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Efficacy of three botanicals and a microbial derivatives acaricide (Abamectin) on the control of jute yellow mite, *Polyphagotarsonemus latus* (Bank)

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Abstract

Three botanical oils and of microbial derivatives an acaricide (Abamectin) were evaluated for their efficacy in controlling yellow mite *Polyphagotarsonemus latus* in the field laboratory of Entomology, Bangladesh Agricultural University, Mymensingh. The selected botanical oils viz. Neem oil, Mahogany oil and Karanja oil and the acaricide Ambush 1.8 EC were tested against jute yellow mite on standing jute plants of the experimental plots and assessed for their effect on the basis of population of the pest at 24, 48 and 72 hours after treatment and the reduction of yellow mite infested plant after 7 and 10 days of spraying. The acaricide Ambush 1.8 EC was highly effective showing reduction of 80.25% mite infested plant. Among the botanicals, Neem oil and Mahogany oil showed better efficacy and caused 60.55 % and 55.89 % reduction of mite infestation. Karanja oil was not found promising in controlling yellow mite of jute. Considering the effectiveness against the mite pest as well as the environmental safety, use of Neem and Mahogany oil and also the reduced risk acaricide, Ambush 1.8 EC might be suggested in the IPM of yellow mite.

Keywords: Yellow mite, Efficacy, Botanical oils, Chemical acaricide

Introduction

Jute is a renewable natural fibre popularly known as the golden fibre. It is one of the cheapest and strongest natural fibres. Jute is second only to cotton in world's production of textile fibers. It is a biodegradable and eco-friendly. It has many advantages over synthetics and protects the environment and maintains the ecological balance.

Jute is one of the few crops, which can be grown in the monsoon season, and can be rotated with rice to restore the soil fertility and structure. The leaves of jute plants enrich the fertility of the soil for sustained agriculture, and have good nutrition value as vegetables. Use of jute sticks as fuel and fencing material as substitute for wood prevents deforestation. Therefore, the increased global concern for the environment, the future prospects for jute remains high.

About 15 million farmers are involved in growing this cash crop and several million more of our population, perhaps an equal number, are involved with its processing, transportation, conversion, etc. In Bangladesh, about 620.2 thousand hectares of land are under jute cultivation and total production is 1323.1 thousand tons (FAO). Jute crop is infested by a number of pests. More than 40 species of insects and mites are considered to be the pests of jute in Bangladesh (Anonymous, 2014). Infestation of yellow mite *Polyphagotarsonemus latus* (Bank) (Acarina : Tersonemidae) is a common and important pest in Bangladesh. It is very small and difficult to see without a 10X or stronger hand lens (Peña and Campbell, 2005). As a result of infestation, the young leaves crinkle, dry up and fall down. This destructive pest also causes terminal leaves to become malformed. Leaves curl downward and turn coppery or purplish. Internodes shorten and the lateral buds break more than normal. The vertical growth of the internodes gets suppressed and side branches develop. In case of heavy infestation the top shoot dies and apical branches appear resulting in great yield loss and deterioration of the quality of fibre. The mite's toxic saliva causes twisted, hardened and distorted growth in the terminal bud of the plant (Baker, 1997). The blooms abort and plant growth is stunted when large populations are present (Denmark, 1980; Wilkerson et al. 2005; Anonymous, 2005). There is no evidence that *P. latus* transmits plant viruses, but injury may be mistaken for damage due to virus attack or herbicide application. Population of mite increase with the increasing dry condition. The pest yellow mite is usually controlled by application of chemical acaricide

which may lead to killing of biological control agents including the predatory mite. Therefore a soft acaricide, Ambush 1.8 EC (Abamectin) was selected for efficacy with the botanicals. Abamectin is a mixture of avermectins containing more than 80% avermectin B1a and less than 20% avermectin B1b. These two components, B1a and B1b have very similar biological and toxicological properties. The avermectins are insecticidal and antihelmintic compounds derived from various laboratory broths fermented by the soil bacterium *Streptomyces avermitilis*. Abamectin is a natural fermentation product of this bacterium. It is used to control insect and mite pests of a range of agronomic, fruit, vegetable (Wikipedia) crops. Botanical oils of many indigenous plants posses some toxic effect against insect and mite pests of many crops. They are considered as bio-rational pesticides for their selectivity and eco-friendly performance against many pest. The botanical oils such as Neem oil, Mahogany oil and Karanja oil are indigenous product and the efficacy of plant based materials against yellow mite of jute are yet to be determined in the environmental condition of Bangladesh. Therefore, experiments were undertaken to evaluate the efficacy of the three botanicals along with an acaricide.

