Effect of Neem (*Azadirachta indica*) and other Plant Extracts on Yellow Mite of Jute

M. D. Hossain, S. Yasmin*, M. A. Latif and N. Akhter

Department of Entomology, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka (1207), Bangladesh

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Correspondence to

E-mail: sabera_sau@yahoo.com

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Abstract

A field experiment was conducted to evaluate the effectiveness of neem and some other plant extracts against yellow mite of jute, *Polyphagotarsonemus latus* (Banks), at the Jute Agriculture Experimental Station (JAES), Manikgonj, Bangladesh during the period from April to August, 2008. Green and dry neem leaf, neem oil, turmeric powder, garlic, mahagoni seed and green allamonda leaf were tested against the pest. Among the different plant materials, neem oil showed the best performance and reduced 64.37%, 84.75% and 93.47% yellow mite population over control after 24, 48 and 72 hours of spraying respectively. The percent plant infestation was also found lowest in neem oil treatment. The treatment had the lowest percent of leaf infestation 4.99%, 3.80% and 0.53% and also the highest reduction of no of nodes per plant 44.39%, 52.4% and 43.85% over control at early, mid and late stages of jute plant respectively. Neem oil increased 24.64% plant height, 27.87% base diameter over control and gave the highest amount of fibre yield (2.68 t ha^{-1}). Green and dry neem leaf extracts, turmeric powder and garlic paste also significantly reduced the mite infestation but their efficacy was not satisfactory. 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.

1. Introduction

Jute (*Corchorus capsularis* L. and *Corchorus olitorius* L.) is the most important cash crop in Bangladesh. Jute fibre and also sticks are extensively used all over the world for its versatility, durability and fineness. It is mostly grown in Indo-Bangladesh region and in some countries of the South East Asia. About 90% of the world's jute is produced in India and Bangladesh (Atwal and Dhaliwal, 2007). Jute is liable to damage by about 40 species of insects and mites at all stages of the growth from seedling to harvest (Kabir, 1975). Among them yellow mite, *Polyphagotarsonemus latus* (Banks) is one of the most common and a serious pest of jute. In Bangladesh, jute crop is frequently attacked by yellow mite, and as a result of its infestation, the plants both fibre and seed crops are severely affected. About 38% loss in fibre yield by yellow mite was estimated under field condition (Kabir, 1975). Its damage is better known as *Telenga* or *Telchita* disease in Bangladesh. It appears on jute at the end of April when the plants are about one foot tall. 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 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 chemicals in mite control programmes, alternative substances are now strongly felt in many developed countries. The biologically active natural plant products can play a significant role in this regard.

Among the botanical insecticides pyrethroids, rotenoids, nicotiniods and unsaturated isobutyl amides have been studied extensively and information relating to structure-activity relationships of these compounds is now well documented (Crosby, 1971). 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 being isolated from various plants (Adityachaudhury et al., 1985). In recent years 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 antifeedent, repellent, toxicant, insect growth inhibitors, chemo-sterillant and anti oviposition activity (Gujar, 1997). In Bangladesh, few studies have been conducted on the efficacy of neem and other plant extracts against yellow mite attack. Therefore, this study was undertaken with the objective to evaluate the comparative effectiveness of neem and other plant materials against yellow mite of jute.

2. Materials and methods

The experiment was conducted during April-August 2008 against yellow mite, *Polyphagotarsonemus latus* (Banks) in the experimental field of Jute Agriculture Experimental Station (JAES), Manikgonj, Bangladesh. The eight treatments namely; Green neem leaf extract @ 1:20 (T_1), Dry neem leaf extract @ 1:30 (T_2), Neem oil 3% (T_3), Turmeric powder extract @ 1: 40 (T_4), Garlic paste extract @ 1:30 (T_5), Mahagoni seed extract @ 1: 10 (T_6), Allamonda leaf extract @ 1: 20 (T_7) and control (T_8) in a field trial was carried out in a randomized complete block design (RCBD) with three replications. The whole field was divided into three blocks of equal size and the unit plot size was 3×2.1 m^2 having 0.75 m space between the plots and 0.3 m between the lines. Seeds of *Corchorus olitorius* jute variety-09897 were collected from the Seed Department of Bangladesh Jute Research Institute (BJRI), Manikmia Avenue, Dhaka and sown into the experimental field on April 20, 2008 in 24 plots. Three times of weeding were done at 15, 35 and 60 days after sowing (DAS). Irrigation was applied as and when necessary. Manures and fertilizers were applied as per recommendation of Muslem uddin miah et al. (2005).

