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Effectiveness of Some Plant Materials against Jute Yellow Mite on *Corchorus Olitorius*

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Abstract
An experiment was conducted to evaluate the effectiveness of plant materials against yellow mite (*Polyphagotarsonemus latus*) on jute (*Corchorus olitorius*) cv. 0–9897 in both greenhouse and field condition at BJRI during the period from March to October 2016. In greenhouse premises, the highest mortality (69.39, 67.77, 63.86, 62.43 and 61.47%) was recorded in extract of neem seed kernel @ 1:20, mehogony seed, pithraj seed, turmeric powder and green neem leaf, respectively. In field condition, the highest reduction (70.20%) of infestation over control, lowest nodes plant^{-1} (52.50), tallest plant (3.10 m) and highest yield increased (38.60%) over control were observed in neem seed kernel extract @ 1:20. In conclusion, neem seed kernel extract, mahogany seed extracts, pithraj seed extract, green neem leaf extract and turmeric powder extract @ 1:20 can be safely used by the farmers as components of IPM program of Jute.

Key words: Growth, Jute, Plant extract, *Polyphagotarsonemus latus* (Banks), Yield

Introduction

Jute is a fibre crop of international eminence and the most important cash crop included foreign exchange earner of Bangladesh. It is cultivated for its phloem fibre and it is extensively used in the world for its versatility, durability and fineness as it is used for the production of newsprint, carpet making, hessians, gunny bags, ropes etc. A large extent on jute and jute products was also described as a very important commodity concerning agriculture industry and trade in Bangladesh. Jute is mostly grown in the Indo–Bangladesh region and in some countries of the South East Asia which contributes about 90% of the World's jute production (Talukder *et al.* 1989; Atwal, 1976). The land and climatic conditions of Bangladesh are also congenial to the production of good quantity of jute especially two species *C. capsularies* L. and *C. olitorius* L. In Bangladesh, it ranks second in production and the total yield was 1633152.65 metric ton under 6.73 lac hectares of cultivable land (BBS, 2015). Therefore, jute is liable to damage by about 40 species of insects and mites at all growth stages which infestation causes 38% loss in fibre yield and seed under field condition (Kabir, 1975). Yellow mite (*Polyphagotarsonemus latus* [Banks]) is the most common and a serious pest of jute which is commonly known as yellow tea mite and also known as "Telenga" or "Telchita" disease in Bangladesh. It appears on jute at the end of April and becomes active in mid–May when the plants are about one foot tall (Kabir, 1975). The damage of the terminal shoots is seldom visible before June. Initial mite attacks are usually seen near dwellings and shady places of leaves. It seems that the mite is carried from plot to plot of the jute planting by wind. The adult mites also play an important role in the dispersal and distribution by carrying female nymphs to younger leaves. The nymphs are held above the male's body by means of a sucker like organ near the tip of Posterior terminus. Both yield and quality of fibre are reduced due to attack of this pest management of mite is based mainly on its chemical control. But the use of chemical acaricides may cause pest resurgence and their residual effect resulting in environmental, social and other problems. To minimize the use of these in mite control programs, biologically active natural plant products can play a significant role in this regard as alternative substances of chemical control which are environmentally safe, less hazardous, less expensive, biodegradable and readily available. Over the past 50 years, more than 2000 plant species belonging to different families and genera have been reported to contain toxic compounds and a multitude of chemical compounds possessing diverse and novel types of structural patterns have been isolated from various plants (Adityachaudhury *et al,* 1985). Therefore, the derivatives of neem (*Azadirachta indica*) have come under close scrutiny of scientist around the world as the most promising source of natural insecticides (Saxena, 1989). However, reports on the use of neem oil in jute pest management are scanty in Bangladesh. Neem has been reported to have antifeedant, repellent, toxicant, insect growth inhibitors, chemosterillant and anti oviposition activity (Gujar, 1992). From the view of above points, the present research was undertaken to identify the effective plant material(s) and their optimum doses which have higher capacity to control the jute yellow mite.

