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RESEARCH ARTICLE

CORRELATION STUDY OF INDIVIDUAL METEOROLOGICAL PARAMETERS AND DISEASE SEVERITY FOR PREDICTION OF PEARL MILLET BLAST

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ABSTRACT

Knowledge of epidemiology provides the basic information to develop efficient and workable plant disease control methods. Environmental factors play an important role to disease development. The various weather variables such as temperature (T), relative humidity (RH) and rainfall influence different parameters of infection process and disease development. Interaction between these weather variables (independent variables) and disease development (dependent variables) pave the way for the development of the prediction models. These diseases are being managed through chemical fungicides, but the efficiency of control measures depends upon the interaction between pathogen and host, which is influenced by environmental factors. Correlation studies showed significant and negative correlation with average maximum temperature (r = - 0.647*). In contrast to temperature, the maximum relative humidity and minimum relative humidity showed a significant positive relationship with the disease. The total rainfall showed a significant positive relationship with the disease (r = 0.668*) indicate that the blast severity increases with the increase in total rainfall. Development of pearl millet blast is favoured by temperature 30-35 ^{o}C, relative humidity 55-75% with intermittent rains (190-100mm) proved most effective for disease development. For greater efficiency, the disease-forecasting models must be developed by taking into account the crop variety, the prevalence of a particular pathotype and the different climatic factors.

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INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.) R. Br)] is one of the assured Kharif crop under environment domesticated in the annual rainfall of 150 mm to 1000 mm in India. It is predominantly a rainfed, salt tolerant crop of rainy season. Bajra grains contain about 11.6% protein, 5% fat, 67.5% carbohydrates and about 2.3% mineral. It provides staple cereal diet to the people grain and fodder purposes, chapatti, bread, snacks, cake, beverages and predigested weaning food besides poultry feed and fodder for cattle. In India pearl millets occupy an area of 7.95 lakh ha with a production of 8.79 mt and productivity of 1106 kg / ha (Anon, 2014). Major pearl millets growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh, Haryana, Karnataka and Tamil Nadu. Pearl millet is affected by a number of diseases. Among the important disease, pearl millet blast (*Pyricularia grisea*) that individually cause substantial yield and quality losses. Several diseases caused by fungi, bacteria, viruses and nematodes have been recorded (Rachie and Majmudar, 1980), out of them downy mildew, ergot, smut, blast and rust are widespread and destructive disease of pearl millet in India. Blast of pear millet also known as Pyricularia leaf spot, is particularly important in pearl millet forage cultivars. Recently it has emerged as a serious disease of dual purpose (grain and fodder) pearl millet hybrids in India (Lukose *et al.,* 2007). The symptoms appear as greyish, water-soaked lesions on foliage that enlarge and become necrotic, resulting in extensive chlorosis and premature drying of young leaves. Studies have been conducted to develop suitable prediction models for adopting timely protection measures.

MATERIALS AND METHODS

The field experiment was conducted during 2009-10 at Research Farm of RVSKVV, Gwalior (M.P). The experiment was laid out in randomized block design with five replications. The local susceptible cultivar was sown. Ten plants from each plot were randomly selected and tagged for the record of blast severity at weekly interval starting from the initiation of the disease, simultaneously the meteorological parameters *viz.* maximum and minimum temperature, maximum and minimum relative humidity (RH) and rainfall were also recorded separately. The temperature and humidity were taken as

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average of last seven days, while rainfall was taken as total of the preceding seven days from the day of recording observation. The progressive severity of blast was recorded at weekly intervals in a blast susceptible cultivar sown on four different dates, the meteorological parameters *Viz.,* temperature (maximum and minimum), humidity (maximum and minimum) and rainfall were also recorded separately for corresponding week**.** The correlation and simple regression was compute between disease severity and individual meteorological parameters were worked out.

KM-252 respectively in June 16th sown crop. Similarly highest incidence of leaf blast (grade-4) was recorded in June 16th sown VR-708. The variety PR-202 performed better in all four dates of sowing and recorded the highest grain yield of 3685 kg/ha in August 2nd sown crop. The investigations revealed that increased leaf, neck and finger blast was due to increased temperature, significantly high amount of rainfall and high relative humidity and vice versa for low blast disease development. Further regression equation was worked out to predict the quantitative effect of above meteorological

Table 1. Weekly progress of pearl millet blast severity under existing meteorological parameters

Date of Observation	Meteorological parameters					Progressive blast severity (%) y
	X1	X2	X3	X4	*X5*	
30.7.2010	35.8	25.9	84.8	66.8	29.1	1.4
06.8.2010	33	24.8	87.7	75.4	96.2	3.9
13.8.2010	34.3	25.7	83.4	64.7	4.7	2.4
20.8.2010	34.5	25.3	87.8	69.7	57.7	3.7
27.8.2010	32.3	25.5	92.2	83.2	132	7.5
03.9.2010	34.1	26.7	87.2	72.7	36.4	4.4
10.9.2010	32.9	26.3	89.7	81.5	14.5	3.4
17.9.2010	33.1	25.9	85.1	75.1	9.4	3.6
24.9.2010	30.5	23.4	89.5	77.8	291	5.6
01.10.2010	33.4	21.2	71.5	62.4	0	1.1

