Research Paper :

Morphological characters responsible for resistance to leaf folder, *Cnaphalocrocis medinalis* Guenee (Pyraustidae: Lepidoptera) in traditional cultivars of rice

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SUMMARY

Twenty two traditional rice cultivars and five recommended cultivars were tested against the leaf folder, under field condition at Agricultural Research Station, Honnavile, Shimoga during *Kharif*, 2009. Resistance was assessed based on the percentage of damaged leaves following 0-9 scale as per the SES. 15 cultivars were resistant and recorded damage score of '1' indicating resistance to leaf folder. Seven cultivars were moderately resistant and remaining five cultivars were found to be moderately susceptible to leaf folder damage. Among the plant, the morphological characters studied, number of trichomes, number of tillers and leaf width, only number of trichomes and leaf width (cm) showed significant correlation with leaf folder infestation.

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Rice (*Oryza sativa* L.) is one of the important cereal crops of the world and forms the staple food for more than 65 per cent of the world population and known as king of cereals. Nearly 90 per cent of the area, production and consumption of rice are confined to South East Asian countries (Mathur *et al.,* 1999). It is essentially a crop of warm humid environment and grown mainly under assured rainfall or irrigation. Since mid sixties despite of the cultivation of high yielding varieties the rice production and productivity has not made an impact due to the unholy triple alliance of insects, diseases and weeds. Therefore, the traditional rice cultivars are highly adapted to the regions and also have special uses and varying levels of resistance to biotic and abiotic stresses. However, traditional rice cultivars are important reservoirs of valuable traits and need special attention for future conservation. It possesses valuable traits *viz.*, medicinal properties, nutrition, taste, aroma, tolerance to drought, submergence and other special uses. More than 50 per cent of rainfed rice in Karnataka is under traditional rice, thus sheltering a potential genetic diversity (Hanamaratti *et al.*, 2008).

In recent years, the leaf folder, *Cnaphalocrocis medinalis* (Guenee) is becoming serious pest of rice. The caterpillar folds the leaves longitudinally into tubular structures and feed on green leaf tissues within the structure. Larval feedings result in white, transparent streaks. Heavy infestation affects the photosynthetic ability and reduction of yield (Fletcher 1914). Further, an identification and understanding of the mechanisms and bases of resistance in the host plant are the major steps to varietal resistance development. In the present study attempts have been made to assess the morphological characters responsible for the incidence of leaf folder on 22 traditional rice cultivars and evaluate them for resistance against leaf folder.

MATERIALS AND METHODS

The field experiment was conducted at Agricultural Research Station, Honnavile, Shimoga during *Kharif*, 2009. The experiment consisted of 22 traditional rice cultivars and five recommended cultivars. These traditional cultivars are infrequently grown in Malnad regions and were collected from Organic Farming Research Centre, Navile, Shimoga. These cultivars were tested against the leaf folder. The experiment was laid out in RCBD design totaling 27 treatments. The plot size was 2.4 x 1.8 m. The seeds of different traditional and recommended cultivars of rice are sown in nursery. Twenty five day old seedlings were transplanted to main field during second week of August, 2009 at 20 x 10 cm spacing and all the agronomic practices were followed as per the recommended package of practices, except plant protection measures (Anonymous, 2006).

The observation on incidence of leaf folder was recorded at 10 randomly selected hills in each treatment at fortnightly interval and per cent leaf folder damaged leaves was worked out by counting the number of infested leaves and total number of leaves of 10 hills in each replication. Based on these, percentage of damaged leaves was calculated and scored as per the 'Standard Evaluation System for Rice' (Anonymous, 1988) and the data were subjected to statistical analysis (DMRT). Varieties were also scored against the 0-9 damage score and were classified for varietal reaction as follows:

Damage score	Scale (damaged plants)	Varietal reaction
0	No damage	Highly resistant
1	1-10%	Resistant
3	11-20%	Moderately resistant
5	21-35%	Moderately susceptible
7	36-50%	Susceptible
9	51-100%	Highly susceptible

Data on plant morphological characters *viz.*, number of trichomes, number of tillers and leaf width were observed. Trichome observation was made by the procedure of Maiti *et al.* (1980). Observation recorded on the number of tillers and leaf width at mid point from middle leaf of the plant per hill from 10 randomly selected hills in each treatment were recorded at different phonological growth stages of the crop such as seedling, tillering, stem elongation, panicle initiation to booting, heading, flowering, mature grain and dough stage at fortnightly intervals and expressed as number of tillers per hill and leaf width in cm in each treatment. Then the number of trichomes, number of tillers and leaf width at mid point was correlated with the incidence of leaf folder.

RESULTS AND DISCUSSION

The overall seasonal mean damage (Table 1) revealed that Kanadatumba (1.80%) recorded significantly lower damage throughout the season and it was at par with MTU-1010 (1.85), JGL- 1798 (2.29), Bangaru sanna (2.38), Gandhasale (2.43), Gangadale (2.51), Selum sanna (2.65), Jeerige sanna (2.66), Pusa sugandhi (2.72) and Mysore mallige (2.79). Whereas Jyothi (21.70%) registered significantly higher seasonal mean damage score followed by Kari mundaga (21.52) and it was at par with Navalisale (21.17), Malgudi sanna (21.10) and Sugandhi (21.02).

