The biological and behavioural impact of some indigenous plant products on rice white backed plant hopper (WBPH) *Sogatella furcifera* (Horvath) (Homoptera: Delphacidae)

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ABSTRACT

Neem, *Azadirachta indica* A Juss. (Meliaceae) products *viz.*, neem seed kernel exract (NSKE) (5%) , neem oil (3%) , neem leaf extract (3%) along with notchi *Vitex negundo* Linn. (Verbenaceae) leaf extract (3%) , periwinckle leaf extract (*Catharanthus roseus* Linn.) (Apocynaceae) (3%), palmarosa oil (*Cymbopogaon maurtini Roxb.)* (0.05%), jatropha oil (*Jatropha carcus L.*) (1%) were evaluated against White Backed planthopper (WBPH) with different methods of application *viz.*, seed treatment , seedling root dip and foliar spray. Percent survival was minimum in NSKE .Mean size, weight and growth index were also minimum in neem products. Insects made more probes in neem products. Honeydew excreted in NSKE treatment was also reduced.

Keywords: Botanicals,Growth index,White backed Plant hopper (WBPH),

INTRODUCTION

In India, rice is grown over an area of 40 to 41 million ha under diverse conditions (Sampath 1990). Such an important crop is attacked by morethan 100 insect species which cause significant economic loss in various regions (Pathak and Khan, 1994). Pest problem increased with the intensification of irrigated rice production, which increases cost of production. Planthoppers are common rice insect pests in Asian rice production regions. The white-backed planthopper (WBPH) *Sogatella furcifera* (Horvath) belonging to the Family Delphacidae (Homoptera), is the main species infesting rice in subtropical and temperate areas. It has been emerged as a potential threat to rice production in tropical Asia. In India, this insect causes extensive damage to the rice crop in Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Orissa, Kerala,Tamil Nadu, Puducherry and Assam. Management of WBPH using synthetic chemicals has failed because of insecticide resistance (Mishra, 2006). In the current "Post – Green Revolution era," emphasis is given on sustainability and efficiency rather than on further intensification with expensive inputs. In pest management, the challenge is to make natural non-chemical methods collectively more effective. Moreover botanical insecticides are naturally occurring chemicals extracted from plants. Insecticidal activities of *Azadirachta indica* A Juss. (Meliaceae); notchi *Vitex negundo* Linn. (Verbenaceae); periwinckle *Catharanthus roseus* Linn. (Apocynaceae); palmarosa, *Cymbopogan maurtini;* jatropha, *Jatropha carcus* were well known in India and other countries. The study carried out on the effects of these plants on the toxicity and behaviour of WBPH using seed treatment, seedling root dip and foliar spray methods.

MATERIALS AND METHODS

Efficacy of botanicals as seed treatment, seedling root dip and foliar were evaluated against WBPH under experiment conducted in a completely randomized block design in the Agricultural College and Research Institute, Madurai insectary. The treatments were periwinckle (*Catharanthus roseus* - 3%) leaf crude extract (NLCE), neem leaf (A*zadirachta indica - 3 %*) crude extract, notchi (*Vitex negundo* - 3%) leaf crude extract, palmarosa (*Cymbopogan maurtini* - 0.05%) oil , jatropha (*Jatropha carcus* - 1%) oil, neem oil (3%), neem seed kernel extract (5%) were used for the experimental categories. Chlorp yriphos and monocrotophos were used as standards.

Seed treatment

Paddy seeds soaked overnight in 10 ml of the respective plant products were sown in mudpots at the rate of 10 seeds per pot. Three well established seedlings were maintained per pot. A week after germination ten newly moulted second instar WBPH nymphs were released per pot and enclosed with polyester film cages. Standard and control seeds were treated with and monocrotophos (0.04 %) and water were respectively.

Seedling root dip

Roots of 30 day – old healthy rice seedlings were dipped in various plant products for 12 h and transplanted in

earthern pots @ three seedlings per pot. Teepol 0.1 per cent was added to different formulations as emulsifying agent. Second instar WBPH nymphs were released @ 10 insects per pot at three days after transplanting and confined with polyester film cage. Standard and control seeds were treated with chlorpyriphos (0.02 %) and water respectively.

