RESEARCH ARTICLE

ASSOCIATION AMONG VARIOUS COMPONENTS OF RESISTANCE TO *PYRICULARIA GRISEA* IN FINGER MILLET

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Abstract: Blast of finger millet incited by the fungus *Pyricularia grisea* is considered as a major limiting factor in the global finger millet production because of its wide distribution and destructiveness under favourable conditions its cause severe yield losses upto 80-90%. Significant correlation among different components of partial resistance was observed. Neck blast severity was positively correlated with linear necrotic area (r=0.949*), coefficient of infection (r=0.993*), apparent infection rate per unit per day (r=0.541*) and AUDPC values (r=0.958*), whereas negative correlation was recorded between neck blast severity and incubation period (r=-0917*). In the tested finger millet genotypes, final finger blast severity varied 6.3 to 39.9% with a mean of 18.7%. Low values of finger blast severity, coefficient of infection, percent finger infection, apparent infection rate, area under disease progress curve values were recorded in finger blast resistant genotypes whereas higher values were noted in susceptible to highly susceptible genotypes.

Keywords: Finger millet, *Pyricularia grisea*, Partial resistance, Neck blast

INTRODUCTION

Finger millet (*Eleusine coracana* L. Gaertn.), belonging family poaceae commonly known as ragi is an important coarse cereal traditional crop widely grown in semi arid areas of African and Asian countries. In India, the crop is cultivated on 2.6 m ha area with a production of about 3.0 m t and productivity of 1428 kg ha^{-1} (Anonymous,2013) and is an important component of dry land agriculture. It is an important staple food in parts of eastern and central Africa and India. The grains are rich source of protein fiber, minerals ,amino acids which are crucial to human health and growth, and these are deficient in most cereals . Blast caused by *Pyricularia grisea* (Cooke) Sacc. is very prominent and affect the productivity, utilization and trade of finger millet. The average loss due to blast has been reported to be around 28-36% (Nagaraja *et al.* 2007), and in certain areas yield losses could be as high as 80-90% (Vishwanath *et al.*, 1986; Rao, 1990). The disease affects the crop at all growth stages, and neck and panicle blast are the most destructive form of the disease (Pande *et al.* 1995; Takan *et al.* 2012). The most susceptible stage for leaf blast is seedling stage, whereas for neck and finger blast is pre-flowering stage. The mechanism of blast resistance in finger millet has been reported that smaller leaf area, narrow leaf angle, fewer stomata, dwarf plant. Several types of resistance have been recognized on the basis of their mode of inheritance, epidemiological terms, mechanism of resistance, and frequency of distribution and stages of growth at which disease occurs.The present study “Studies on various components of partial resistance to blast disease has been designed has been designed to identify of the fourteen components of slow blasting resistance in finger millet.

MATERIALS AND METHODS

The experiments were conducted at college of agriculture, Rewa (M.P.) Association among various components of resistance to blast disease in finger millet and correlation coefficient among Neck, finger and leaf blast infections. The data were analyzed statistically using Randomized Block Design (RBD). The data obtained from different experiments were analyzed by the “F” test significance and treatments were compared by mean of critical differences at 5% probability levels. If the F test is not significant it was indicated by letters NS. The values expressed in percentage were transformed to angular (Arc-sine) values before analysis.

Standard error of mean - To test the significance difference among the treatment means following formula were used :

$$S.Em\pm = \frac{EMS}{\sqrt{r}}$$

Where, EMS = Error mean sum of squares
r = Number of replications

Standard error of differences -It was calculated using following formula:

$$S.Ed\pm = \frac{2\ EMS}{\sqrt{r}}$$

Where, EMS = Error mean sum of squares
r = Number of replications

Critical differences (CD) -It was measured using following formula

C.D. = S.Ed± x ‘t’ at 5% for error df

Where,

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CD = Critical difference, S.Ed± = Standard error of differences, t = Table value of 't'

Coefficient of variation (CV) -It was calculated using below mentioned formula.