Materials and Methods

The experiment was carried out at the both greenhouse premises and field of Bangladesh Jute Research Institute, Dhaka during March to October, 2016. The jute variety 0–9897 of *Corchorus olitorius* L. was used for the study. The jute seeds were collected from the Breeder Seed Department of BJRI. The earthen pots (12" diameter) were brought from the market and filled with dairy soil and sand. During the experiment, weeding, mulching and

irrigation were done as and when necessary but no plant protection measures were taken. Urea, TSP, MP, Gypsum and ZnSO4 @ 200, 50, 60, 95 and 11 kg ha^{-1}, respectively were used as prescribed by BJRI. The total amount of TSP, MP, Gypsum, Zinc sulphate and the half of urea were applied at the time of final land preparation and the remaining half of the urea was applied after 45 days of seed sowing. The test pest was jute yellow mite, *Polyphagotarsonemus latus* (Order: Acarina, Family: Tarsonemidae). Sixteen extract treatments *viz.* green neem leaf @ 1:10, 1:20 and 1:20 (T_1 to T_3), pithraj seed @ 1:10, 1:20 and 1:20 (T_4 to T_6), Mahogany seed @ 1:10, 1:20 and 1:20 (T_7 to T_9), turmeric powder @ 1:10, 1:20 and 1:20 (T_{10} to T_{12}) and neem seed kernel @ 1:10, 1:20 and 1:20 (T_{13} to T_{15}) included control (T_{16}) were used in greenhouse lab condition. Infestation level was also determined by calculating deformed leaves including fibre yield in the field condition among six treatments *viz.* @ 1:20 of green neem leaf, pithraj seed, Mahogany seed, turmeric powder and neem seed kernel extract (T_1 to T_5) including control (T_6). All the plant materials were collected from the BJRI campus, Dhaka and turmeric powder was collected from the local market. The collected leaves of green neem, matured fruits of mahogany and neem, and pithraj seeds were washed under running tap water dried in the sun. Collected neem seeds were also dipped in water for 48 hours for easy removal of the shell. After remove the shell, kernels of seeds were collected and then dried in sun. All the dried materials made into powder with the help of a grinder. One hundred gram of all powder including collected turmeric powder(s) were dissolved in 1000, 2000 and 3000 ml of water separately for overnight to prepare 1:10, 1:20 and 1:30 concentration. The suspensions were filtered through linen cloth for spraying. The prepared extract of different plant materials are presented in Fig. 1.

Fig. 1. Prepared extract of different plant materials

When sufficient infestations of yellow mite were built up in all the pots, then extracts were sprayed as per treatment on the infested plants. Each treatment was replicated three times. Egg and nymph of yellow mite and their adult male and female populations were visible under Stereo Microscope which was presented in Fig. 2 and Fig. 3 under greenhouse condition. Yellow mite infested jute plant was also presented in Fig. 4. The percent mortality due to yellow mite infestation was calculated as per following formula after 24, 48 and 72 hrs of spray.

$$\% \text{ corrected mortality} = \left(1 - \frac{Ta \times Cb}{Tb \times Ca}\right) \times 100$$

Where, Ta= No. of mites after treatment; Tb=No. of mites before treatment; Ca= No. of mites after treatment in control and Cb= No. of mites before treatment in control

Fig. 2. Egg and nymph of yellow mite under Stereo Microscope

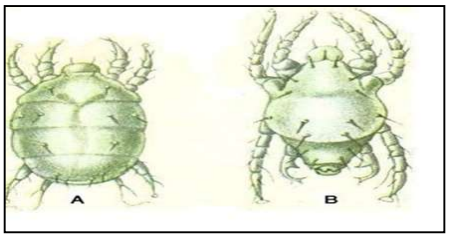

Fig. 3. Microscopic view of adult female (A) and male (B) population of jute yellow mite

