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Evaluation of botanicals, microbials and non-synthetic insecticides for the management of leafhopper, *Amrasca devastans* distant in cotton

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Abstract
An investigation was carried out during 2014 -15 to evaluate the different botanicals, microbials and non-insecticidal materials, insecticides against leafhopper, *Amrasca devastans* Distant infesting cotton crop under field condition at Agricultural College and Research Institute, Killikulam, Tuticorin District, Tamil Nadu. The result of the field study revealed that, among all the botanical and non-insecticides used, teak leaf extract @ 5.0 % and neem seed kernel extract @ 5.0 % were found to be effective by reducing the leafhopper with the mean population 3.80 /3 leaves and 4.51 /3 leaves, respectively. Pink Pigmented Facultative Methylotrophic bacteria (PPFM) treatment did not enhance the population of leafhopper (5.44 /3 leaves).

Keywords: Botanicals, microbials, Non-synthetic insecticides, leafhopper, cotton.

1. Introduction
Cotton, *Gossypium* spp. (Family: Malvaceae) is one of the most commercially important fiber crops in the world. It is grown in 111 countries along the world. In India, it is cultivated in 8.97 million ha with a production of 21.3 million bales of seed cotton [5]. Moreover, due to the top most position in Indian agriculture and it is also popularly known as white gold. Cotton fiber is an important raw material to the textile industries and plays a key role in national economy in terms of employment generation and foreign exchange. Production of cotton is limited by various factors among which insect pests are also important. During growth period, 148 insect pests have been recorded on cotton crop, out of which only 17 species have been recorded as major insect pests of cotton crop [1]. Cotton pests can be primarily divided in to sucking pests and bollworms. Among the sucking pests, the leafhopper, *Amrasca devastans* Distant is an important pest that infests from the beginning of the crop, delaying early plant development; the leafhopper infestation might extend through the development of the plants if control practices are not adopted. Cotton is the most highly valued cash crop in India, but it appears major polluter crop because of heavy and indiscriminate pesticide use especially insecticides for controlling insect pests. While searching for a best alternative, use of botanicals will be a good choice for controlling insect pests and also paves way for eco-friendlier pest management. Botanicals, an essential component in bio-intensive pest management, help to reduce the dependence on chemical pesticides and ecological deterioration and they serve as insecticides, insect repellents and insect feeding deterrents [7, 8, 11-16].

Hence, the present investigation was emphasized on the use of botanicals *viz*., sweet flag, Alum, kadukai extract, neem oil (0.5 and 2%), Neem Seed Kernel Extract (NSKE) (5%), teak leaf extract, tobacco waste extract and microbes like Pink Pigmented Facultative Methylotrophic bacteria (PPFM bacteria), *Pseudomonas fluorescens* for the management of leafhopper in cotton.

Material and Methods
The experiment was conducted at Agricultural College and Research Institute, Killikulam, Tuticorin District, Tamil Nadu, using cotton variety SVPR 2 during 2014 - 2015. The crop was sown in 5 x 4 m^2 plots maintaining 30 cm and 60 cm inter plant and inter row distances. The standard agronomic practices were given at a proper time as per the Crop Production Guide by Tamil Nadu Agricultural University. Botanicals *viz*., sweet flag, Alum (potassium double sulfate of aluminium, $KAl(SO_4)_2$), kadukai extract, neem oil (0.5 and 2%), Neem Seed Kernel

Extract (NSKE) (5%), teak leaf extract, tobacco waste extract and water served as untreated check.

Preparation of spray solutions

The bio-inoculant PPFM and the antagonistic microorganism P. *fluorescens* were obtained from the Agricultural College and Research Institute, Killikulam. The spray fluids with alum and PPFM were prepared with need based addition of agricultural grade surfactants (Lipstick®). The procedure adopted for the preparation of spray fluid with other materials is detailed below.

Sweet flag *(Acorus calamus* L.*):* The rhizome of *A. calamus* was shade dried and powdered. The powder was soaked @ 5 g /lit of water for overnight and filtered with the white muslin cloth and sprayed with the surfactant.

