

**RESISTANCE OF RICE (*ORYZA SATIVA*) TO TWO SPECIES OF
RICE LEAFFOLDERS, *CNAPHALOCROCIS MEDINALIS*
GUENEE AND *MARASMIA PATNALIS* BRADLEY
(LEPIDOPTERA : PYRALIDAE)¹**

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ABSTRACT

Experiments were carried at the University of Wales, Cardiff, UK and the Agricultural Research Station, Girandurukotte, on the nature of resistance of rice varieties to two rice leaffolder species, *Cnaphalocrocis medinalis* and *Marasmia patnalis*. First instar larvae of the above two species were allowed to feed on pieces of leaves in petri dishes. Survival rates of both species and pupal weights of *M. Patnalis* were measured to determine the level of resistance of the varieties tested. Antixenosis for oviposition was studied allowing *M. Patnalis* moths to lay eggs on caged plants. Lower pupal weights were observed when *M. patnalis* larvae were fed on resistant varieties, Choorapundy, Ptb 33, Muthumanikam and local varieties Bg 400-1 and Bg 300. Both leaffolder species had lower survival rates when fed on the resistant varieties and Bg 400-1. In addition *C. medinalis* larvae fed on Bg 300, Bg 379-2 and Bg 450 also had lower percentage survival. Only Muthumanikam has antixenosis for oviposition. Further studies are needed to determine the nature of resistance to rice leaffolder species using other evaluation techniques. Resistant varieties (Muthumanikam, Choorapundy and Bg 400-1) and susceptible varieties (Bg 94-1 and Bg 380) could be used in these studies for comparison.

KEY WORDS: Leaffolder, Rice (*Oryza sativa*)

INTRODUCTION

Two rice leaffolder species have been recorded from Sri Lanka, namely, *Cnaphalocrocis medinalis* and *Marasmia patnalis* (Bradley, 1981; Wickremasinghe, 1980). Of the two species, *M. patnalis* was found to be dominant in many parts of the country (Dhanapala, 1989). Presently

¹Part of M. Phil thesis submitted by the senior author to the School of Pure and Applied Biology, University of Wales, Cardiff, UK.

insecticides are the only available method to control rice leaffolders. Over-reliance on synthetic chemical insecticides has focused the deleterious effects of pesticides and the need for alternative pest management systems. Plant resistance is one alternative which can be used in pest management.

Plant resistance to insects can be described in terms either of the effects on the survival of the insect or of the reactions of the plant. Painter (1951) proposed that plant resistance, could be explained by three fundamental mechanisms namely non-preference, antibiosis and tolerance. Kogan and Ortman (1978) suggested the term antixenosis to replace non-preference. Antixenosis means the group of plant characters and insect responses that lead to or away from the use of a plant or variety for oviposition, for food or for shelter or for combinations of the three.

Antibiosis means a toxic or other direct detrimental effect of one organism on another (Painter, 1951; Metcalf and Luckmann, 1975). Tolerance was defined as the basis of resistance on which the plants show an ability to grow and reproduce itself or to repair injury to a marked degree in spite of supporting a population approximately equal to that damaging a susceptible host (Painter, 1951). From the 16 criteria which can be used to determine plant resistance (Dahms, 1972), observation of the comparative effects of forced insect feeding on plants by measuring length of insect life cycle and mortality could be used to evaluate insect resistance in plants easily. The weight of insects after a standard feeding period on different cultivars, and determination of the number of eggs laid on different varieties, are also useful methods of evaluation (Ortman and Peters, 1979).

Visual evaluation of infested cultivars has been used most frequently by workers to determine leaffolder resistance in rice either in the field (Joshi *et al.*, 1986) or in the greenhouse (Heinrichs *et al.*, 1985). Heinrichs *et al.* (1985) gave a scale to classify the level of resistance in each variety, based on damage level. The effect of forced larval feeding on larval survival and pupal weight could be used to evaluate leaffolder resistance in rice varieties. A study was therefore undertaken to evaluate the resistance of some local rice varieties to two rice leaffolder species, *Cnaphalocrocis medinalis*, and *Marasmia patnalis* using the above methods. This paper discusses the results this study.