Table 2. Relationship between blast and meteorological parameters

Factor	r (Correlation coefficient)	Regression equation
Max. temp. vs blast sev.	-0.647*	Y=32.3708-0.8587X1*
Mini. temp. vs blast sev.	0.230^{NS}	Y=3.011+0.2677X2NS
Max. RH. vs blast sev.	0.764*	Y= -18.197+0.255X3*
Mini. RH. vs blast sev.	0.820**	Y= -12.539+0.2227X4**
Total Rainfall vs blast sev.	0.668*	Y=2.7489+0.0142X5*

Note:-. X1 - Max. temp.^{0}c *Significant at 5% prob. Level.
X2 – Min. temp. ** Significant at 1% prob. Level.
X3- Max. Humidity (%) NS- Non Significant
X4 – Min. Humidity (%)
X5- Rainfall in mm.

RESULTS AND DISCUSSION

The data revealed that the effect of environmental factors on the blast severity presented in Table 1. The minimum (1.1%) blast severity was recorded in 1/10/2010 date of observation and the maximum (7.5%) blast severity was recorded in 27/08/2010 date of observation. The Correlation studies showed significant and negative correlation with average maximum temperature (r = - 0.647*), it indicate that pearl millet blast severity increases with the corresponding decrease in the average maximum temperature summarized in Table 2. In contrast to temperature, the maximum relative humidity and minimum relative humidity showed a significant positive relationship with the disease that is r = 0.764*and r = 0.820* respectively, which clearly show that the disease increases with the corresponding increase in the maximum and minimum relative humidity. The total rainfall showed a significant positive relationship with the disease (r = 0.668*) indicate that the blast severity increases with the increase in total rainfall. This finding is supported by Patro and Madhuri (2014) studied that under favourable environmental conditions the losses caused by *Pyricularia grisea* are severe due to leaf, neck and finger blast in finger millet. The highest incidence of neck blast of 72.67 and 67.00 per cent was noticed in the susceptible genotypes VR-708 and KM-252 respectively in June 16th sown crop, where minimum temperature of 26.1o C, maximum temperature of 32.36o C, relative humidity of 89.9 per cent and a very high amount of rainfall prevailed. Highest finger blast severity of 58.32 and 51.37 per cent in genotypes VR-708 and

parameters on the blast severity (Table 2). The regression equation y = 32.3708 – 0.8587 X1, indicate that the average maximum temperature should be < 37.7^{0}C for the appearance of blast and there after one per cent decrease in maximum temperature, the blast severity may increase by 0.85%. The regression equation y = -18.197 + 0.255X3, indicate that the average maximum relative humidity should be > 71.4% for appearance of blast and there after the blast severity may increase by 0.25% by one per cent increase in the maximum relative humidity. The regression equation y = -12.539 + 0.2227X4, indicate that the average minimum relative humidity should be > 56.3% for appearance of blast and further one per cent increase in minimum relative humidity may result in an increase of blast severity by 0.22%. There regression equation y = 2.7489 + 0.0142 X5, indicate that one mm (millimeter) rainfall may result in an increase of blast severity by 0.0142 per cent. Thus the present investigation showed that early sowing results in maximum incidence of blast and reduction in yield. Whereas, late sowing results in less incidence of blast disease and less affected the yields. Present finding is supported by Patel and Tripathi (1998) for their report on finger millet blast caused by *Pyricularia grisea.* The average minimum and maximum temperature of 22^{0}C and 29^{0}C respectively with 85-99% average relative humidity during the crop growth period was found favorable for the disease. This finding is closely associated by Netam *et al.* (2014) reported that the crop was sowing in different dates to observed incidence and severity of blast of finger millet. Minimum leaf blast severity and neck and finger blast incidence as well as highest grain yields were

recorded from 1st June sown crop during both the years. The weather parameters recorded and correlated with disease development, in two years indicated that the average minimum and maximum temperatures of 21°C and 29°C respectively a 70-81% relative humidity were along with the most important factors favouring blast disease development. Present study indicated that decrease in temperature and increase in humidity may favour the disease development and may cause epidemic of leaf blast or neck blast or finger blast.

Conclusion

Pearl millet blast severity showed a significant and positive relationship with relative humidity (maximum and minimum) and total rainfall. In contrast to this disease showed the negative correlation with maximum temperature. Further regression study reveals that minimum and maximum relative humidity should be more than 56 and 71% respectively for the initiation of the disease and there after one per cent increase in minimum and maximum relative humidity, the disease severity would increase 0.22 and 0.25% respectively. Regression study also revealed that the average maximum temperature should be $<37.7^0$C and thereafter 1% decrease in maximum temperature may result in increase of blast severity by 0.85%. The regression equation between rainfall and disease severity indicate that rainfall in one of the important meteorological parameter for the development of the disease.

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