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Screening of rice landraces and their morpho-biochemical basis of resistance against *Cnaphalocrocis medinalis*

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ABSTRACT

Host plant resistance is very important in contrast of spraying insecticide to manage leaf folder, *Cnaphalocrocis medinalis*. From wide germplasm of rice, fifty rice landraces were screened and traits for resistance are characterized against leaf folder under natural climatic conditions. The occurrence % leaf damage showed significant variation and revealed the presence of resistance-susceptibility status among tested land races of rice. The infestation of leaf folder recorded significantly less in highly resistant landraces, viz. Rajboga, Kari kagga and Mapilai samba -1 (0.55–0.90%) in comparison to the highly susceptible genotypes, viz. GK -5, Krishna leela, Kaggalikearona, Bangaragandu, Kundipullan, Puttabatta-2 and Navara (66.03 to 74.77%). The correlation analysis revealed that plant height, length of flag leaf and panicle length had negative significant influence on the leaf folder % leaf damage infestation and offered resistance. The amount of total sugar and reducing sugars, free amino acids, nitrogen and phosphorus were recorded higher in the susceptible entries whereas, total phenols, potassium and tannins were found significantly higher in resistant genotypes.

Keywords: *Cnaphalocrocis medinalis*, Host plant resistance, Landraces, Rice

Rice (*Oryza sativa* L.) is one of the primary food crops of the world which belongs to the family Poaceae, more than half population of the globe depend on rice for nourishment (Lal *et al.* 2014). Rice is major cereal crop in eastern and southern regions of India and show advantage in relation to national food security. The biotic factors affect the rice in various stages of crop which include weeds, diseases and insect pests are the chief restriction in production. The leaf folder, *Cnaphalocrocis medinalis* Guenee is a major pest of rice and its incidence increases both in lowland and upland rice fields, especially in those areas where new and high yielding varieties are grown extensively. Many studies reported the high incidence of leaf folder cause significant leaf damage up to 60–70% (Kushwaha and Singh 1984). The infestation of leaf folder initiates from the transplanting to harvest stage. The larval stages roll the leaves longitudinally and bind the leaf edges. It feeds on chlorophyll staying within the folded leaves as a result plant loss its general vigour and photosynthetic activity with severally poor filling of grain leads to drastically reduced yield. Use of chemical for the management of leaf folder is most common tactic and therefore, insecticides increase the cost of production and further leads to development of resistance in the pest (Nadarajan and Skaria 1988). Plants undergo different changes when attacked by pests in response to injury to prevent the feeding by different strategies. These strategies become major part of insect-plant interaction and gained great importance. So, identification of these biochemical bases for resistance-susceptibility status will help in strengthening the host plant resistance projects against leaf folder pest in rice. Therefore, the present experiment was undertaken on morphological and biochemical traits of the plants in influencing the incidence and biological development of *C. medinalis*.

MATERIALS AND METHODS

Screening material: The study was carried out on a different array of 50 rice landraces. These landraces were collected from Zonal Agricultural Research Station, V.C. Farm Mandya (Table 1) (2017-18).

Evaluation of relative % leaf damage by leaf folder, C. medinalis: The test landraces were sown in treatment two weeks prior to anticipated peak population of leaf folder. 20-25 days old seedling of each entry was planted in the one row of 20 hills at 20 cm × 15 cm between rows and plants. For each 10 entries in each replication, two rows of highly

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Table 1 Reaction of landraces to resistance-susceptibility against leaf folder, *C. medinalis*