Foliar spray

Thirty day-old seedlings were sprayed with respective plant products using hand atomizer (100 ml capacity) @ 10 ml spray fluid. An hour later 10 second instar WBPH nymphs were released to each treatment and caged with polyester film. Standard and control seeds were treated with monocrotophos (0.04 %) and water respectively. Mortality of nymphs was recorded at 24 h and subsequently at weekly intervals till all the nymphs dead or became adults. The growth index of WBPH in each treatment was calculated following formula (Saxena *et al* ., 1974).

Growth index = Nymphs developing to adults (%)/Mean developmental period (days)

For measuring the feeding area, five gravid females of WBPH were assessed indirectly by honey dew excretion method proposed by Pathak and Heinrichs (1982). Number of probes was calculated by the method followed by Naito (1964). Data from toxicity and behaviour experiments were subjected to analysis of variance. Significant differences between treatments were determined by Duncan's Multiple Range Test (DMRT) ($P < 0.05$) using standard soft wares.

RESULTS

The results on survival, mean developmental period and growth index of WBPH in relation to different botanicals is furnished in Table 1. In seed treatment bioassay, the survival was higher in NSKE followed by neem oil, palmarosa oil, jatropha oil and notchi leaf crude extract and they were on par with each other. Mean developmental period was also more in NSKE and palmarosa oil treatments compared to untreated control. Growth index in NSKE was on par with neem oil, jatropha and palmarosa oil.

In seedling root dip method, the survival was higher in NSKE followed by neem oil, and palmarosa oil. As observed in the previous methods mean developmental period was also more in NSKE. In contrast the growth index was minimum in NSKE as against in control of foliar spraying. Similarly the survival was minimum in NSKE (20.0%) followed by neem oil, palmarosa oil and jatropha oil. Mean developmental period was again prolonged in neem products and the minimum growth index was noted in NSKE applied as foliar spray.

The size and weight of the adults developed in NSKE and neem oil treatments were lesser. The length and breadth were, 2.07, 2.11 mm and 0.83, 0.85 mm respectively as against 3.56 and 1.16 mm in control. The adults weighed 0.96 and 0.97 mg in NSKE and neem oil respectively as against 1.68 mg in untreated control.

Insects made more number of probes in neem products compared to other botanicals. The maximum and minimum probes were recorded in NSKE and control respectively. Next to neem products, palmarosa oil (42.0) and jatropha oil (38.00 probes) had recorded more number of probes.

Table 1. Effect of plant products and methods of application on the survival (%), growth index and developmental period (DP) (in days) of white backed planthopper.

Treatment	Seed treatment			Seedling root dip			Foliar spraying		
	Survival	DP	Growth index	Survival	DP	Growth index	Survival	DP	Growth index
C. roseus	83.3 (66.14)^{e}	13.00^{b}	6.40^{de}	76.6(61.72)^{e}	13.33^{bcd}	5.74^{c}	73.3(59.0)^{c}	12.33^{ab}	5.94^{c}
NLCE	80.0 (63.43)^{de}	13.66^{bc}	5.85^{d}	74.0(59.71)^{e}	12.66^{abc}	5.78^{c}	70.00 (56.79)^{c}	13.00^{b}c	5.38^{c}
V. negundo	70.0 (56.79)^{cd}	13.66^{bc}	5.12^{c}	70.3(56.99)^{e}	12.33^{ab}	5.70^{c}	50.00 (45.00)^{b}	13.33^{bc}	3.75^{b}
C. maurtini	60.0 (50.77)^{bc}	14.33^{c}	4.18^{bc}	50.0(45.0)^{bc}	12.66^{abc}	3.94^{b}	50.00 (45.00)^{b}	13.00^{bc}	3.84^{b}
J. carcus	63.3 (52.78)^{c}	14.00^{bc}	4.52^{bc}	53.3(48.85)^{cd}	13.33^{bcd}	3.99^{b}	53.3 (46.92)^{b}	12.66^{abc}	4.21b^{c}
Neem oil	50.0 (45.0)^{ab}	14.00^{bc}	3.57^{b}	46.6(43.08)^{abc}	13.33^{bcd}	3.49^{b}	50.00 (45.00)^{b}	13.66^{cd}	3.66^{b}
NSKE	46.6 (43.08)^{a}	14.33^{c}	3.25^{ab}	36.7(37.22)^{ab}	14.00^{cd}	2.62^{a}	20.00 (26.57)^{a}	14.66^{d}	1.36^{a}
Insecticide	43.3 (41.15)^{a}	14.66^{c}	2.95^{a}	33.3(35.22)^{a}	14.33^{d}	2.32^{a}	16.6 (23.86)^{a}	14.66^{d}	1.13^{a}
Control	90.3 (77.74)^{f}	11.33^{a}	7.96^{e}	96.8(79.71)^{f}	11.66^{a}	8.30^{d}	86.6 (68.86)^{d}	11.66^{a}	7.42^{d}