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MATERIALS AND METHODS

Experiments were conducted at the School of Pure and Applied Biology, University of Wales, Cardiff, UK, using *M. patnalis* that originated from Sri Lanka and at the Agricultural Research Station (ARS), Girandurukotte, Sri Lanka, using *C. medinalis*. Experiments in UK were conducted in a constant temperature cabinet ($28 \pm 2^\circ\text{C}$) with a relative humidity of 85—90%. In Sri Lanka, experiments were conducted under room temperature ($25\text{—}32^\circ\text{C}$) with a relative humidity of 85—90%. Plants for culture were grown in plastic pots (100 cm dia) at Cleppa Park Field Research Station, UK in a growth chamber using artificial light. Insect cultures were maintained in acrylic cages as described by Waldbauer and Marciano (1979).

Antixenosis for oviposition by *M. patnalis*

For the antixenosis experiments, 18 rice varieties (Table 1) were used. Twenty female and 25 male moths which had emerged during the previous night were released in a glass cage (80 cm $\times$ 50 cm $\times$ 60 cm), having 5-7 week-old plants of the test entries. In one hill there were 5 tillers of each variety. Since all varieties could not be tested at once, varieties were tested separately in two sets (11 varieties in the first set and 10 varieties in the second set), by placing them in a circular manner.

Bg 94-1 was used as susceptible control and Muthumanikam as the resistant control for each set. From the third day onwards each morning the number of eggs laid on each hill were counted and new plants introduced into the cages. This was repeated for five days. Every morning, before introducing new plants, the numbers of dead male and female moths were counted, and new moths of the same age were added to maintain 20 females and 25 males. Each rice variety was considered as a treatment and days of counting as replicates.

Antibiosis for larval survival by *M. patnalis*

First instar larvae hatched from eggs on potted plants which were kept in oviposition cages 4 days before, were released into petri dishes (5 larvae per dish) containing pieces of leaves, each from a particular rice variety. Each set was replicated 6 times. Leaves

were kept on moistened filter papers. Petri dishes were kept in large plastic boxes. Fresh leaf pieces and water were added daily and larvae transferred to new petri dishes as needed (usually within 2–3 days).

The number of larvae pupating and pupal weights were recorded. Mean number of larvae pupated on each variety was converted to log values for statistical analysis.

Artibiosis for larval survival by *C. medinalis*

This experiment was conducted at ARS, Girandurukotte. Every other week, starting from December 1987, 23 rice varieties (Table 2) were planted separately in 1 m×1 m plots in the field to obtain rice plants with same maturity. Fertilizer application and other practices were followed according to the recommendations of Sri Lanka Department of Agriculture.

Leaves taken from 45 day-old plants from each variety were placed between moistened filter papers in petri dishes. Newly emerged larvae were introduced into petri dishes at the rate of 5 larvae per dish, each of which contained a leaf from a particular rice variety. There were four sets of dishes (20 larvae) for each rice variety. Water and leaves were added daily and larvae transferred into new petri dishes whenever necessary (within 2–3 days for 1–3rd instar, and every day for 4th and 5th instars). Ten days after introduction, the number of petri dishes used were increased so that only 2 larvae were in each, because of increased food consumption rates of later instar larvae.

Petri dishes containing larvae were kept on trays which were placed on a stand the bases of which were immersed in a salt solution to deter ants. Numbers of larvae pupating were recorded. Numbers of larvae pupating were converted into log values for statistical analysis.

RESULTS AND DISCUSSION

The number of eggs laid on each plant varied between varieties. Muthumanikam which was reported to be resistant to *C. medinalis* by Heinrichs *et al.* (1985) and two other Sri Lankan varieties, Bg 34-8 and Bg 400-1, had lower number of eggs per plant during the study period than the other varieties (Table 1).

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There were significant weight differences among the pupae (*M. patnalis*) reared on the different varieties (Table 1). Lower pupal weights were observed for pupae whose larval stages were reared on resistant varieties (Table 1). From the 15 local varieties evaluated, Bg 400-1 and Bg 300 also had similar effects on pupal weight of *M. patnalis*.

Numbers of larvae pupated varied among rice varieties (Tables 1 and 2). Highest larval mortality was observed when larvae were grown on the resistant variety, Choorapundy. Of the local varieties tested, Bg 400-1 gave the highest mortality. When larvae were fed on leaves of some resistant varieties adults could not emerge from the pupal exuvia properly and consequently died. This situation was not observed on larvae fed on susceptible varieties.