Upon classification of cultivars (Table 2), 15 cultivars *viz.,* Selum sanna, Mysore mallige, Pusa sugandhi, Gandhasale, Gouri sanna, Andhra basumati, Kanadatumba, Jeerige sanna, Gandhasale, Mukkannu sanna, HMT, Bangaru sanna, JGL- 1798, MTU-1001 and MTU-1010 had a damage score of '1' indicating resistance to leaf folder, while seven cultivars *viz.,* Chinniponni, Dehali basumati, Ratnachudi, Anandi, N.M.S- 2, Navara and Jaya were moderately resistant (damage score of '3') and rest of the five cultivars *viz.,* Kari mundaga, Navalisale, Malgudi sanna, Sugandhi and Jyothi were moderately susceptible (Score '5') to leaf folder.

The number of trichomes on the surface of leaf in the tested rice cultivars and their relationship with mean per cent damaged leaves (Table 1) revealed that, the trichome density ranged from 1.39 to 50.03 per cm^2 leaf area recorded in Gandhasale and Ratnachudi, respectively. Generally resistant cultivars had highest number of trichome density per centimeter square leaf area except Mysore mallige (8.17), Gandhasale (1.39), Jeerige sanna (4.02), MTU-1001 (6.29) and MTU-1010 (14.17) possessing less number of trichomes and showing resistance to leaf folder, such exceptions may be because that not only morphological characters (trichomes) but also biochemical features of plant influence the resistance (Alagar *et al.,* 2008). However moderately susceptible cultivars had lowest number of trichomes per centimeter square leaf area *viz.,* Karimundaga (3.82), Navalisale (2.19), Malgudi sanna (8.52), Sugandhi (3.22) and Jyothi (4.13). Therefore, it clearly indicates that higher number of trichomes decreases the incidence of leaf folder and lower number of trichomes increases the incidence of leaf folder.

Table 1 : Response of plant morphological characters of traditional and recommended rice cultivars against the incidence of leaf folder (*Cnaphalocrocis medinalis* Guenee)

Traditional cultivars	% Damaged leaves**	Number of trichomes/ cm^2 leaf area**	Number of tillers**	Leaf width at mid point(cm)**
Selum sanna	2.65 (8.67)^{fgh}	40.33 (6.30)^{b}	11.30 (3.39)^{ab}	0.81 (1.15)^{c}
Mysore mallige	2.79 (9.02)^{efgh}	8.17 (2.16)^{h}	10.52 (3.39)^{ab}	0.85 (1.15)^{c}
Kari mundaga	21.52 (27.60)^{a}	3.82 (1.77)^{i}	12.25 (3.53)^{ab}	1.08 (1.24)^{abc}
Chinniponni	11.33 (19.13)^{cd}	2.99 (1.60)^{ij}	12.42 (3.53)^{ab}	0.86 (1.16)^{bc}
Pusa sugandhi	2.72 (9.32)^{efgh}	33.56 (5.68)^{c}	12.72 (3.57)^{ab}	0.84 (1.15)^{c}
Dehali basumati	11.22 (18.76)^{d}	2.86 (1.43)^{ij}	11.82 (3.45)^{ab}	0.84 (1.15)^{c}
Gandhasale	2.43 (8.67)^{fgh}	1.39 (1.30)^{j}	12.76 (3.69)^{a}	0.72 (1.22)^{abc}
Ratnachudi	11.04 (18.87)^{d}	50.03 (7.08)^{a}	11.21 (3.37)^{ab}	0.90 (1.18)^{bc}
Navalisale	21.17 (27.33)^{a}	2.19 (1.52)^{ij}	12.45 (3.68)^{a}	0.87 (1.28)^{ab}
Gouri sanna	3.51 (10.31)^{efg}	26.07 (4.93)^{d}	12.85 (3.59)^{ab}	0.82 (1.15)^{c}
Anandi	12.88 (20.98)^{c}	28.13 (4.70)^{d}	12.45 (3.56)^{ab}	0.92 (1.19)^{bc}
Andhra basumati	3.97 (10.72)^{ef}	26.04 (4.90)^{d}	11.37 (3.40)^{ab}	0.87 (1.17)^{bc}
Kanadatumba	1.80 (7.62)^{h}	30.42 (5.67)^{c}	12.44 (3.67)^{a}	0.73 (1.22)^{abc}
Malgudi sanna	21.10 (27.32)^{a}	8.52 (2.83)^{g}	12.91 (3.70)^{a}	0.91 (1.31)^{a}
Jeerige sanna	2.66 (9.31)^{efgh}	4.02 (1.67)^{ij}	11.30 (3.39)^{ab}	0.90 (1.18)^{bc}
Sugandhi	21.02 (27.24)^{a}	3.22 (1.75)^{i}	12.89 (3.68)^{a}	0.92 (1.31)^{a}
Gangadale	2.51 (8.85)^{fgh}	30.17 (5.63)^{c}	12.79 (3.72)^{a}	0.70 (1.21)^{abc}
N.M.S - 2	12.09 (19.57)^{cd}	33.59 (5.71)^{c}	11.35 (3.38)^{ab}	0.89 (1.17)^{bc}
Mukkannu sanna	3.76 (10.92)^{e}	40.85 (6.36)^{b}	10.72 (3.29)^{b}	0.84 (1.15)^{c}
Navara	11.40 (19.63)^{cd}	3.22 (1.75)^{i}	10.52 (3.39)^{ab}	0.85 (1.28)^{ab}
HMT	3.08 (9.84)^{efg}	18.94 (4.21)^{e}	11.63 (3.43)^{ab}	0.71 (1.21)^{abc}
Bangaru sanna	2.38 (8.70)^{fgh}	35.01 (6.07)^{b}	11.16 (3.49)^{ab}	0.77 (1.24)^{abc}
JGL- 1798*	2.29 (8.47)^{gh}	29.41 (5.46)^{c}	10.73 (3.30)^{b}	0.98 (1.21)^{abc}
Jaya*	17.33 (24.33)^{b}	24.55 (4.97)^{d}	11.50 (3.43)^{ab}	0.96 (1.20)^{abc}
Jyothi*	21.70 (27.74)^{a}	4.13 (1.73)^{i}	12.25 (3.53)^{ab}	0.94 (1.20)^{abc}
MTU-1001*	3.04 (9.87)^{efg}	6.29 (2.21)^{h}	11.62 (3.45)^{ab}	0.98 (1.21)^{abc}
MTU-1010*	1.85 (7.71)^{h}	14.17 (3.76)^{f}	11.24 (3.40)^{ab}	0.93 (1.19)^{bc}
S.E.±	0.58	0.11	0.10	0.03
C.D. (P=0.05)	1.66	0.32	0.29	0.10