Fresh green neem leaves (*Azadirachta indica*) were washed under running tap water and then air dried. Ten gram green leaves were taken into an electric blender with 200 ml water. After blending, the mixture was filtered through fine cloth and the extracts were considered as 1: 20 neem leaf extract. For the preparation of dry neem leaf extract, green leaves were dried for 7 days. 10 g dry neem leaves were soaked in 300 ml water for overnight and the extracts were filtered through fine lilen cloth to get 1:30 dry neem leaf extract. To get 1:40 turmeric powder extract, the dried turmeric was grinded by a blender and 10 g turmeric powder was soaked in 400 ml water for overnight. Ten gram of garlic was crushed and dissolved in 300 ml of water for overnight to get 1:30 of garlic paste extract. 10 g clean dried mahagoni seeds were crushed and dissolved in 100 ml water for overnight to get 1: 10 mahagoni seed extract. Similarly, the allamonda leaves were collected and washed under running tap water. Air dried fresh 10 g green allamonda leaves were taken into an electric blender with 200 ml water to get 1:20 leaf extract. All the extracts were filtered through fine cloth. Neem oil used in this experiment was collected from national tree fair, Sher-e-Bangla Nagar, Dhaka and its concentration was 100%. From this stock, 3% neem oil solution was prepared by adding 97 parts of distilled water with 3 parts neem oil. The emulsion of neem oil in water was prepared by adding 1% liquid nikalin detergent (emulsifier) as described by Mariappan and Saxena (1983). Two times of spraying was done. The first spraying was done at 30 DAS and the second was done at 45 DAS. The spraying was done in the afternoon to avoid sunlight and drift caused by strong wind.

The number of mite infested plants was counted before spray and at 3 and 7 days after spray. The number of yellow mite was counted with the help of sterio-microscope before spray and 24 hrs, 48 hrs and 72 hrs after spray. The total number of leaves and the number of mite infested leaves also counted from each of the sampled plant. The number of nodes from each of the three selected plants was noted and the number was expressed on plant^{-1} basis.The height of three selected plants was measured with a meter scale from the ground level to the top of the plants and the mean height was expressed in centimeter. The base diameter of three selected plants was measured with a ribbon meter scale from the base of the plants and the mean diameter was expressed in centimeter. After application of the treatments percent reduction of mite infested plants, mite population and number of nodes plant^{-1} were estimated. Percent increase of height and diameter of plants were calculated. After harvest, the total yield was calculated in tons hectare^{-1} and percent increase or decrease of yield over untreated control was also estimated. Data were analyzed by using MSTAT software for analysis of variance. Mean values were ranked by Duncan's Multiple Range Test (DMRT) at 5% level of significance which was used to compare the mean differences among the treatments (Gomez and Gomez, 1984).

3. Results and Discussion

3.1. Effect of neem and other plant extracts on jute yellow mite population

The effect of neem and other plant extracts on population of yellow mite was determined at different time intervals after spraying. The data in Table 1 expressed that the lowest number of yellow mite (15.00 cm^{-2}) was observed in neem oil after 24 hours of spraying, which was statistically identical with green neem leaf extract (18.67 cm^{-2}), dry neem leaf extract (18.33 cm^{-2}), turmeric powder extract (17.67 cm^{-2}), garlic paste extract (18.67 cm^{-2}), and significantly different from other treatments. On the other hand, the maximum number of mite was observed in untreated control (44.00 cm^{-2}), which was significantly different from the other treatments. After 48 hours of spraying, the lowest population of mite (7.33 cm^{-2}), was obtained in neem oil, which was statistically similar with allamonda leaf extract (7.67 cm^{-2}), green neem leaf extract (11.00 cm^{-2}), turmeric powder extract (9.33 cm^{-2}), garlic paste extract (10.00 cm^{-2}), mahagoni seed extract (11.67 cm^{-2}) and significantly different

Table 1: Mean population of yellow mite on jute leaves after different time of exposure under different treatments

