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POTENTIAL FOR UTILISING WILD RICE SPECIES AS SOURCES OF RESISTANCE TO THE WHITEBACKED PLANTHOPPER, *SOGATELLA FURCIFERA* (HORVATH) (HOMOPTERA : DELPHACIDE)

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ABSTRACT

Three species of wild rice and eight genetically diverse rice varieties were evaluated for resistance to *Sogetella furcifera* (Horvath) using seedbox screening test. The wild rice species, *Oryza officinalis*, *O. latifolia* and *O.punctata* and eight genetically diverse rice varieties viz., N 22 (Wbph1), ARC 10239 (Wbph2), Ptb 33 (Wbph3), Podwi A8 (wbph4), N'diang Marie (Wbph5) IR 2035-117-3 (Wbph1 + Wbph2), Chaia Anaser (Wbph1 + Wbph 3) and TN 1 (no resistance gene) were included in the study. In the free choice screening test, wild rices maintained their extremely high level of resistance even after prolonged exposure to *S. furcifera* nymphs while plant damage ratings of cultivated rices increased progressively. The quantity of food ingested and assimilated by *S. furcifera* was significantly less on wild rices than on cultivated varieties. Compared to resistant varieties with diverse genes, *S. furcifera* caged on wild rices had slow nymphal development, reduced longevity and low fecundity. Egg hatchability was adversely affected on wild rices particularly on *O. officinalis*. Population growth was also less on wild rices. Steam distillate extracts of wild rices were more toxic to the first instar nymphs of *S. furcifera* than the extracts of resistant varieties with diverse genes.

KEY WODS: Wild rice species, Resistance, Whitebacked planthopper

The whitebacked planthopper, *Sogatella furcifera* (Horvath) has increased in importance in the last decade both in upland and lowland crops particularly in areas where rice varieties resistant to the brown planthopper, *Nilaparvata lugens* Stal. have been grown successfully (Heinrichs and Rapusas, 1983 ; Khan and Saxena, 1984). Continuous cropping, reduced genetic variability of short-statured high yielding varieties and application of high levels of nitrogenous fertilisers have further compounded the *S. furcifera*, problem (Sairi, 1981; Suiri etal, 1982) Serious out cereaks of the pest have been reported in Bangladesh, China, Pakistan, Taiwan and Vietnam (Alam and Alam, 1977 ; Mochida *et al.*, 1982 ; Gyawali, 1983). In India, severe outbreaks of *S. furcifera* and subsequent yield reductions have been reported from states of Madhya Prade ' Andhra Pradesh and Tamil Nadu (Kushwaha *et al.*, 1986).

Breeding for resistance to *S. furcifera* has been recognised as a major tactic in the management of the insect and more than 400 potential sources of resistance have been identified at the International Rice Research Institute, Philippines, by evaluating more than 40,000 rice varieties from all over the world (Romena *et al.*, 1986).

The genetics of inheritance for *S. furcifera* resistance has been studied at IRRI and four dominant genes Wbph1 in N22 (Sindhu *et al.* 1979)., Wbph2 in ARC 10239 (Angeles *et al.*, 1981), Wbph3 in Ptb 33 (Angeles *et al.*, 1985), Wbph5 in N'diang Marie (Wu and Khush, 1985) and a recessive gene Wbph4 in Podwi A 8 (Hermandez and Khush, 1981) have been identified. In addition, digenes, Wbph1 + 1 recessive gene in WC 1240 (Angeles *et al.*, 1981). Wbph1 + Wbph2 in IR 2035-117-3 (Angeles *et al.*, 1981), Wbph2 + 1 recessive gene in Colombo (Angeles *et al.* 1981), Wbph1 + Wbph3 in Chaia Anaser and Katuyhar Dhan (Wu and Khush, 1985) have been identified. Breeding for insect resistance is complicated by the development of biotypes. *S. furcifera* is able to overcome the resistance in rice varieties with different genes for resistance (Heinrichs and Rapusas, 1983). To determine the potential value of wild rice species, the present study evaluated the resistance of three species of wild rices to *S. furcifera* in comparison with eight genetically diverse rice varieties and also to provide new sources of resistance to breeders for incorporating into improved breeding lines.