Materials and Methods

The efficacy of Neem, Mahogany and Karanja oil and a acaricide (Ambush 1.8 EC) were evaluated against jute yellow mite *P. latus* in the field laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh, during the period from March to August, 2013. Jute plants of tossa (*Corchorus olitorius* L.) OM-1a susceptible variety sown on 15 March. It was grown as BJRI recommended cultivation procedure. Fifteen plots were selected. Each plot was 4 m² in size. After natural population (infestations) build up in the field, at the plant age of 28 days the plots were treated with the treatments and control plots were left untreated. Young 3rd leaves from the tip were collected at 60, 90 and 120 days after sowing (DAS), because yellow mites are commonly found on the lower surfaces of young apical leaves and flowers, where they deposit their eggs. The number of mite of different stages (egg, larva, pupa, female and male) per cm² leaf (20 leaves/plot) was counted under a stereomicroscope.

Abundance of yellow mite

All botanicals and Ambush with 1% concentration were applied to the jute plant infested with yellow mite. The experiment was conducted in a Randomized Complete Block Design (RCBD) and was replicated 3 times.

The spraying of botanical oils and acaricide was made with the help of a hand-operated sprayer. Care was taken to avoid spray drift on adjacent plants. The spraying was done in such a way that the spray droplet did not coalesce and drain down in the soils and whole plant was thoroughly covered by spray material. After spraying each botanical oil with designed dose the sprayer was washed and cleaned properly. Before, each application, the sprayer was calibrated in order to use the right dose on the plants without wastage of botanical oils by determining the quantity of water required for each plant. The control plants were sprayed only with water.

Five jute plants were selected randomly from each plot. For recording data of different parameters, yellow mite population was recorded at 24, 48 and 72 hours after spraying. Plant height was recorded after 60, 90 and 120 days after planting (DAP). Total number of leaves per five plants, total number of infested leaves, number of curled or deformed leaves per plant and number of dropped leaves per plant were recorded.

Percent reduction of pest under field condition was recorded using the following formula –

$$(\%) \text{Reduction} = \frac{N - N_1}{N} \times 100$$

Here,

- N = No. of mite infested plant in control plot
- N₁ = No. of mite infested plant in treated plot

Number of mite population /leaf after 24, 48, and 72 hours of spraying, number of mite infested plants / plot after 7 and 10 days of spraying, per cent reduction / plant, number of curled or deformed leaves / plant due to infestation and number of dropped leaves / plant due to infestation were recorded. Analysis of variance was done with the help of computer package Minitab and means were separated by using Tukeys pair wise test.

Results and Discussion

Effect of botanical oils and an acaricide on the Survival of Jute yellow mite

Population of yellow mite recorded in the botanicals and acaricide treated plant at different time intervals after spraying is shown in Table 1.

Survival data of *P. latus* after 24 hours of spraying showed that there was a significant difference in the effect of the botanical oils and the acaricide. The mean number of jute yellow mite survived per leaf was lowest (9.67/leaf) in treatment with Ambush which was similar (10.00/leaf) in the treatment with neem oil. After 2 days of spraying of acaricide the mean number of jute yellow mite per leaf was 6.67. Neem oil treated plot showed identical result of Ambush treated plot which was 7 mites per leaf.

Mean number of yellow mite survived per leaf was the lowest (2.67) in the chemical acaricide after 72 hours of spraying. Yellow mite population per leaf was highest (10.67) in Karanja oil and lowest (4.67) in Neem oil treated plants after 72 hours. Among the three botanicals karanja oil was less effective in which higher number of mites were found to survive.

Table 1. Effect of three botanicals and an acaricide on the survival of yellow mite

Treatments	Mean no. of population of yellow mite at different times after spraying		
	24 hrs.	48 hrs.	72 hrs.
Neem oil	10.00 c	7.00 b	4.67 c
Mahogany oil	13.33 bc	9.00 bc	7.33 bc
Karanja oil	16.33 ab	13.33 ab	10.67 b
Ambush 1.8 EC	9.67 c	6.67 b	2.67 c
Control	21.33 a	17.00 a	15.67 a
LSD	3.98	2.47	2.50
CV (%)	6.58	7	6.11
Level of significance	**	**	**

- Means in a column followed by same letter(s) are not significantly different

Among the three botanicals, neem oil showed better performance. This result is in agreement with (Singh, 2003) who found that 1 % neem oil was highly effective against survival of jute yellow mite. Anil et al. (2001), reported that mahogany and karanja oils of same dose had significant influence in reducing the infestation of jute yellow mite.