Figures in parentheses are arc sine transformed values; In a column means followed by the same letter (s) are not significantly different ($P < 0.05$) by DMRT.

Table 2. Effect of plant products on the mean size (in mm) and weight (in mg), number of probes and amount of honeydew excreted by White backed planthopper

Treatments	Length	Breadth	Weight	Number of probes/2" length of culm	Amount of honeydew excreted (mm^2)
Periwinckle leaf crude extract (3%)	2.35[d]	1.03[c]	1.23[c]	30.00[e]	217.66[e]
Neem leaf crude extract (3%)	2.77[f]	1.05[c]	1.33[d]	38.33[de]	179.00[ed]
Notchi leaf crude extract (3%)	2.23[bc]	0.94[b]	1.08[b]	32.00[de]	111.66[a]
Palmarosa oil (0.05 %)	2.26[c]	0.94[b]	1.08[b]	42.00[b]	153.00[bc]
Jatropha oil (1%)	2.64[e]	0.94[b]	1.09[b]	38.00[bc]	204.33[de]
Neem oil (3%)	2.11[a]	0.85[a]	0.97[a]	49.66[a]	127.00[ab]
NSKE	2.07[a]	0.83[a]	0.96[a]	51.00[a]	98.33[a]
Insecticide	2.20[b]	0.85[a]	0.95[a]	35.66[cd]	211.33[de]
Control	3.56[g]	1.16[d]	1.68[e]	25.66[f]	357.00[f]

In a column means followed by the same letter (s) are not significantly different ($P < 0.05$) by DMRT

Significant difference was observed in honey dew excretion between treated and control. Honeydew excretion was lesser in NSKE treatment, notchi leaf crude extract (111.66 mm^2) and with neem oil (127 mm^2). The maximum spread of 357 mm^2 was measured in control (Table 2.).

DISCUSSION

Results on the biology and behavioural effects of tested indigenous plant extracts on the *S. furcifera* reported in the present study, confirm their potential for control of white-backed planthopper populations. From the results, it was very clear that among the tested plants, the neem products severely affected the growth and development of WBPH and it was found that it acted as a growth inhibitor. Neem seed kernel extract act as an antifeedant and insect growth regulator against many insect pests including the rice leaffolder *Cnaphalocrocis medinalis* (Guenee) (Senthil Nathan *et al.,* 2006). Similarly the feeding activity as measured in terms of honeydew excretion and probing was also getting affected. Earlier Sridharan (1995) had reported that neem products affected the honey dew excretion in plant hoppers. The antifeedant property of neem products against plant hoppers has been well documented by Rajasekaran *et al.* (1986) and Saxena *et al*. (1987). Growth index was reduced and the developmental period was prolonged with the neem products except in neem leaf extract. These observations are in line with the findings of Saxena and Rembold (1984); Kareem *et al*. (1989); Dash and Senapathi (1995); Alice and Venugopal (2000). Among the neem products NSKE five per cent was superior when compared to neem oil three percent, due to the fact that seed kernels contains more neem seed bitter principles and contain more fraction of alkaloids as reported by Schmutterer (1990). Senthil Nathan *et al*. (2007) also reported that nymphs that were chronically exposed to neem extract (aqueous ethanol) showed a reduction in weight (45–60%). Even low concentrations of AZA, can be used effectively to inhibit the growth and survival of BPH.

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