Kadukai extract (*Terminalia chebula* var. *Chebula*): The epicarp of the kadukai (after removal of the seeds) were dried and powdered. The powder was soaked @ 5 g per litre of water for overnight and filtered with the white muslin cloth and sprayed with the surfactant.

Neem oil (0.5 and 2%): Neem oil was available readily in the market can be sprayed @ 5 ml and 20 ml /lit of after thorough mixing with the along with the surfactant

NSKE (5%): After removing the outer shell the neem seeds @ 50 g /lit were ground thoroughly and tied in a white muslin cloth and made it to dip inside the water meant for soaking overnight. On the next day, the supernatant was used for spraying along with the surfactant.

Teak leaves extract (*Tectona grandis*): The fallen teak leaves were collected and shade dried. The dried leaves were made in to powder and that was @ 50 g /lit of water for overnight and the supernatant was to be used for spraying along with the surfactant.

Tobacco waste (*Nicotiana tabacum*): Tobacco waste available in the market was soaked @ 25 g /lit of water overnight and the supernatant was used for spraying along with the surfactant.

The nymphal and adult population of leafhopper, *A. devastans* Distant was recorded on ten plants selected at random per plot through the use of magnifying lens. In each plant three leaves, one each from top, middle and bottom strata were observed and mean per leaf was calculated. The crop was sprayed three times at fortnight interval. The first spray was carried out at 25th days after sowing (DAS) *i.*e., when the pest attack reached economic threshold level followed by 40th and 55th DAS. The counting of insect population was carried out after 5 days after spraying at respective intervals. The nymphal population of leafhopper was recorded on 10 plants selected at random per plot. In each plant, three leaves, one each from top, middle and bottom strata were observed and mean per leaf was calculated. The experiment was laid out in Factorial Randomized Block Design (FRBD). There were 12 treatments replicated three times. The data gathered were transformed in to square-root values for statistical scrutiny, wherever necessary [10].

Results and Discussion

In the present study, teak leaf extract at 5.0 per cent and NSKE 5.0 per cent were found to be effective by reducing the leafhopper with the mean population 3.80 /3 leaves and 4.51 /3 leaves, respectively (Fig. 1). Insect control, similar to insecticide spraying, achieved by spraying teak leaf extract has been reported by [11] in brinjal against fruit borer and *hadda* beetle. [7] documented that the acetone extracts of *T. grandis* was found to exhibit both feeding deterrent and toxic activities. The effectiveness of neem seed kernel extract against *A. devastans* on cotton in reducing the incidence by 32.59 per cent was revealed in the present study (Table 1) is in conformity with the earlier studies by [2, 6, 15]. Based on their feeding deterrent and toxic properties, this plant extracts have potential for use as alternative crop protectant against certain pest species.

The present study revealed that, *P. fluorescens*, a plant growth promoting rhizobacteria (PGPR), treated plants harboured lesser population of leafhopper though it was not significantly better than the untreated ones. Moderate effectiveness of *P. fluorescens* against leafhopper has earlier been documented by [3-12].

The present investigation revealed less harbourage of leafhopper in plants that were treated with PPFM (at 5.0 ml/l). [9] obtained more bolls with the seed treatment and foliar spray of PPFM. Use of PPFM (seed treatment at 0.2 kg / 5 kg seeds, soil application basal (at 2.0 kg/ha) and foliar spray (at 500 ml/ha) at panicle initiation and flag leaf stages) for mitigation of terminal drought is recommended in Tamil Nadu [4].

In the present investigation, alum (at 0.50%) treatment enhanced the population of leafhoppers in cotton. Alum dissolved in tobacco liquor would kill caterpillars on gooseberry bushes [17]. They discussed that alum is a stringent and could have acted as an insect repellent by changing the flavor of plants. The high osmotic pressure of a concentrated solution of alum or alum in tobacco solution could have an effect on soft-bodied forms. Potash alum could serve as candidate for managing various mosquito habitats in the field [14]. Potash alum posed adverse effect on the tegument of larvae and acted as contact poison, which was apparently visible in treated larvae. They documented that the major malaria vector in India, *i.e. Aedes stephensi* is highly susceptible to potash alum. Potash alum, a fairly cheaper and readily available eco-friendly compound could be recommended as a potential chemical larvicide against *Ae. aegypti*, a dengue vector at mosquito breeding sites in the vicinity of human dwellings [13].