MATERIALS AND METHODS

Three wild rice species and eight genetically diverse rice varieties obtained from the International Rice Germplasm Centre, IRRI, Phillippines were used in the study. Wild rice species, *Oryza officinalis, O. latifolia* and *O. punctata* and eight genetically diverse rice varieties *viz.*, N 22 (Wbph 1), ARC 10239 (wbph2), Ptb 33 (Wbph3), (Wbph3), Podwi A8 (wbph4), N'diang Marie (Wbph5) IR 2035-117-3 (wbph1 + Wbph2), Chaia Anaser (Wbph1 + Wbph3) and TN 1 (no resistance gene) were evaluated for resistance to *S. furcifera* using the seedbox screening test and mechanisms of resistance were studied under greenhouse conditions at the Tamil Nadu Agricultural University, Coimbatore during 1994-1995 at temperatures ranging from 20-30°C. *S. furcifera* reared on TN1 plants for several generations in the greenhouse was used as the test insect.

Seedbox screening test and settling responses

In the seedbox screening test, all the 11 accessions were sown in 40 cm rows in wooden trays (60 x 45 x 10 cm). Seven days after sowing, the seedlings in each tray were thinned to 15 per row, infested with second instar nymphs at the rate of eight nymphs per seedling and covered by a fibreglass screen cage Treatments (accessories) were arranged in a randomised complete block design replicated five times. Nymphs that settled on the seedlings were counted 1, 8, 24 and 48 h after being infested. Plant damage rating was done using a 0-9 scale 7, 11 and 15 days after infestation.

Ingestion and Assimilation of Food

To determine the quality of food ingested and assimilated, newly emerged, water-satiated brachypterous females that had been starved fro 2 h were weighed individually on a microbalance (mg sensitivity). Each test insect was placed within an airtight parafilm sachet on the stem of 30 day old test plants. After 24 h, the weight of each female and its excreta were recorded. Similarly, control insects were weighed individually and were given access to a moist cotton swab inside a parafilm sachet to prevent disiccation. The amount of food ingested and assimilated by the insect was calculated as follows (Saxena and Pathak, 1977):

$$\text{Food assimilated} = W1 \times \frac{C1 - C2}{C1} + W2 - W1$$

where, W1 = initial weight of insect
W2 = final weight of insect
C1 = initial weight of control insect
C2 = final weight of control insect

Food ingested = Food assimilated + Weight of excreta

There were five replications for each accession including control, each replicate comprised of five females caged individually in parafilum sachets on five different plants.

Growth and Development

To determine the growth and development, first instar nymphs in batches of 10 each were caged on 30 day old potted plants of each test accession. Each accession had five replications arranged in a randomised complete block design. Growth was measured by the number of nymphs that became adults and the time taken to reach the adult stage. The insects' growth index was calculated as the ratio of percentage of nymphs developing into adults to the mean developmental period in days.

Adult Longevity

The longevity of newly emerged males and females on resistant and susceptible rice accessions was determined by infesting 10 pairs of males and females per pot. There were five replications for each accession, each per pot. There were five replications for each accession, each pot represented a replication. Survival of males and females was recorded daily up to 30 days after infestation.

Fecundity and Hatchability

To determine fecundity and harchability, three pairs of newly emerged males and females were caged on 30 day old potted plants of test accessions, replicated five times and arranged in a randomised complete design in a water filled iron tray. The total number of nymphs emerged on plants represented the viable eggs produced by the females. At the end of nymphal emergence, unhatched eggs were counted by dissecting leaf sheaths under a 20 x binocular microscope.

Population Growth

To determine population increase, 30-day-old potted plants of each were infested with four pairs of newly emerged males and females per pot. Each treatment (accession) was replicated five times in a randomised complete block design. Nymphs and adults were counted 30 days after infestation.