$$CV = \frac{\sqrt{EMS}}{X} \times 100$$

Where, CV = Coefficient of variation, EMS = Error mean sum of squares,

X = General mean of the characters

Correlation coefficient -Correlation coefficients measure the intensity or degree of linear relationship between two random variables. **C**orrelation coefficients among blast infections and component characters for partial or slow blasting resistance were calculated according to procedure given by Miller *et. al.,* (1958).

$$rij = \frac{Cov\ (i\ j)}{\sqrt{Var\ (i) \times var\ (j)}}$$

Where,

r_{ij} = Coefficient of correlation between i^{th} and j^{th} characters

Cov ($_{ij}$) = Covariance between i^{th} and j^{th} characters

Var (i) = Variance of i^{th} character

Var (j) = Variance of j^{th} character

Correlation coefficients were computed by substituting corresponding variances and covariance's in the above formula. The estimation of covariance between two characters was derived in the same way as for corresponding variances components.

Phenotypic correlation coefficient was tested as per the procedure given by **Panse and Sukhatme (1967).**

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \text{ at (n-2) degree of freedom}$$

The calculated value is compared with 't' value at error degree of freedom and 5% or 1% probability level.

Correlation coefficient among all the blast infection, components of slow blasting resistance and morphological parameters in all possible combination at phenotypic and genotypic levels were estimated as per standard procedure.

RESULT AND DISCUSSION

Correlation coefficient (r) in all possible blast infections were estimated and presented in Table 1.1. Significant positive correlation of leaf blast incidence with neck blast (r = 0.556*) and finger blast (r = 556*) was observed. Similarly, correlation coefficient between neck blast and finger blast (r = 0.982*) was positive and significant. Data of the present study revealed that correlation between leaf blast with neck and finger blast was moderate, where as correlation between neck and finger blast was strong and high. The estimates of correlation coefficients (r) among leaf blast severity and components characters of slow blasting resistance are presented in Table 2. The leaf blast severity (LBS) was found to be positively correlated with coefficient of infection (r = 0.948*), apparent infection rate (r = 0.829*), area under disease progress curve (r = 0988*), lesion necrotic (r = 0.967*), lesion area (r = 0.957*) and lesion circumference (r = 0.976*), where as incubation period (r = -0.858*) was negatively correlated with leaf blast severity. The association of coefficient of infection with apparent infection rate (r=0.684*), area under disease progress curve (r=0.936*), lesion number (r=0.959*), leaf area (r=0.961*) and lesion circumference (r=0.960*) was positive and significant, but correlation with incubation period (r= -0.814*) was negative. The correlation coefficients of incubation period with apparent infection rate (r= -0.753*), area under disease progress curve (r= -0.855*), lesion number (r= -0.799*), lesion area (r= -0.813*), and lesion circumference (r= -0.832*) were significant and negative. Significant positive correlation of apparent infection rate with area under disease progress curve (r=0.824*), lesion number (r=0.728*), lesion area (r=0.729*), and lesion circumference (r=0.761*) was observed. Area under disease progress curve was positively correlated with lesion number (r=0.966*), lesion area (r=0.941*), and lesion circumference (r=0.973*). Significant positive correlation of lesion number with lesion area (r=0.988*), lesion circumference (r=0.983*) and lesion area with lesion circumference (r=0.993*) were recorded.

Correlation among leaf blast severity and agro-morphological characters

The correlation coefficients among leaf blast severity and agro-morphological characters are presented in Table 3. Leaf blast severity showed significant positive correlation with stomata density (r=0.848*), leaf angle of lower leaves (r=0.919*), leaf angle of middle leaves (r=0.839*) and leaf angle of upper leaves (r=0.843*). Days to maturity (r= -0.613*) and plant height (r =-0.722*) were negatively correlated with leaf blast severity. Significant positive correlation of days to maturity with plant height (= 0.763*), was recorded but it exhibited significant negative correlation with stomata density (r = -0.865*), leaf angle of lower leaves (r = -0.722*), leaf angle of middle leaves (r -0.666*), and leaf angle of upper leaves (-0.662*). Significant negative correlation between plant height and stomata density (r = -0.757*), leaf angle of lower leaves (r = -0.664*), and leaf angle of middle leaves (r = -0.770*) was recorded. Stomata density significant positive correlation with leaf angle of lower leafs (r= 0.880*), leaf angle middle leaf (r= 0.779*) and leaf angle of upper leaf (r= 0.883*). Leaf angles of lower leaves, middle leaves and upper leaves were positively correlated with each other. Correlation of tillers per plant with leaf blast severity and other component characters were non- significant.