Genotype	% leaf damage			Status	Score
	30 DAT (Mean ± SD)	50 DAT (Mean ± SD)	Mean		
Kavekantak	18.76±1.11	32.87±2.73	25.81	MS	5
GK -5	64.89±4.37	75.30±4.06	70.10	HS	9
Gangadale	21.26±0.66	36.94±2.87	29.10	MS	5
Talasiya	23.35±1.61	30.93±1.83	27.14	MS	5
Neermulka	20.28±1.01	28.14±2.41	24.21	MS	5
Karimunduga	13.44±1.17	19.51±1.37	16.47	MR	3
Manjulasona	24.87±1.64	28.03±2.28	26.45	MS	5
Naweli	36.63±1.22	64.92±4.08	50.78	S	7
Jig Madike	22.64±2.74	25.29±1.30	23.96	MS	5
Game	23.08±1.95	33.53±2.69	28.31	MS	5
Khushiadikshan	24.26±2.29	29.44±0.97	26.85	MS	5
Kalajeera	12.41±0.92	16.95±2.20	14.68	MR	3
Rahodaya	11.17±1.44	22.87±1.67	17.02	MR	3
China Ponno-2	34.58±1.84	45.31±4.25	39.95	S	7
Neermullare	6.69±0.55	8.62±1.36	7.66	R	1
Aishwarya	22.90±2.08	27.45±1.00	25.17	MS	5
Mara Batta-2	14.63±1.01	17.51±2.19	16.07	MR	3
Krishna Leela	71.56±3.00	77.98±1.75	74.77	HS	9
Tagarhi	28.80±2.17	29.47±0.93	29.14	MS	5
Malgudisanna-2	5.84±0.28	12.38±2.22	9.11	R	1
Kaggalikearona	66.18±2.80	75.12±2.52	70.65	HS	9
Bangaragandu	61.59±2.56	70.47±2.08	66.03	HS	9
Kana kunja	33.08±1.35	66.95±3.23	50.01	S	7
Kundipullan	67.78±0.84	75.75±3.01	71.77	HS	9
PSB 87	13.95±1.73	17.87±1.77	15.91	MR	3
Nirga Samba	7.11±1.35	22.63±2.60	14.87	MR	3
Bangara Kale	37.46±2.64	61.96±2.62	49.71	S	7
Jenugudu	5.78±0.30	8.48±1.11	7.13	R	1
Kalakoli	25.34±2.67	55.59±8.70	40.46	S	7
Black Sticky	41.29±3.63	53.84±2.62	47.56	S	7
China Ponni	10.65±1.16	17.14±1.54	13.90	MR	3
Vol Bogsugandha	11.34±1.35	27.41±2.16	19.38	MR	3
Punkattkodi-1	46.76±1.01	56.21±3.29	51.49	S	7
Punkattkodi-2	21.77±1.66	32.87±2.26	27.32	MS	5
Murkanna Sanna	17.00±2.23	38.25±2.46	27.63	MS	5
Dunda	19.03±1.36	25.80±3.53	22.42	MS	5
Mapilai Samba-1	0.64±0.03	0.88±0.10	0.76	HR	0
GK-1	9.26±0.30	26.95±2.29	18.11	MR	3
Mapilai Samba-2	13.36±2.05	25.87±1.77	19.62	MR	3
Puttabatta-2	61.12±1.90	80.36±3.83	70.74	HS	9
Nagland Rice	35.78±1.17	53.40±4.76	44.59	S	7
Narali	5.78±1.01	19±1	19.85	MR	3
Rajboga	0.86±0.03	0.94±0.04	0.90	HR	0
Nalibatta	47.10±1.70	55.25±2.83	51.17	S	7
Sanbag	24.44±2.07	67.16±2.60	45.80	S	7
That Jasmine	18.72±1.93	36.98±2.48	27.85	MS	5
Navara	63.15±2.55	78.89±4.04	71.02	HS	9
Kyasare-1	19.96±1.34	37.14±2.52	28.55	MS	5
Adri Batta	2.78±1.00	4.50±0.90	3.64	R	1
Kari Kagga	0.39±0.03	0.71±0.15	0.55	HR	0
Mean	25.96	37.16	31.64		
SE m±	1.09	1.58			
CD@ P= 0.05	3.06	4.43			

Highly resistant-HR, Resistant-R, Moderately resistant-MR, Moderately susceptible-MS, Susceptible-S, Highly Susceptible-HS susceptible check Jaya planted. To enhance the infestation of defoliators, steady water level of 5 inches was maintained in the experimental field to increase the relative humidity and 25% excess urea was also applied to induce infestation (Rao *et al.* 1971). The relative reaction of test landraces to leaf folder incidence was evaluated by taking observation on % leaf damage per 10 hills in each entry was made on 30 and 50 days after transplanting following the method standard evaluation system (SES) developed by International Rice Research Institute, Los Banos, Philippines.

$$\text{Percent leaf damage (\%)} = \frac{\text{Number of infested leaves per hill}}{\text{Total number of leaves per hill}} \times 100$$

SES for leaf folder	
Score	Damage
0	No damage
1	1-10%
3	11-20%
5	21-30%
7	31-60%
9	61% and above

Contribution of plant characteristics in imparting resistance-susceptibility to leaf folder

Morphological characters: Data were recorded on 18 landraces based on resistance-susceptibility categories representing each 10 randomly selected hills was 60 days after transplanting on plant height, flag leaf length and width, number of tillers, length of peduncle and panicle length with standard scale.