Fig. 4. Yellow mite infested plant of jute

Similarly, all extract were sprayed on infested plots with a repetition of 2nd spray after 20 days of 1st spray under field condition. The control plots were kept untreated and each treatment was replicated 3 times. The number of infested plants $plot^{-1}$ was recorded before spray and at 7th day after spray for calculation the percent reduction of infestation over control by the following formula:

$$\text{Reduction (\%)} = \frac{\text{No. of infested plants in control plot - No. of infested plants in treated plot}}{\text{No. of infested plants in control plot}} \times 100$$

The recorded data were statistically analyzed to obtain the level of significance using the MSTAT software for analysis of variance developed by Russel (1986) and laid out in both Randomized Complete Block Design (RCBD) & Complete Randomized Design (CRD). The treatment means were separated by Duncan's Multiple Range Test (DMRT) at $p \leq 0.05$.

Results and Discussion

Effect of aqueous extract of plant materials on jute yellow mite in greenhouse condition

The effect of different concentrations of plant materials such as green neem leaf extract, pithraj seed extract, mahogany seed extract, turmeric powder extract, neem seed kernel extract had significant and positive influenced on percent mortality of yellow mite in pot. Among the extract treatments, the highest percent mortality (69.39%) was recorded in neem seed kernel extract @ 1:20 (T_{14}) while rest of the treatments showed identical second highest percent mortality except T_1 (58.31%) over control at 72 hours (Table 1). This result revealed that all the plant extract had similar impact on percent mortality over control. Accordingly, pande *et al.* (1987) reported 1% neem leaf extract and 5% neem seed kernel which were very much effective against *Tetranychus neocaledomcus* and *Tetranychus urticae.* Based on the above findings, neem seed kernel extract @ 1:20 followed by other treatments of green leaf, pithraj seed, mahogany seed, turmeric powder and neem seed kernel extract except green neem leaf extract 1:10 were selected for field trial.

Table 1. Effect of plant materials on percent mortality of jute yellow mite in pot under greenhouse condition

Treatment	No. of mites cm^{-2} in leaf before treatment	% mortality over control at		
		24 hrs	48 hrs	72 hrs
T_1: Green neem leaf extract @1:10	51	55.48 f	56.49 d	58.31 b
T_2: Green neem leaf extract @1:20	48	59.43 cdef	60.58 abcd	61.47 ab
T_3: Green neem leaf extract @1:30	52	56.16 f	57.59 cd	60.59 ab
T_4: Pithraj seed extract @1:10	49	58.98 cdef	58.43 bcd	60.13 ab
T_5: Pithraj seed extract @1:20	48	61.40 bcd	61.48 abcd	63.86 ab
T_6: Pithraj seed extract @1:30	45	56.80 ef	58.07 bcd	61.40 ab
T_7: Mahogany seed extract @1:10	54	65.34 ab	62.44 abcd	65.31 ab
T_8: Mahogany seed extract @1:20	50	63.30 bc	65.71 ab	67.77 ab
T_9: Mahogany seed extract @1:30	43	60.52 cde	63.19 abcd	64.36 ab
T_{10}: Turmeric powder extract @1:10	45	58.72 def	60.59 abcd	60.97 ab
T_{11}: Turmeric powder extract @1:20	45	62.35 bcd	62.52 abcd	62.43 ab
T_{12}: Turmeric powder extract @1:30	52	63.33 bc	61.95 abcd	60.61 ab
T_{13}: Neem seed kernel extract @1:10	51	65.07 ab	65.96 ab	65.34 ab
T_{14}: Neem seed kernel extract @1:20	52	68.56 a	67.96 a	69.39 a
T_{15}: Neem seed kernel extract @1:30	49	65.56 ab	64.89 abc	64.08 ab
T_{16}: Control	40	–	–	–
Level of significance	–	**	**	**
LSD$_{(0.05)}$	–	**3.811**	**6.651**	**7.962**
CV (%)	–	**4.65**	**8.05**	**9.47**