Correlation among neck blast severity and component characters of resistance

The correlation coefficient (r) among neck blast severity (NBS) ,length of necrotic area (LNA) , coefficient of infection (CI) , incubation period (IP), apparent infection rate (r), and area under disease progress curve (AUDPC) values were calculated and Sunil and Anil kumar, 2003. The result of the present study are in agreement with the observation and positive correlation in various components of resistant to *Pyricularia grisea* in finger millet.

CONCLUSION

The results of the present study showed that finger millet genotypes had a diversity of resistance against leaf, neck and finger blast. Significant positive correlation was observed among leaf, neck and finger blast infections. Strong correlation between neck and finger blast and lower correlation of leaf blast with neck and finger blast was recorded Significant differences between finger millet genotypes and components of partial or slow blasting resistance were recorded. Neck blast severity was positively correlated with linear necrotic area (r=0.949*), coefficient of infection (r=0.993*), apparent infection rate per unit per day (r=0.541*) and AUDPC values (r=0.958*), whereas negative correlation was recorded between neck blast severity and incubation period (r=-0917*). In the tested finger millet genotypes, final finger blast severity varied 6.3 to 39.9% with a mean of 18.7%. Attempt should be made to determine more components of partial or field resistance and their association with blast disease through analysis of components of resistance in finger millet.

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Table 1. Coefficient of correlation (r) among leaf, neck and finger blast in finger millet genotypes

Variables	Leaf blast	Neck blast	Finger blast	Variables tested	Students T test		
					T Value	T Table	Significance at 5%
Leaf blast (V_1)	1.000	0.540*	0.556*	V_1 - V_2	2.269	2.179	Significant
Neck blast (V_2)		1.000	0.982*	V_1 - V_3	2.322	2.179	Significant
Finger blast (V_3)			1.000	V_2 - V_3	18.66	2.179	Significant
Mean incidence	27.6(%)	15.5(%)	18.7(%)				

Table 2. Correlation coefficients (r) among components of partial resistance in finger millet against leaf blast.

Variables	LBS	CI	IP	r	AUDPC	LN	LA	LC
LBS	1.000	0.948*	-0.858*	0.829*	0.998*	0.967*	0.957*	0.976*
CI		1.000	-0.814*	0.684*	0.936*	0.959*	0.961*	0.960*
IP			1.000	-0.753*	-0.855*	-0.799*	-0.813*	-0.832*
r				1.000	0.824*	0.728*	0.729*	0.761*
AUDPC					1.000	0.966*	0.941*	0.973*
LN						1.000	0.988*	0.983*
LA							1.000	0.993*
LC								1.000

*Significant at 5%

Leaf blast severity (LBS), Coefficient of infection (CI) , Incubation period (IP) , Apparent infection rate (r), Area under disease progress curve (AUDPC) , Lesion number (LN) , Lesion area (LA) , Lesion circumference (LC)

Table 3. Correlation coefficients (r) among components of partial resistance in finger millet against leaf blast.

Variables	LBS	M	PH	T	SD	LAL	LAM	LAU
LBS	1.000	-0.613*	-0.722*	-0.457	0.848*	0.919*	0.839*	0.843*
M		1.000	0.763*	0.332	-0.865*	-0.722*	-0.666*	-0.662*
PH			1.000	0.398	-0.757*	-0.664*	-0.770*	-0.514
T				1.000	-0.424	-0.521	-0.408	-0.508
SD					1.000	0.880*	0.779*	0.833*
LAL						1.000	0.753*	0.849*
LAM							1.000	0.797*
LAU								1.000

*Significant at 5%

Leaf blast severity (LBS), Days to maturity (M), Plant height (PH), Tillers per plant (T) Stomata density (SD), Leaf angle of lower leaves (LLA), Leaf angle of middle leaves (MLA) , Leaf angle of upper leaves (ULA)

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