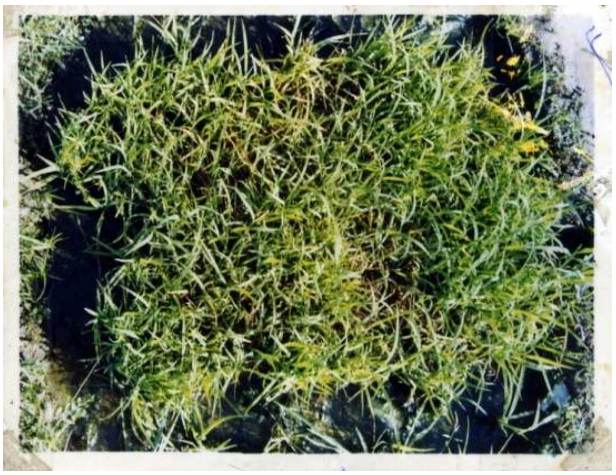
Table 3: Effect of different dosages of nitrogen on incidence of diseases in rice nursery

Nitrogen (kg/ha)	Incidence (Percentage)					
	Leaf blast	Percent increase	Brown spot	Percent decrease	Sheath slight	Percent increase
0	3.00	--	50.00	--	5.00	--
20	4.50	50	47.50	6	4.50	10
40	5.00	67	46.00	8	5.20	4
60	6.50	117	45.00	10	5.00	0
80	9.50	217	40.50	19	6.00	20
100	11.00	267	30.00	40	6.50	30
120	20.00	567	20.00	60	7.30	46
***C*.D. at 1%**	**2.14**		**3.58**		**1.72**	

Table 4 : Effect of seed rate efficiency on occurrence of diseases in rice nursery

Seed rate	Incidence %		
Kg/ha	Leaf blast	Brown spot	Sheath blight
60	2.00	5.00	2.00
80	2.50	8.00	3.00
100	4.00	15.00	4.50
120	10.00	21.70	5.70
140	14.50	30.50	6.00
160	20.50	40.00	6.80
C.D. at 1%	0.98	1.75	1.14

Studies conducted revealed the blast disease was increased with increase of Nitrogen dosages in nursery of rice. It has been found that the rate, frequency and timing of nitrogen application had a much greater influence on leaf blast than on brown spot diseases as was observed in previous reports (Dos *et al* 1986). However, the no nitrogen treatment had less blast incidence than the treatments where nitrogen was applied but this was probably not sufficient to influence the relative occurrence of brown spot disease. In the present study, the increased nitrogen dose really impended the incidence of brown spot disease in rice nursery. The brown spot was consistently decreased with increase in nitrogen doses in nursery whereas it is interesting to attribute that sheath blight disease appeared in variable incidence without a significance response of nitrogen application. High doses of silicate, magnesium have been reported to increased severity of bacterial blight of paddy (Inoue and Tsuda, 1959) whereas potassium has been shown to decrease the disease (Yamanaka et al, 1952). On the other hand, Kim and Cho (1970) have reported that potassium and phosphorus applications at twice the normal level tend to stimulate lesion development of bacterial blight.



Rice Blast

Pathogen: *Pyricularia grisea*

The results revealed that the incidence of the blast disease of rice was greatly effected by the rate and frequency of dosage of nitrogen in nursery conditions. Thus to prevent the occurrence of rice blast indiscriminate application of nitrogen should be avoided. Though increased dose of nitrogen showed slight increase of sheath blight but brown spot disease revealed decreasing percentage of incidence. In general high temperature and high relative humidity favoured all the diseases under study. There was a significant increase in the incidence percentage of all the diseases with the increase seed rates due to overlapping of sprouted seeds resulting in rotting and weakening in seedling vigour. These studies have a direct effects on the farming community so that they could adopt the correct doze of nutrients, seed rate and also adopt strategies to save the seedlings from temperature fluctuations which are most prevalent under Kashmir ecology.

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