Toxicity of Steam Distillate Extracts to First Instars

Extracts were obtained by stem distillation of leaves and leaf sheaths of 50-day-old plants of resistant and susceptible rice accessions following the method of Saxena and Okech (1985). A 200 g ground sample was steam distilled for 3 h during which about 900 ml of distillate was collected. The distillate was extracted with diethyl ether (300 ml distillate : 100 ml diethyl ether) by thoroughly shaking a mixture of the two together in a separating funnel for five minutes. Diethyl ether absorbed the essential oils and other volatiles and the mixture settled above the water layer in the funnel. The water layer was discarded. The ether extract was pooled in a 500 ml beaker, to which 100 g of anhydrous sodium sulfate was added. The resultant mixture was kept inside a fume hood to evaporate excess ether until the remaining volume was about 25 ml. The beaker was then covered with aluminium foil and held overnight to allow the sodium sulfate to absorb traces of water from the extract. The extract was evaporated further to 10 ml and decanted into a weighed glass vial which was then covered with perforted aluminium foil and placed inside a desiccator. Ether was evaporated under a vacuum leaving behind an yellow oily residue. The vial was reweighed, sealed with nitrogen and kept at - 10°C. Toxicity of steam distillate to first instar nymphs was studied as described by Saxena and Khan (1986). Ten-day-old TN1 seedlings were dipped separately in 2000 ppm equivalent of the extract of resistant and susceptible rice accessions and placed individually in test-tubes (15 x 1.5 cm). Control seedlings were untreated or treated or with acetone. The test-tubes were capped and arranged in a randomised complete block design in an incubator. Each treatment including the control was replicated five times.

Data for all tests were subjected to analysis of variance and the means were compared using Duncan's (1951) multiple range test at $P > 0.05$ level.

RESULTS AND DISCUSSION

Because of increasing cost of insecticides, insecticide induced pest resurgence and the danger of insecticides to poorly protected applicators in the tropics, the use of *S. furcifera* resistant cultivars is the most economical and practical means of controlling *S. furcifera* (Romena *et al.*, 1986). Although five genes for resistance to *S. furcifera* have been identified, their resistance is not stable as colonies reared on resistant varieties for two generations increased in virulence compared with those reared on TN 1 only (IRRI, 1980).

The wild relatives of the cultivated cereals form an important reservoir of genetic variability for insect and disease resistance (Brar and Khush, 1986). Wild rices (*Oryza* spp.) represent a valuable source of germplasm to cope with biotype selection (Velusamy, 1989). The potential for utilisation of

Table 1. Damage ratings of selected wild and cultivated rices to infestation by whitebacked planthopper nymphs in free choice test

Species	IRRI Accession Number	Damage Rating* Days after infestation 7	11	15
O. officinalis	110114	1.0c	1.0e	1.0d
O. punctata	101439	1.0c	1.0e	1.4d
O. latifolia	100963	1.0c	1.0e	1.0d
O. sativa				
N22	4819	1.0c	5.4b	9.0a
ARC 10239	20803	1.0c	3.4c	9.0a
Ptb 33	19325	1.0c	2.2d	7.0c
Podwi A8	15201	2.6b	6.2b	9.0a
N'diang Marie	15859	1.0b	3.4c	8.2b
IR 2035-117-3	-	1.0c	2.6cd	7.4bc
Chaia Anaser	16197	1.0c	3.0cd	7.8bc
TN 1	-	8.6a	9.0a	9.0a

In a column, means followed by the same letter are not significantly different P=0.05 : Duncan's (1951) multiple range test).

* Mean of five replications.

wild rices as *S. furcifera* resistant donors is great as *O. officinalis*, *O. latifolia* and *O. punctata* sustained significantly low plant damage compared to varieties with diverse genes inspite of prolonged exposure to *S. furcifera* nymphs in the seedbox screening test. Extremely high levels of resistance to *S. furcifera* in *O. officinalis* and *O. latifolia* and *O.punctata* have been reported earlier (Velusamy, 1989).

Plant Damage Ratings and Settling Responses

In the seedbox screening test, all the 10 accessions exhibited resistant reactions seven days after infestation with mean damage ratings ranging from 1.0 to 2.6 while the susceptible check, TN 1 had a rating of 8.6 (Table 1). At 11 days after infestation, wild rices *O. officinalis*, *O. punctata* and *O. latifolia* had a significantly low damage rating of 1.0 while damage ratings for rice varieties with diverse genes for *S. furcifera* resistance ranged from 2.2 to 5.4 and the susceptible check had a rating of 9.0. Wild rices maintained their extremely high level of resistance by recording a significantly low damge rating of 1 even 15 days after infestation while damage by *S. furcifera* feeding on rice varieties with diverse genes increased progressively exhibiting moderately susceptible to susceptible reactions.

Table 2. Settling response of *S. furcifera* nymphs on seedlings of selected wild and cultivated rices in a free choice seedbox screening test.