Biochemical constituents: Leaf samples of healthy rice plants from the field were collected at 50 days after transplanting and were analyzed for the estimation of different biochemical parameters. The samples dried at 35**°C** in hot air oven for 24–48 h. The dried samples were grinded using mixer grinder. Ten gram of plant sample was taken in separate conical flask and 150 ml of 80% ethanol was added and refluxed for 30 minutes on hot water bath. The supernatant was transferred to another flask and use for the estimation of total sugars, reducing sugars, phenols, tannin, total free amino acid by using the methods of Bray and Thorpe (1954) and Moore and Stein (1948). The nitrogen and crude protein both were analyzed by Piper (1945) while the phosphorus and potassium are estimated by Jackson (1973).

Statistical analysis: The data of field experiment was subjected to ANOVA and Pearson's correlation, multiple regressions and Tukey's test at 5% to identify the key plant traits influencing the leaf folder damage and its development using IBM SPSS version 20.

RESULTS AND DISCUSSION

Relative resistance-susceptibility of test inbred to leaf folder, C. medinalis % leaf damage:. Among 50 landraces studied the % leaf damage of *C. medinalis* recorded at 30 DAT varied from 0.39±0.03 to 67.78±0.84 similarly at 50 DAT it varies from 0.71±0.15 to 78.89±4.04 from all the landraces (Table 1). Three landraces, viz. Rajboga, Kari Kagga and Mapilai Samba-1 were categorized highly resistant (HR) with score 0 (infestation ranges from 0.55 to 0.90), four genotypes were resistant with score of 1 (infestation ranges from 3.64 to 9.11), 11 rice landraces were moderately resistant (MR) with score 3 (Infestation ranges from 14.68 to 19.85), fifteen genotypes were moderately susceptible (MS) with score 5 (Infestation ranges from 22.42 to 29.14), ten landraces were susceptible (S) with score 7 (Infestation ranges from 39.95 to 51.17) and seven local landraces were highly susceptible (HS) with score 9 (% leaf damage varies from 66.03 to 74.77).

Morphological characters in relation to the resistance/susceptibility to leaf folder, C. medinalis: The tillers of the landraces Rajboga, Kari Kagga, Mapilai Samba-1 were highly vigorous and were on par with the leaf folder damage. The seedling vigors of Naweli, China Ponno-2, Kana Kunja, Bangara Kale, Kalakoli, Black Sticky, Punkattkodi-1, Nagland Rice, Nalibatta and Sanbag was significantly less and was at par with highly susceptible genotypes GK-5, Krishna Leela, Kaggalikearona, Bangaragandu, Kundipullan, Puttabatta-2, and Navara (Table 2). The plant height of the landraces Rajboga, Kari Kagga and Mapilai Samba-1 was significantly higher (149.67-156.67) whereas, the landraces Kundipullan, Krishna Leela and Puttabatta-2 (91.33-95.00) exhibited least plant height. Plant height showed negative association with susceptibility to leaf folder infestation in the test germplasm. The length of the flag in highly resistant and resistant landraces, viz. Mapilai Samba-1, Rajboga, Kari Kagga, Neermullare, Malgudisanna-2 and Jenugudu (43.00-57.00) were higher, whereas less length of flag leaf observed in Krishna Leela, Kundipullan, Puttabatta-2 (18.00-20.30). The width of flag leaf was observed less on Mapilai Samba-1, Rajboga and Kari Kagga (0.81-0.91) whereas, leaves of landraces, *viz.* Naweli, Kana Kunja, Punkattkodi-1, Kundipullan, Krishna Leela and Puttabatta-2 (1.69-2.10) were significantly longer. The highest number of tillers recorded in Puttabatta-2 (34.15) and least in Neermulka. This morphological parameter showed non-significant positive correlation against leaf folder infestation. The length of peduncle was significantly more in the highly susceptible landraces 1 (21.46-25.14) and less in highly resistant entries (12.22-13.64). The panicle length of the landraces Mapilai Samba-1, Rajboga, Kari Kagga, Neermullare, Malgudisanna-2 and Jenugudu (21.54-25.46) had more length however, the highly susceptible varieties Kundipullan, Puttabatta-2 and Krishna Leela (10.52-11.62) had short length.