In a column, figures having similar and no letter(s) do not differed significantly at $p \leq 0.05$, whereas figures with dissimilar letter(s) differed significantly as per DMRT at same level; **= significant at 1% ($p \leq 0.01$) level of probability

Effect of different plant materials on yellow mite (1st spray) under field condition

The effect of different plant materials on percent reduction over control of plant infestation by yellow mite was determined in the field. Results of Table 2 indicated that after 1st and 2nd spray, all different plant materials reduced considerable amount of plant infestation. The highest reduction of plant infestation was 68.65 and 70.20% recorded in neem seed kernel extract (T_5) treated plots followed by mahogany seed extract, T_3 (63.07 and 68.46%) treated plots after 1st and 2nd spray, respectively. However, the lowest but identical reduction of plant infestation were recorded in green neem leaf (T_1) and turmeric powder extract (T_4) after both 1st (53.54 and 54.64%, respectively) and 2nd (62.37 and 61.72%, respectively). Pithraj seed extract (T_2) treated plots provided moderate of 57.38 and 65.38% reduction over control after 1st and 2nd spray, respectively (Table 2). The results indicated that neem seed kernel extract and mahogany seed extract were most effective, while pithraj seed extract and turmeric powder extract were moderately effective against jute yellow mite. It was reported by Anonymous (2009) that the highest 60% reduction of yellow mite infestation was recorded in 1:20 ratio of mahogany seed extract while Banu *et al*. (2007) reported that green leaf extract and dry neem leaf extract reducing yellow mite infestation over control in jute. It has also been reported that different plant materials were controlled various insect pests (Pasini *et al.,* 2003; Karmakar and Bhole,

2001; Naganagouda *et al*., 1997). Islam (2006) also showed 1% neem oil and green neem leaf extract at the dose 1:20 is very much effective for reducing mite population in jute. In the present study, the results of field trial clearly indicates that neem seed kernel extract, mahogany seed extract and pithraj seed extract were most effective plant materials while green neem leaf extract and turmeric powder extract were moderately effective against jute yellow mite.

Effect of different plant materials on internodes of jute plant

The effect of different plant materials showed significant positive increased on number of internodes plant^{-1} at three growth stages of jute plant (Table 3). At early stage, the lowest number of nodes plant^{-1} (20.05) was recorded in neem seed kernel extract (T_5) followed (21.30) by mahogany seed extract (T_3). At the middle stage, the lowest number of nodes plant^{-1} 33.85 was recorded from the neem seed kernel extract (T_5) which was statistically identical to mahogany (T_3) and pithraj (T_2) seed extract (35.85 and 37.70, respectively). Similarly, the lowest number of nodes plant^{-1} (52.50) was recorded from the neem seed kernel extract (T_5) treatment which was statistically identical to Mahogany (T_3) and pithraj (T_2) seed extract treatment (54.50 and 57.50, respectively). The untreated control (T_6) had the highest number of nodes plant^{-1} (36.00, 80.25 and 92.50) at all growth stages *viz.* early at 35 DAS, middle at 80 DAS and later stage at 120 DAS, respectively which was significantly different from other all treatments. The results indicate that neem seed kernel extract, mahogany seed extract and pithraj seed extract showed the better performance on reducing the number of nodes plant^{-1} at all stages of jute plant growth than untreated control plant. It should be noted that severe infestation of mite on jute plant causes defoliation, stunting of plant growth, increased the number of nodes plant^{-1} (Fig. 5) and decreased the fibre quality. Because application of different plant materials reduced the mite infestation included plant significant increased of plant height that decreased the number of nodes with in a unit area. The above findings of the present study due to different plant materials was in accordance with the findings observed by Pande *et al.* (1987) and Devraj (1990). They also found that the neem leaf extract (1%) and neem seed kernel extract (5%) were effective against mites. So the effectiveness of different plant materials against mites proved promising in the present study.