Varieties Choorapundy, Muthumanikam, Yakadayan and Ptb 33, which were reported to be resistant to *C. medinalis* in the Philippines (Heinrichs *et al.*, 1985) were found to be moderately resistant to populations of *C. medinalis* in Sri Lanka (Table 2).

A similar type of antibiosis was observed in *M. patnalis* (originated from Sri Lanka) larvae when reared on resistant varieties. Resistant varieties showed antixenosis for oviposition by adult moths and poor development and survival of larvae. Similar results were reported by Pathak and Saxena (1979) in the Philippines. Of the 15 Sri Lankan rice varieties evaluated, Bg 400-1 had a similar level of resistance (for both species) as the resistant varieties reported by Heinrichs *et al.* (1985).

Since the experimental methods used here do not fully reproduce field conditions, further studies are needed using other resistance evaluation methods and should be continued for more seasons. The number of entries can be restricted by neglecting highly susceptible varieties based on these results as suggested by Pathak and Saxena (1979). However, improved varieties such as Bg 400-1 and Bg 300 should be evaluated in different situations to determine the possibility of using them for rice leaffolder management, until new varieties are developed.

ACKNOWLEDGEMENTS

The authors express their sincere appreciation to Agricultural Research Project (ARP), Ministry of Agricultural Development and Research, Sri Lanka for financial assistance. The senior author thanks the Department of Agriculture, Sri Lanka, for granting study leave to undertake this Project. He also wishes to express his gratitude to Mr. Bandula Bandara for his technical assistance.

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Table 1. Number of eggs laid, pupal weight and percentage larval survival for different rice varieties (*M. patnalis* at Cardiff, UK)

Variety	*No. of eggs laid per plant		**Weight of pupae (mg)	Larval survival (%)
	1st set	2nd set		
Muthumanikam	3.83 a	11.83 a	11.06 abc	48 bc
Ptb 33	21.33 bc		11.13 abc	42 ab
Choorapurdy	21.17 abc		10.09 a	32 a
Bg 750	20.50 bc		14.43 bcde	66 cd
62-355	9.50 ab		14.25 e	68 cd
Bg 34-8	5.00 a	15.67 b	13.13 bcde	62 cd
Bg 276-5	30.33 bc		14.10 de	68 cd
Bg 34-6	37.83 c		14.11 de	64 cd
Bg 94-1	18.33 bc	23.83 c	14.06 de	68 cd
Bg 350	11.50 ab		14.09 de	68 cd
H4	72.33 c		12.75 abcde	64 cd
Bg 11-11		15.00 b	13.09 bcde	62 cd
Bg 379-2		14.00 b	11.64 abcde	68 cd
Bg 400-1		11.5 a	11.35 abcd	48 bc
Bg 3-5		20.33 c	13.83 cde	74 cd
Bg 407-2		37.67 e	13.97 de	74 d
Bg 300		31.00 d	10.92 ab	58 bcd
Bg 301		36.17 e	13.75 cde	72 d

* Mean of 6 days; ** Mean of 30 larvae (4 replicates)

In a column, treatment means having a common letter are not significantly different by Duncan's Multiple Range Test (DMRT) at the 5% level

Table 2. Survival of *C. medinalis* larvae on different rice varieties, (ARS, Girandurukotte)

<i>Variety</i>	<i>Larval survival (%)</i> *
Choorapundy	26 a
Muthumanikam	46 b
Bg 400-1	46 b
Yakadayan	46 b
Ptb 33	48 bc
Bg 300	51 bcd
Balan	55 bcd
Bg 379-2	55 bcd
Bg 450	59 cd
Darukasail	60 d
62-355	75 e
H 4	76 e
Bg 11-11	80 e
Bg 750	80 e
Bg 276-5	80 e
Bg 3-5	80 e
Bg 301	81 e
Bg 34-8	83 e
Bg 34-6	83 e
Bg 407-2	83 e
Bg 350	84 e
Bg 94-1	85 e
Bg 380	91 e

* Mean of 80 larvae

In a column treatment means having a common letter are not significantly different by DMRT at the 5% level