Among the various morphological parameters, the landraces categorized based standard system of rice evolution, viz. Mapilai Samba-1, Rajboga, Kari Kagga, Neermullare, Adri Batta, Malgudisanna-2 and Jenugudu showed good mean performance in natural environment with least damage. The results of correlation analysis revealed that leaf width showed significant positive association between

Table 2 Variation in morphological character of test landraces during *kharif* season

Category	Landraces	Plant height (cm)	Length of flag leaf (cm)	Width of flag leaf (cm)	Number of tillers	Peduncle length (cm)	Panicle length (cm)
HR	Mapilai Samba-1	152.32^{ij}	57.00^{i}	0.85^{a}	29.37^{de}	12.22^{a}	25.33^{g}
	Rajboga	149.67^{hij}	54.61^{i}	0.81^{a}	25.33^{abd}	13.15^{a}	24.56^{fg}
	Kari Kagga	156.67^{j}	53.33^{i}	0.89^{a}	30.37^{de}	13.64^{ab}	25.46^{g}
R	Neermullare	143.33^{fghij}	45.31^{h}	1.05^{b}	29.33^{de}	15.34^{abc}	23.46^{fg}
	Malgudisanna-2	147.00^{ghij}	43.00^{h}	1.02^{b}	25.33^{abcd}	15.00^{ab}	21.65^{ef}
	Jenugudu	139.67^{efghi}	44.33^{h}	1.05^{b}	22.03^{abc}	16.00^{abcd}	21.54^{ef}
MR	Kalajeera	134.66^{defgh}	40.50^{gh}	1.26^{c}	27.03^{bcd}	17.23^{bcd}	19.67^{e}
	Mara Batta-2	129.00^{def}	38.33^{fgh}	1.23^{c}	29.33^{de}	17.27^{bcd}	18.66^{de}
	China Ponni	133.30^{defg}	35.31^{efg}	1.10^{b}	24.01^{abcd}	17.52^{bcde}	18.57^{de}
MS	Kavekantak	123.33^{d}	32.30^{def}	1.40^{d}	29.33^{de}	19.21^{cdef}	15.64^{cd}
	Gangadale	124.67^{de}	31.67^{def}	1.45^{de}	21.33^{ab}	19.64^{defg}	14.85^{bc}
	Neermulka	120.32^{bcd}	29.33^{cde}	1.50^{e}	20.03^{a}	19.52^{defg}	14.96^{bc}
S	Naweli	111.67^{cd}	25.33^{bcd}	1.78^{f}	27.08^{bcd}	21.52^{efgh}	12.51^{abc}
	Kana Kunja	105.00^{ab}	22.67^{abc}	1.69^{f}	29.33^{de}	21.46^{efgh}	13.65^{abc}
	Punkattkodi-1	106.64^{abc}	24.50^{abc}	1.80^{f}	26.04^{abcd}	22.42^{fgh}	12.80^{abc}
HS	Kundipullan	91.33^{a}	20.30^{ab}	2.10^{h}	27.05^{bcd}	23.51^{gh}	10.64^{a}
	Krishna Leela	95.00^{a}	18.00^{a}	2.00^{g}	28.08^{cde}	24.75^{h}	11.62^{ab}
	Puttabatta-2	92.66^{a}	18.00^{a}	2.03^{gh}	34.15^{e}	25.14^{h}	10.52^{a}
	SEm ±	1.4	1.38	0.01	1.28	0.74	0.67
	CD @ 5%	4.01	3.98	0.04	3.70	2.13	1.94

Highly resistant-HR, Resistant-R, Moderately resistant-MR, Moderately susceptible-MS, Susceptible-S, Highly Susceptible-HS

% leaf damage and leaf folder infestation and negative correlation leaf length. Similar results were observed by by Chalapathi Rao *et al.* (2002), Chintalapati *et al.* (2019) and Xu *et al.* (2010) who recorded that the leaf length had not significant effect on infestation of leaf folder but leaf width had significant positive associations existed with % damage. Likewise, Sarao *et al.* (2013) observed significant positive response between width of flag leaf and infestation of leaf folder. Punithavalli *et al.* (2011) also reported that height of the plant is negatively correlated with damage of leaf folder.