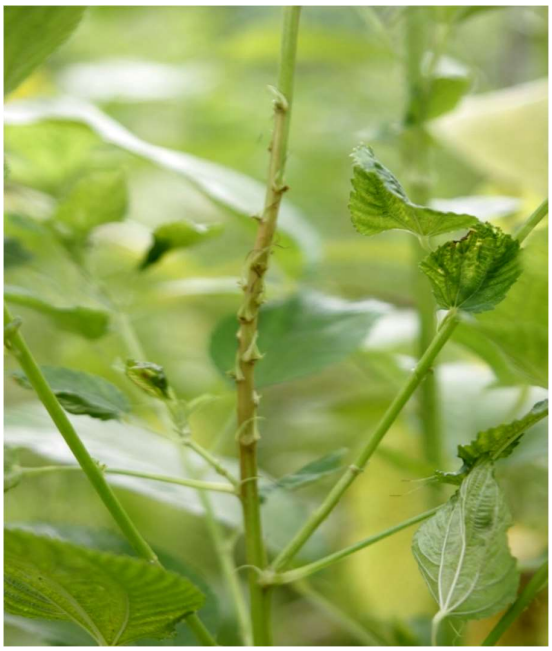

Fig. 5. Severely yellow mite infested jute plant showing internodes and increased number of nodes

Table 2. Effect of plant materials on percent reduction over control of yellow mite in the field condition

Treatment	First spray			Second spray		
	Average no. of mite infested plants plot^{-1} before spray	No. of mite infested plants plot^{-1} after 7days of spray	Percent reduction over control	Average no. of mite infested plants plot^{-1} before spray	No. of mite infested plants plot^{-1} after 7days of spray	Percent reduction over control
T_1: Green Neem Leaf Extract @1:20	74.25	26	54.68 c	48.75	15.75	61.72 c
T_2: Pithraj Seed Extract@1:20	62.5	23	57.38 bc	43	14.25	65.38 bc
T_3: Mahogany Seed Extract@1:20	81	21	63.07 ab	37	13	68.46 ab
T_4: Turmeric powder extract@1:20	88.5	25	53.54 c	34.25	15.5	62.37 c
T_5: Neem Seed Kernel Extract@ 1:20	68.25	20	68.65 a	35.25	12.25	70.20 a
T_6: Control	75	67.25	0.000 d	49.25	41.25	0.000 d
Level of significance	–	–	**	–	–	**
LSD(0.05)	–	–	**4.897**	–	–	**4.216**
CV (%)	–	–	**6.6**	–	–	**5.12**

In a column, figures having similar and no letter(s) do not differed significantly at $p \leq 0.05$, whereas figures with dissimilar letter(s) differed significantly as per DMRT at same level; **= significant at 1% ($p \leq 0.01$) level of probability

Effect of different plant materials on plant height

The effect of different plant materials on height of jute is presented in Table 3. At the time of harvest, neem seed kernel extract (T_5) treatment contributed the highest plant height (3.10 m) followed by pithraj (T_2) and mahogany (T_3) seed extract (3.02 and 3.05 m,

respectively) whereas pithraj (T_2) and mahogany (T_3) seed extract treatments were statistically identical. The lowest plant height (2.90 m) was recorded from untreated control (T_6) which was significantly lower than all other treatments. The above results indicate that different plant materials had significant effect on increasing height of jute plant. However, mite infestation causes growth stunting and finally reduces the plant height but application of different plant materials contributed the highest increased of plant height by reducing the mite infestation during the study. Such the similar observation with the present findings was also reported by the research findings of Islam (2006) who also reported that the plant height of 314 cm and 299 cm were recorded from @ 1:20 neem seed kernel extract and @ 1:20 green neem leaf extract. The effect of plant materials on increasing plant height as observed in the present study was also in conformity with the finding reported by Palaniswamy and Ragini (2000) against yellow mite on chili where they proved that the 5% aqueous extract of neem leaf reduced the mite population on chili and increased height.