Application of all the botanicals and the acaricide caused a significant reduction of infestation in jute plants after one week of spraying (Table 2). All the botanicals were found almost similar in there effect in reducing the mite infestation after 7 and 10 days application.

The efficacy of acaricide was significantly different from those of botanicals. After 7 and 10 days of spraying a higher reduction of mite infested plant was found with the acaricide causing a reduction of (72.25% and 80.15%) pest infestation in jute plant respectively. Chari et al. (1999) observed that neem oil at 1% concentration was highly effective in the reduction of yellow mite. Keita et al. (2001) found maximum percent reduction of *P. latus* on jute after application of Ambush 1.8 EC @ 0.5 ml/l.

Efficacy of three botanicals and a microbial derivatives acaricide

Table 2. Effect of three botanicals and an acaricide on the percent reduction of yellow mite population per plant

Treatments	% reduction of mite infested plants at different time interval	
	7 DAT	10 DAT
Neem oil	54.00 b	60.55
Mahogany oil	51.36 ab	55.89
Karanja oil	31.00 bc	35.00
Ambush 1.8 EC	72.25 a	80.25 a
Control	24.67 c	25.00
LSD	7.98	7.25
CV(%)	5.89	6.56
Level of significance	**	**

- Means in a column followed by same letter are not significantly different at 1% level
- DAT = Days After Treatment

Effect of botanicals and acaricide on growth of Jute Plants

Plant height (cm) at 90 and 120 days after planting due to infestation shown in Table 3. Among the treatments the highest plant height was (106.66 cm) in neem oil and lowest was (97.7 cm) in mahogany oil at 90 days.

Chari *et al.* (1999), who observed that neem oil at 1% concentration was highly effective in increasing the growth of jute through the control of jute yellow mite.

The plant height was (109.54 cm) after 90 days of planting. Similar observation was reported by Talukder, (2000) who obtained the effect of Ambush on plant height after its application against jute yellow mite.

Table 3. Growth of jute plant as influenced by yellow mite with application of botanicals and an acaricide

Treatments	Plant height (cm) at 90 days	Base diameter cm/plant at the time of harvest
Neem oil	106.66 ab (18.3)	5.10 b (28.46)
Mahogany oil	97.71c (8.36)	4.80 bc (20.90)
Karanja oil	104.27 b (15.61)	4.77 bc (20.15)
Ambush 1.8 EC	109.54 a (21.45)	6.69 a (68.51)
Control	90.19 d	3.97 c
LSD	4.71	0.95
CV(%)	5.24	9.98
Level of significance	**	**

- Means in a column followed by same letter(s) are not significantly different
- Data in Parenthesis indicates Percent (%) increase of plant height and it was calculated based on the data of control.

Damage of jute leaves by using some botanicals and an acaricide is represented in Fig. 1. Percent of infested leaves /plant was the highest (19.33) in karanja oil and lowest (14.67) in neem oil. Lolage and Patil, 1992 showed that, neem, mahogany and karanja oil significantly reduced the damage of jute leaves.

Damage of jute leaves by using acaricide is presented in Figs. 1&2. Percent of infested leaves /plant was 12.00, percent of curled or deformed leaves within infested leaves / plant was 28.00 and percent of dropped leaves within infested leaves / plant was 7.00.

Percent of number of curled or deformed and dried or dropped leaves within infested leaves / plant is represented in Fig. 2. Percent of number of curled or deformed leaves within infested leaves / plant was the highest (53.33 %) in karanja oil and lowest (45.67 %) in neem oil. Percent of number of dropped leaves within infested leaves / plant was highest (16.67 %) in karanja oil and the lowest (9.67 %) in neem oil.