Species	Nymphs settled on seedlings (%) at h after release			
	1	8	24	48
O. officinalis	4.2a	5.0c	2.4e	1.6e
O. punctata	4.0a	5.6c	4.0d	4.0d
O. latifolia	4.4a	5.4c	4.6d	4.4d
O. sativa				
N22	4.0a	8.8b	7.6bc	8.0c
ARC 10239	4.6a	9.0b	7.8bc	8.2c
Ptb 33	4.0a	8.2b	8.8b	9.2bc
Podwi A8	4.0a	8.8b	9.2b	10.8b
N'diang Marie	4.4a	8.6b	8.8b	9.0c
IR 2035-117-3	4.2a	9.2b	8.4b	8.4c
Chaia Anaser	4.6a	8.4b	6.6c	8.0c
TN 1	4.2a	14.2a	23.2a	23.4a

In a column, means followed by the same letter are not significantly different P=0.05 ; Duncan's (1951) multiple range test).

* Mean of five replications.

In the free choice seedbox test, the settling response of *S. furcifera* nymphs was uniform on wild and cultivated rice (Table 2). However, 8h after release, significantly higher percentage of nymphs settled on the susceptible TN 1 plants. Significantly low percentage of nymphs settled on wild rice species at 8, 24 and 48 h after infestation as compared to cultivated rices with different genes.

Compared with cultivated rices, wild rices *O. officinalis*, *O. latifolia* and *O. punctata* were less preferred for settling by *S. furcifera* which reflected the non-preference mechanism of resistance (Velusamy, 1989).

Ingestion and Assimilation of Food

The quantity of food ingested and assimilated by *S. furcifera* was significantly highest on susceptible TN 1 plants (Table 3). Among the resistant accessions, the quantity of food ingested and assimilated was significantly lowest on *O. officinalis* (Table 4). On *O. punctata* and *O. latifolia*, the quantity of food ingested and assimilated by *S. furcifera* was significantly higher but lower than that on rice varieties with diverse genes. Reduced *S. furcifera* feeding on resistant wild rices has been repored by Velusamy (1989).

Adult Longevity

Longevity of males and females was significantly higher on suscetible TN 1 plants (Table 3). Both males and females were restless on wild rice species and survived for significantly shorter periods on *O. officinalis* as compared to other resistant rice accessions. Among the resistant accessions, longevity of males and females was significantly higher on rice varieties with diverse genes for resistance than on wild rices *O. punctata* and *O. latifolia* but significantly lower than on susceptible TN 1 plants.

Growth and Development

Growth and development of *S. furcifera* nymphs were adversely affected on all resistant accessions. No nymphs survived on *O. officinalis*

Table 3. Quantity of food ingested and assimilated and longevity of adults of *S. furcifera* on selected wild and cultivated rices

Species	Food ingested per female / 24 h (mg)*	Food assimilated per female / 24 h (mg)*	Longevity (days)** Male	Female
O. officinalis	0.68i	0.04g	2.2g	2.2g
O. punctata	1.19h	0.17e	4.6f	3.6f
O. latifolia	1.11h	0.12e	4.4f	2.6fg
O. sativa				
N22	4.90c	0.35c	8.0c	8.0c
ARC 10239	1.64ef	0.23d	7.0cde	7.4cd
Ptb 33	1.52fg	0.24d	6.6de	6.4de
Podwi A8	5.70b	0.40b	10.4b	10.0b
N'diang Marie	1.99d	0.32c	7.2cde	7.8c
IR 2035-117-3	1.40g	0.22d	6.2e	5.6e
Chaia Anaser	1.74e	0.25d	7.8cd	6.4de
TN 1	8.97a	0.56a	17.0a	25.6a

In a column, means followed by the same letter are not significantly different P=0.05 : Duncan's (1951) multiple range test).

* Mean of five replications ; each replication had five individual insects caged singly in a parafilm sachet on each plant.

** Mean of five replications : each replication had ten newly emerged males and females caged on 30-day-old-plants.

Table 4. Growth and development of *S. furcifera* nymphs on plants of selected wild and cultivated rices

Species	Nymphs becoming adults	Developmental period*	Growth index**
O. officinalis	0.0e	0.0h	0.0f
O. punctata	20.0d	17.0a	1.17d
O. latifolia	14.0d	17.1a	0.81e
O. sativa			
N22	44.0c	14.3de	3.06c
ARC 10239	42.0c	14.4d	2.90c
Ptb 33	36.0c	14.8c	2.43c
Podwi A8	60.0b	13.3f	4.50b
N'diang Marie	42.0c	14.1e	2.96c
IR 2035-117-3	38.0c	15.6b	2.42c
Chaia Anaser	37.0c	14.4de	2.64c
TN 1	96.0a	12.6g	7.58c

In a column, means followed by the same letter are not significantly different P=0.05 : Duncan's (1951) multiple range test).