* Recommended varieties, ** Mean of 10 hills/ 3 replication
Figures in the parenthesis are square root transformed values
Figures in the same column with similar alphabets are on par

The mean maximum per cent damaged leaves recorded being 21.70 per cent in Jyothi and mean minimum incidence was 1.80 per cent in Kanadatumba showed damage rating of '1' (resistant) and had narrow leaves with less than 0.75cm leaf width. Whereas moderately susceptible cultivar Jyothi that showed damage rating of '5' and broad leaves with 0.75 to less that 1.08cm leaf width. Therefore, it clearly indicates that cultivars which were having least leaf folder damage, possessed narrow leaves with less than 0.85cm leaf width except Andhra basumathi (0.87cm), Jeerige sanna (0.90), JGL-1798 (0.98), MTU-1001 (0.98) and MTU-1010 (0.93) possessed more than 0.85cm leaf width with least leaf folder damage. This is probably due to the presence of toxic substances or absence or insufficient amount of essential nutrients and nutrient imbalances on these varieties that are imparting resistance to leaf folder.

The simple correlation observed between morphological characters of plant and leaf folder infestation, indicates that there was relationship with negative and significant (r = -0.40*) with trichome density and positive significant relationship (r = 0.53*) with leaf width at mid point. The present observation is in agreement with the findings of Nigam *et al.* (2008) who reported the data recorded on per cent leaf folder infestation and plant morphological characters (plant height, number of leaf, leaf width and texture of leaf) and showed that there was positive significant correlation between leaf width and per cent infested leaves (r = 0.70** and 0.917**). Khan and Saxena (1985) evidently proved that the density

Table 2 : Incidence of leaf folder on rice cultivars

Damage score	Damaged leaves (%)	No. of cultivars	Varietal reaction	Cultivars with damaged leaves (%)
0	No damage	0	HR	Nil
1	1-10%	15	R	Kanadatumba (1.80), MTU-1010* (1.85), JGL- 1798* (2.29), Bangaru sanna (2.38), Gandhasale (2.43), Gangadale (2.51), Selum sanna (2.65), Jeerige sanna (2.66), Pusa sugandhi (2.72), Mysore mallige (2.79), MTU-1001* (3.04), HMT (3.08), Gouri sanna (3.51), Mukkannu sanna (3.76) and Andhra basumati (3.97)
3	11-20%	7	MR	Ratnachudi (11.04), Dehali basumati (11.22), Chinniponni (11.33), Navara (11.40), N.M.S-2 (12.09), Anandi (12.88) and Jaya* (17.33)
5	21-35%	5	MS	Sugandhi (21.02), Malgudi sanna (21.10), Navalisale (21.17), Kari mundaga (21.52) and Jyothi* (21.70)
7	36-50%	0	S	Nil
9	51-100%	0	HS	Nil

*Recommended rice varieties

of trichomes on the abaxial surface of TKM 6 showed resistance to leaf folder. Dakshayani *et al.* (1993) reported that the larval preference was negatively correlated with trichome density. Palaniswamy and Ragini (1999) reported the lower larval survival and pupation on resistant cultivars, showing that antibiosis was also involved in rice resistance to leaf folder.

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