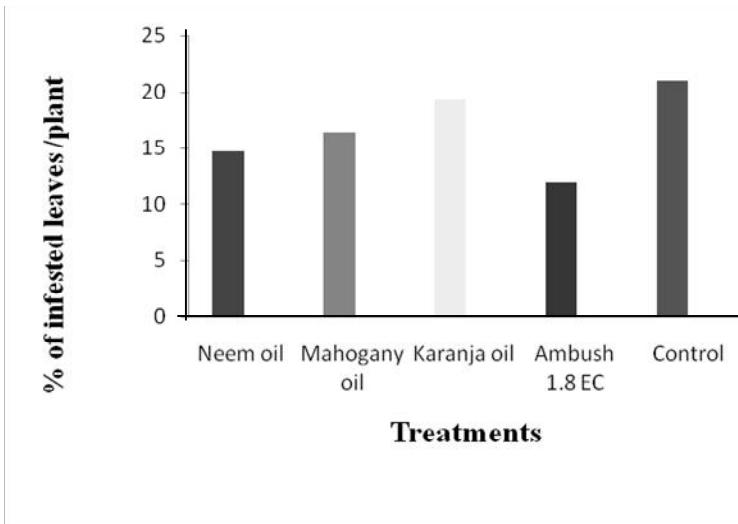


Fig. 1. Effect of botanicals and an acaricide on the infestation of jute yellow mite

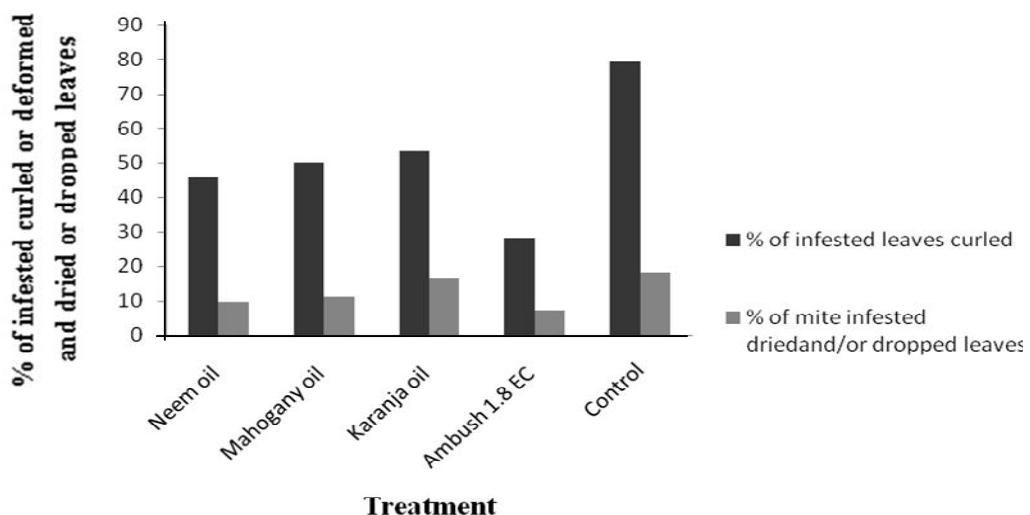


Fig. 2. Showing percent of infested curled or deformed and dried or dropped leaves within infested leaves after application of botanicals and acaricide

Piao *et al.* 1999, found maximum percent mortality of *P. latus* on jute after application of Ambush 1.8 EC @ 0.5 ml/l. The percentage of hatching was also significantly reduced by the application of Ambush 1.8 EC @ 4 ml/l as reported by (Watson *et al.* 1985). Yeasmin *et al.* 2013 also found similar results after application of Neem oil which increased 24.64% plant height, 27.87% base diameter over control and gave the highest amount of fibre yield (2.68 t ha⁻¹). Neem oil and mahagoni seed extract might be used for the control of yellow mite but it needs to explore the toxic compound of mahagoni seed.

Yellow mite infestation caused curly, deformed and dried leaves symptom. Dropping of leaves occurred in serious stage of attack. Application of different plant reduced the damage to a considerable level. All the three oils provided considerable control of jute yellow mite. The acaricide (Ambush 1.8 EC) reduced the deformation, curly appearance and dropping of leaves to a significantly higher level.

Results of several field trials have demonstrated differences between residual efficacies of several acaricide treatments. Virtually all growers use Ambush 1.8 EC to control broad mite. Sekh, *et al.*, (2007). However considering the other factors such as toxic and toxicity to the botanical oils especially neem oil and mahagoni oil might be used for the control of yellow mite but it needs to explore the toxic compound of mahagoni seed.

Conclusion

The present research finding it can be concluded that the maximum damage of jute by yellow mite occurred in untreated plot and the lowest in the acaricide treated plot. Among the botanicals neem oil and mahogany oil were found to be best for controlling jute yellow mite. Karanja oil was not as promising in controlling this pest. It is unlikely that any single method of pest control tactics can achieve an acceptable level of control of yellow mite. Therefore, an integrated approach should be developed in combination with Abamectin, neem oil and mahagoni oil in controlling yellow mite. It demands further investigation, for using them in IPM package.

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