Effect of different plant materials on base diameter of jute

The result obtained from the present research regarding plant base diameter of jute is presented in Table 3 and showed significant influenced among the plant materials extract. At the time of harvest, the highest base diameter (15.93 mm) was recorded with neem seed kernel extract (T_5) treated plot which was statistically identical (15.86 mm) to mahogany seed extract (T_3) while all other treatments except control showed average second highest but statistically identical plant base diameter. The lowest plant base diameter (14.50 mm) was recorded from the untreated control plot which was significantly lower than all other treatments. The above results indicate that different plant materials had significant effect on increasing base diameter of jute plant by reducing the mite infestation.

Table 3. Effect of different plant materials on number of internodes of Jute plant

Treatment	No. of internodes plot at			Plant height (m)	Plant base diameter (mm)	Yield (t ha^{-1})	Increased yield over control (%)
	Early stage (35 DAS)	Middle stage (80 DAS)	Late stage (120 DAS)				
T_1: Green Neem Leaf Extract @1:20	25.50 c	46.50 b	62.25 b	3.00 b	15.24 b	2.629 cd	29.41 bc
T_2: Pithraj Seed Extract@1:20	24.25 cd	37.70 c	57.50 c	3.02 ab	15.34 b	2.706 bc	33.25 ab
T_3: Mahogany Seed Extract@1:20	21.30 de	35.85 c	54.50 c	3.05 ab	15.86 a	2.782 ab	37.04 a
T_4: Turmeric powder extract@1:20	27.25 b	47.50 b	66.25 b	2.98 b	15.39 b	2.581 d	27.12 c
T_5: Neem Seed Kernel Extract@ 1:20	20.05 e	33.85 c	52.50 c	3.10 a	15.93 a	2.815 a	38.60 a
T_6: Control	36.00 a	80.25 a	92.50 a	2.90c	14.50 c	2.033 e	0.000 d
Level of significance	**	**	**	**	**	**	**
LSD(0.05)	**2.71**	**4.19**	**4.09**	**8.025**	**0.452**	**0.095**	**5.29**
CV (%)	**8.95**	**5.83**	**4.18**	**4.77**	**1.94**	**2.57**	**12.73**

In a column, figures having similar and no letter(s) do not differed significantly at $p \leq 0.05$, whereas figures with dissimilar letter(s) differed significantly as per DMRT at same level; **= significant at 1% ($p \leq 0.01$) level of probability

Effect of different plant materials on fibre yield of jute

Effect of different plant materials had significant influence on yield of jute fibre and also on yield increased over control. The highest fibre yield (2.815 t ha^{-1}) ws recorded with the neem seed kernel extract (T_5) treatment followed (2.782 t ha^{-1}) by mahogany seed extract which contributed the statistically identical highest increased of fibre yield over control (38.60 and 37.04%, respectively). However, untreated plot gave the lowest yield (2.033 t ha^{-1}) but the lowest increased over control (27.12%) was recorded from the turmeric powder extract (T_4) treated plots, which were significantly different from other treatment. The extract of green neem leaf (T_1) and pithraj seed (T_2) also showed significant increased of fibre yield by 29.41 and 33.25%, respectively over control. It was reported by Anonymus (2009) that 27% fibre increased over control was from mahogany seed extract and 23.5% fibre yield increased over control was reported from jute seed extract treated plot. The present study indicated that the plant materials had positive and significant influenced for the increasing of fibre yield over control by reducing the yellow mite in jute. Similar findings were also reported by Banu *et al.* (2007) who reported that the use of green neem leaf extract and dry neem leaf extract against yellow mite gave increased fibre yield over control.

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