* Mean of five replications : each replication had ten newly emerged nymphs caged on 30-day-old plants.

** Growth index, per cent nymphs becoming adults divided by mean developmental period.

(Table 4). Among other resistant accessions, the percentage of nymphs becoming adults was significantly lower on wild rices *O. punctata* and *O. latifolia*. The developmental period of survivors also differed significantly among test accessions ; it was longest on *O. latifolia* (17.1 days) and shortest on susceptible TN 1 (12.6 days). Because of low adult emergence and prolonged developmental period of survivors, the growth index of *S. furcifera* was sign itly lowest on *O. latifolia* (Table 4). The growth index on susceptible TN 1 was significantly highest followed by rice varieties with known genes for resistance to *S.furcifera*.

Even on *O. latifolia* and *O. punctata* significantly low percentage of nymphs became adults as compared to rice varieties with diverse genes. The retarded nymphal development on wild rices could be attributed to reduced feeding rate and assimilation of ingested food as reported by Khan and Saxena (1985). reduced longevity of males and females on wild rices reflected their antibiotic effect on adult survival. Other workers have also made similar observations on the longevity of *S.furcifera* adults on resistant varieties (Khan and Saxena, 1985 ; Velusamy, 1989).

Fecundity and Egg Hatchability

Fecundity and egg hatchability were higher on susceptible TN 1 plants (Table 5). Fecundity was lowest on resistant *O. officinalis* followed by *O. punctata* and *O. latifolia*. Compared to wild rices, the fecundity and egg hatchability were significantly higher on resistant varieties N 22, ARC 10239, Ptb 33, Podwi A 8, N'diang Marie, IR2635-117-3 and Chaia Anaser but lower than on susceptible TN 1 plants. Among the cultivated rice varieties with diverse genetic make up, fecundity was significantly higher on Podwi A 8 followed by N 22, ARC 10239 and N'diang Marie. Egg hatchability was also significantly higher on Podwi

Table 5. Fecundity, egg hatchability and population growth of *S. furcifera* on selected wild and cultivated rices and toxicity of steam distillate extracts to first instar nymphs.

Species	Eggs laid by 3 females in 24 h (no.)*	Hatchability (%)*	Population growth (no.)**	Treatment (extract sprayed on TN 1)***	Nymphal mortality (%)
O. officinalis	18.8h	20.2g	0.0h	*O. officinalis*	96.0a
O. punctata	29.6g	36.2e	18.4g	*O. punctata*	92.0a
O. latifolia	27.6gh	30.4f	11.2g	*O. latifolia*	94.0a
O. sativa				*O. sativa*	
N22	89.8c	52.4c	77.4c	N22	13.0d
ARC 10239	77.4d	42.0d	65.4d	ARC 10239	14.0d
Ptb33	49.6ef	40.4d	49.2e	Ptb33	38.0b
Podwi A8	142.4b	63.0b	153.4b	Podwi A8	12.0d
N'diang Marie	58.4e	43.0d	53.4e	N'diang Marie	32.0e
IR 2035-117-3	46.4f	41.0d	38.2f	IR 2035-117-3	40.0b
Chaia Anaser	52.6ef	42.4d	50.6e	Chaia Anaser	34.0e
TN 1	308.4a	93.6a	288.0a	TN 1 extract	12.0d
				Acetone	0.0e
				None	0.0e

In a column, means followed by the same letter are not significantly different P=0.05 ; Duncan's (1951) multiple range test).

* Mean of five replications ; in each replication three newly emerged males and females were caged on 30-day old plants.

** Mean of five replicants ; in each replication four pairs of males and females were caged on 30-day-old plants.

*** Mean of five replications ; 10-day-old TN1 seedlings were treated with 2000 ppm of steam distillate.

A8 and ARC 10239 compared to other resistant varieties.

The most pronounced and dramatic effect of resistant rice accessions is exerted on fecundity and egg hatchability of *S. furcifera*. Not only fecundity was significantly low on *O. officinalis*, *O. latifolia* and *O. punctata* but also the egg hatchability was adversely affected. Wu *et al.*, (1986) demonstracted the detrimental effects of wild rice *O. punctata* on the ovariole development and egg hatchability of *N. lugens*. According to Khan and Saxena (1985), the chemical environment of resistant hosts affects the permeability of chorion and viterlline membrane or renders these membranes permeable to some substances harmful to developing *S. furcifera* embryos, thereby affecting their ability to survive. Because of retarded developmental period; reduced feeding, low fecundity and egg hatchability, population increase on all resistant accessions was low particularly on wild rices.