Changes in biochemical constituents of the test landraces after leaf folder infestation in relation to their resistance/ susceptibility: Many significant alterations in the content of different biochemical traits were observed after the leaf folder infestation (Table 3). Total phenol content, under field condition was significantly higher in the highly resistant landraces (0.54-0.68 mg/g) and lower in highly susceptible landraces (0.13-0.18 mg/g). The total sugar content, under infested conditions, was significantly less in the highly resistant landraces Mapilai Samba-1, Rajboga and Kari Kagga (3.72-3.81 mg/g) as compared to susceptible and highly susceptible genotypes (7.54-9.54 mg/g). Likewise, the reducing sugars observed lower in highly resistant and resistant landraces (5.98-8.93 mg/g) while notice higher in highly susceptible landraces (14.56-15.23 mg/g). The crude protein content, was significantly lower in the highly resistant landraces (2.45-3.12 mg/g) and higher in the susceptible and highly susceptible landraces, viz. (6.34-7.23 mg/g). Significantly total free amino acids low content was recorded in highly resistant landraces Mapilai Samba-1, Rajboga and Kari Kagga (14.89-15.19 mg/g), whereas, maximum amount of amino acids was exhibited by the susceptible and highly susceptible landraces (21.45-25.56 mg/g) likewise the tannin content was significantly higher in the highly resistant and resistant entries (4.62-5.82 mg/g). The nitrogen content was observed higher in the highly susceptible landraces (2.25-2.31 mg/g) while noticed lower in highly resistance and resistance entries (1.05-1.45 mg/g) Similarly, the amount of phosphorus recorded higher in (0.40-0.57 mg/g) while less recorded in (0.11-0.14 mg/g). The potassium content in leaves observed higher in the resistant entries (2.64-3.21 mg/g) while observed lower (1.12-1.17 mg/g).

The damage of pest often influences in the production of wide range of biochemical. Likewise, in the present study results, the correlation analysis of total phenol showed negative association with infestation have been recorded impart resistance against leaf folder in rice also (Mohan *et al.* 1988, Felton *et al.* 1992). The content of phenols in leaves inhibit growth and development of pest by binding with dietary proteins and also due to the antioxidative properties of phenols (Haukioja and Niemela 1977). The higher amount of total sugar and reducing sugars have been related with susceptibility to brown plant hopper in rice (Watanabe and Kitagawa 2000). Further, the difference in relative amount of sugars between different genotypes with difference in

Table 3 Influence of biochemical constituents on landraces against leaf folder

Category	Landraces	Phenols (mg g^{-1})	Total sugars (mg g^{-1})	Reducing sugars (mg g^{-1})	Crude proteins (mg g^{-1})	Total free amino acids (mg g^{-1})	Tannins (mg g^{-1})	N (mg g^{-1})	P (mg g^{-1})	K (mg g^{-1})
	Mapilai Samba-1	0.68^{m}	3.79^{a}	5.98^{a}	2.45^{a}	14.89^{a}	5.64^{n}	1.28^{c}	0.12^{a}	3.12^{j}
HR	Rajboga	0.58^{l}	3.72^{a}	5.90^{a}	3.12^{c}	15.13^{b}	5.82^{o}	1.15^{b}	0.11^{a}	3.17^{k}
	Kari Kagga	0.54^{kl}	3.81^{a}	6.78^{b}	2.87^{b}	15.19^{b}	5.79^{o}	1.05^{a}	0.14^{a}	3.21^{l}
	Neermullare	0.41^{hi}	4.98^{c}	8.43^{e}	4.12^{d}	16.23^{c}	4.67^{l}	1.41^{de}	0.25^{bc}	2.67^{hi}
R	Malgudisanna-2	0.44^{ij}	4.88^{c}	8.93^{f}	4.15^{d}	16.84^{d}	4.95^{m}	1.45^{ef}	0.28^{cd}	2.64^{h}
	Jenugudu	0.49^{jk}	4.61^{b}	8.12^{c}	4.71^{e}	16.16^{c}	4.62^{l}	1.38^{d}	0.23^{b}	2.69^{i}
	Kalajeera	0.39^{ghi}	5.11^{d}	9.67^{d}	5.32^{h}	18.11^{g}	3.23^{i}	1.50^{fg}	0.30^{de}	2.13^{g}
MR	Mara Batta-2	0.37^{fghi}	5.27^{e}	9.56^{g}	5.04^{f}	17.69^{e}	3.56^{k}	1.54^{g}	0.32^{e}	2.15^{g}
	China Ponni	0.35^{fgh}	5.56^{f}	9.97^{g}	5.15^{g}	17.91^{f}	3.32^{j}	1.62^{h}	0.33^{ef}	2.17^{g}
	Kavekantak	0.31^{efg}	6.34^{g}	10.67^{h}	5.94^{j}	19.13^{h}	2.56^{g}	1.83^{i}	0.39^{ghi}	1.89^{f}
MS	Gangadale	0.3^{def}	6.45^{g}	11.23^{i}	5.81^{i}	19.23^{h}	2.96^{h}	1.91^{j}	0.37^{gh}	1.86^{ef}
	Neermulka	0.32^{efg}	6.98^{h}	11.43^{i}	5.92^{j}	20.02^{i}	2.19^{f}	1.87^{ij}	0.36^{fg}	1.82^{e}
	Naweli	0.26^{cde}	7.84^{j}	13.45^{k}	6.34^{k}	22.98^{l}	1.70^{d}	1.98^{k}	0.42^{ij}	1.58^{d}
S	Kana Kunja	0.24^{cde}	7.54^{i}	12.98^{j}	6.56^{m}	21.45^{j}	1.67^{d}	2.08^{l}	0.40^{hij}	1.52^{c}
	Punkattkodi-1	0.22^{bcd}	7.93^{j}	13.91^{l}	6.47^{l}	22.39^{k}	1.83^{e}	1.98^{k}	0.44^{j}	1.55^{cd}
	Kundipullan	0.18^{abc}	9.45^{l}	14.56^{m}	6.93^{m}	25.14^{n}	0.89^{c}	2.25^{m}	0.56^{kl}	1.12^{a}
HS	Krishna Leela	0.14^{ab}	9.54^{l}	14.78^{m}	7.23^{o}	24.13^{m}	0.64^{a}	2.25^{m}	0.53^{k}	1.15^{ab}
	Puttabatta-2	0.13^{a}	8.90^{k}	15.23^{n}	7.11^{n}	25.56^{o}	0.76^{b}	2.31^{m}	0.57^{l}	1.17^{b}
	SEm ±	0.02	0.02	0.05	0.01	0.03	0.01	0.01	0.01	0.01
	CD @ 5%	0.04	0.07	0.14	0.03	0.07	0.04	0.03	0.01	0.02