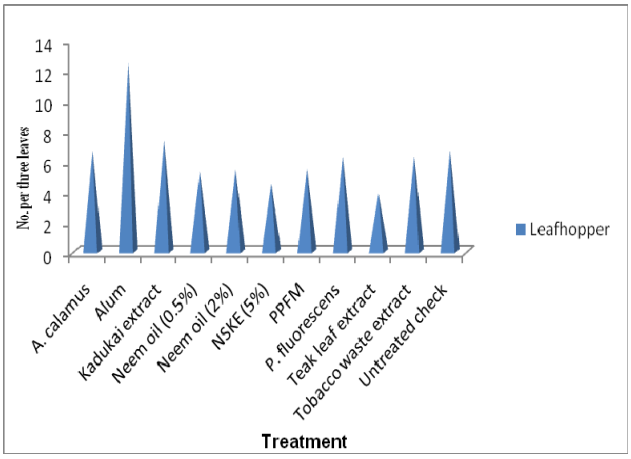

Fig 1: Influence of different botanicals, microbials and non-synthetic insecticides on the incidence of *A. devastans* in cotton

Table 1: Efficacy of botanicals, microbials and non-synthetic insecticides against leafhopper, *A. devastans* in cotton

Treatment	Dose (lit^{-1})	Leafhopper population (No. / 3 leaves) Days after sowing (DAS)				(+) / (-) over UTC (%)
		30	45	60	Mean	
Acorus calamus	10 g	4.13 A (2.15) abc	5.27 A (2.38) a	10.53 B (3.31) f	6.64 (2.61) cd	- 0.75
Alum	5 g	6.60 A (2.65) bcd	14.80 B (3.90) d	16.00 B (4.06) g	12.47 (3.54) e	86.40
Kadukai extract	5 g	8.60 C (3.01) d	5.80 A (2.50) abc	7.47 AB (2.81) bcde	7.29 (2.77) d	8.97
Neem oil (5ml)	5 ml	4.40 (2.21) abc	3.13 (1.89) a	8.20 (2.92) def	5.24 (2.34) abc	- 21.68
Neem oil (20ml)	20 ml	6.07 (2.50) abcd	4.27 (2.17) abc	5.80 (2.46) b	5.38 (2.37) abc	- 19.58
Neem Seed Kernel Extract (5.0%)	50 g	3.20 (1.92) a	4.47 (2.22) abc	5.87 (2.52) bc	4.51 (2.22) ab	- 32.59
Pink Pigmented Facultative Methylotrophs	10 ml	6.27 (2.58) bcd	3.80 (2.06) ab	6.27 (2.58) bcd	5.44 (2.40) abc	- 18.69
Pseudomonas fluorescens	5 g	5.00 (2.34) abc	5.60 (2.46) abc	8.20 (2.91) de	6.27 (2.57) bcd	- 6.28
Teak leaf extract	50 g	3.67 (2.04) ab	4.07 (2.13) abc	3.67 (2.04) a	3.80 (2.07) a	- 43.20
Tobacco waste extract	25 g	5.67 (2.43) abcd	4.80 (2.27) abc	8.40 (2.97) ef	6.29 (2.56) bcd	- 5.98
Untreated check	-	7.47 (2.73) cd	5.53 (2.45) d	7.07 (2.75) bcde	6.69 (2.64) cd	-
Mean	-	5.55 (2.41) A	5.59 (2.40) A	7.95 (2.85) B	6.37 (2.55)	-

Mean of three replications. Figures in parentheses are √X+0.5 transformed values. In a column/row, means followed by a common letter are not significantly different at 5 % level (LSD).

	T	P	T x P
Significance	0.01	0.01	0.01
CD (p=0.05)	0.35	0.18	0.61

Conclusion

Teak leaf extract at 5.0 per cent and Neem seed kernel extract 5.0 per cent reduced the leafhopper population. PPFM treatment did not enhance the population of leafhopper. These botanical insecticides can be recommended for the management of leafhopper in cotton looking to their effectiveness, economics and safety to the natural enemies.

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