Population Growth

On resistant wild rice species, the increase in population 30 dyas after infestation was significantly lower than on resistant cultivated rices (Table 5). Insects failed to survive and reproduce on highly resistant *O. officinalis*. Population increase on wild rices, *O. punctata* and *O. latifolia* was also significantly low as compared to resistant cultivated rice varieties. Compared with wild rices, population increase on digenic and monogenic varieties was two to eight folds higher but significantly lower than that on susceptible TN 1 plants. Low population growth on resistant varieties has also been reported earlier (Khan and Saxena, 1985 ; Velusamy, 1989).

Toxicity of Steam Distillate Extracts

The extracts of *O. officinalis*, *O. latifolia* and *O. punctata* plants were significantly more toxic

to first instars than extracts of other accessions (Table 5). Among the extracts of cultivated rices, Ptb 33 and IR2035-117-3 were significantly toxic to first instars.

Unlike the cultivated rices, wild rices conferred extremely high levels of resistance to *S. furcifera* and among the three species of wild rices, *O. officialis* had extremely high level of resistance as insect responses were adversely affected on this species. Wild rice species have non-preference and antibiosis as major components of resistance and there is great scope for utilising them as donors since biotypes develop on cultivars with non-preference and antibiosis components of resistance. Steam distillate extracts of *O. officinalis, O. latifolia* and *O. punctata* were extremely toxic to first instar nymphs which suggest that wild rices may regulate the synthesis of allelochemicals, the concentration of which may be lower in resistant cultivated rices.

Wild rice species such as *O. officinalis, O. latifolia* and *O. punctata* reported to be resistant to *N. lugens, S. furcifera* and green leafhopper, *Nephotettix virescens* (Heinrichs *et al.*, 1985 ; Velusamy, 1989) are of interest in the development of high yielding rice varieties with stable resistance to *furcifera*. With the developmental of genetic engineering techniques, rice breeders at IRRI have recently succeeded in transferring genes for resistance to *N. lugens* and *S. furcifera* from *O. officinalis* and *O. sativa* across crossability and recombination barriers (Khush and Jena, 1987) and these breeding lines conferred highest level of resistance to *N. lugens, S. furcifera* and *N. virescens* than those derived from cultivated rices (Velusamy and Saxena, unpublished data).

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WEED MANAGEMENT IN DRY SEEDED LOWLAND RICE

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ABSTRACT

Pre-emergence application of pretilachlor plus 0.3 kg a.i./ha at 3 days after seeding (DAS) with one hand weeding (HW) effectively reduced the density of dominant *Trianthema portulacastrum* (2.9 No.m^{-2}) which recorded the minimum total weed dry weight (39.5 g m^{-2}) and maximum weed control efficiency (WCE) of 85.0 per cent. Pretilachlor plus did not exhibit any crop injury and recorded the maximum seedling growth characters and stand establishment leading to increased number of panicles (319 m^{-2}). This treatment gave the best per hectare yield of 5.5 t and benefit cost ratio (B:C) of 3.12.

KEY WORDS: Weed Management, Dry seeded rice, Herbicides

Rice contributes about 40 per cent of total food grain production in India and is grown under diversified situations. The traditional transplanted rice growers in Cauvery new delta zone of Tamil Nadu often switch over to direct sown semi-dry rice wherein premonsoon dry seeding is followed by (fb) flooding after a month due to scarcity of water and labour. In dry seeded rice, weed management plays a vital role because of simultaneous emergence of crop and weed (Moody, 1977). Use of herbicides becomes the only practical alternative. But most of the pre-emergence herbicides applied at germination stage becomes toxic to rice seedlings. Hence, an attempt was made to identify the efficient weed management strategy for dry seeded lowland rice.

MATERIALS AND METHODS

Field experiments were conducted in the Cauvery new delta zone during September to January, 1992 and 1994 following randomized block design with four replications and five weed control treatments viz., pre-emergence thiobencarb fb post emergence 2, 4-D Na salt, pre-emergence thiobencarb fb HW, pre-emergence pretilachlor plus fb HW, post emergence bentazon fb HW and