Highly resistant-HR, Resistant-R, Moderately resistant-MR, Moderately susceptible-MS, Susceptible-S, Highly Susceptible-HS.

susceptibility indicated that these compounds might act as phagostimulant to gall midge and leaf folder (Vijaykumar *et al.* 2012). In addition, the biochemical analysis of the protein and infestation of the leaf folder showed the significant positive correlation. Similarly, Punithavalli *et al.* (2013) showed that the higher amount of soluble protein observed in TN1 (5.77 mg/g) was most susceptible variety and lower amount of soluble protein recorded in TKM6 (1.33 mg/g) was found resistant to leaf folder. The similar studies also carried out by Rath and Misra (1998) and Amsagowri *et al* (2016). Susceptibility to rice leaf folder has been recorded to be related to increase level of nitrogen in rice. Similarly, Das *et al.* (2001) reported positive relationship level of nitrogen with susceptibility of rice genotypes to caseworm, *Nymphuia depunctalis*. Application of K fertilizers imparts resistance against pest (Salim 2002, Scott and Gratton 2006, Amtmann *et al.* 2008).

Association of morphological and biochemical parameters with leaf folder incidence: Significant and positive correlation coefficient of width of flag leaf and peduncle length was observed with infestation (0.98 and 0.97, respectively) while non-significant positive correlation observed with number of tillers (0.25). The plant height, length of flag leaf and panicle length showed negative correlation (0.98, 0.93 and 0.93 respectively) were found associated with resistance to leaf folder in the test landraces. The infestation of leaf folder damage was significantly and positively correlated with total sugar, reducing sugar, crude protein, total free amino acid nitrogen and phosphorus (0.98, 0.96, 0.90, 0.98, 0.95 and 0.94 respectively) and significantly negatively correlated with total phenol (0.91), tannin (0.94) and potassium (0.94). So, the total soluble sugar, reducing sugar, crude protein, amino acids and nitrogen were found to be related with susceptibility to leaf folder as they favored the development and growth of leaf folder whereas, total phenols, tannins and potassium content in leaves lowered the leaf folder survival, were associated with resistance to leaf folder in the test landraces. The present study on host plant resistance recognized as the basic parameter of resistance against leaf folder in fifty different landraces of rice. The plant height, length of flag leaf, width of flag leaf, number of tillers, panicle length, total phenols, total sugars, reducing sugars, crude protein, tannins, amino acids, nitrogen, phosphorus and potassium serve as important basis of these mechanism. Physio-chemical characters can be utilized in rice screening programs to detect leaf folder novel resistant source from wide germplasm. Further, physio-chemical traits can act as marker and will aid the breeding for resistance programs to identify the new sources of resistance and long-lasting protection against leaf folder.

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