Treatments	Before spray		After spray	
	A	B	C	D
Green neem leaf extract	54.67[a]	18.67[bc]	11.00[bc]	6.33[bc]
Dry neem leaf extract	51.67[ab]	18.33[bc]	12.33[b]	5.33[bc]
Neem oil	50.00[ab]	15.00[c]	7.33[c]	4.00[c]
Turmeric powder extract	50.00[ab]	17.67[bc]	9.33[bc]	6.67[bc]
Garlic paste extract	47.67[ab]	18.67[bc]	10.00[bc]	5.33[bc]
Mahagoni seed extract	41.67[b]	19.67[b]	11.67[b]	7.00[b]
Allamonda leaf extract	43.00[b]	19.67[b]	7.67[c]	4.67[bc]
Control	46.00[ab]	44.00[a]	44.33[a]	45.67[a]
CD (p=0.05)	9.62	4.02	4.01	2.66

A=No. of mite cm^{-2} before spraying; B=No. of mite cm^{-2} after 24 hrs; C=No. of mite cm^{-2} after 48 hrs; D=No. of mite cm^{-2} after 72 hrs; Same letter(s) are statistically similar at (p=0.05) by DMRT

from other treatments (Table 1). Significantly maximum number of mite was observed in untreated control (44.33 cm^{-2}), which was statistically higher than other treatments. Similarly, after 72 hours of spraying, the number of mite was minimum (4.00 cm^{-2}) in neem oil, which was statistically similar with green neem leaf extract (6.33 cm^{-2}), dry neem leaf extract (5.33 cm^{-2}), turmeric powder extract (6.67 cm^{-2}), garlic paste extract (5.33 cm^{-2}), allamonda leaf extract (4.67 cm^{-2}), and significantly different from other treatments while the untreated control treatment had the maximum number of mites (45.67 cm^{-2}) which was significantly different from other treatments (Table 1).

Figure 1 showed that significant variation was observed in case of percent reduction of mite population at 24, 48 and 72 hours of spraying of different plant materials. The percent reduction of mite population was found highest (64.37%) in neem oil, which was almost identical with dry neem leaf extract (64.13%), turmeric powder extract (64.30%) and green neem leaf extract (62.29%) after 24 hours of spraying. In contrast, the lowest percent reduction of mite population over control was observed in mahagoni seed extract (52.46%). Similarly, after 48 hours of spraying, neem oil had better performance (84.75%) in percent reduction of mite population over control while the other treatments also significantly reduced mite population over control. after 72 hours of spraying, the highest percent reduction of mite population over control was found in neem oil (93.47%) and the other treatments had significant effect on mite population reduction over control. Therefore, all the plant extracts had the significant effect in controlling mite population, but their effect was varied with concentration. Among different plant materials, neem oil at 3% concentration had the better performance for controlling mite population at all the three times of spraying. The results agree with the findings of Isman (1993), who reported that 1% neem oil and

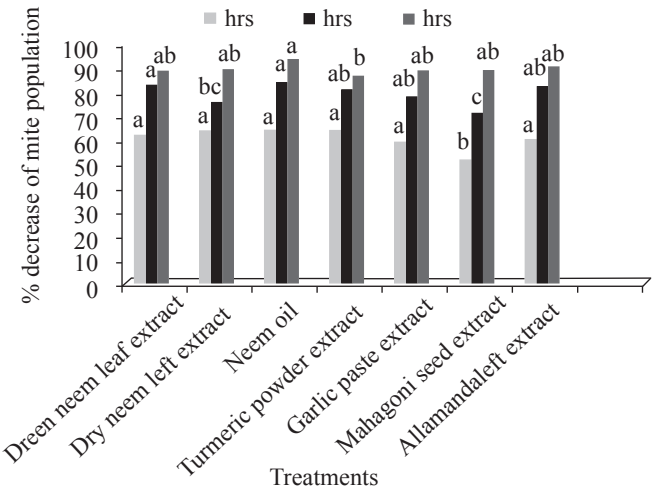

Figure 1: Mean percent reduction of mite population on jute leaves after 24 hrs, 48 hrs and 72 hrs of spraying with neem and other plant extracts

green neem leaf extracts were very much effective for reducing mite population in jute. Sanguanpong and Schmutterer (1992) showed that cold pressed neem oil reduced the fecundity of mites on treated plants and the survival of nymph hatched from treated eggs and thus reduced the mite population. They also reported that neem oil in sublethal concentration caused growth disrupting effects on the nymphal stage and ovicidal effects. Therefore, this finding supported the results obtained in the present study.

3.2. Effect of neem and other plant extracts on yellow mite infested jute plants

The number of mite infested plant was significantly varied in different treatments against yellow mite attack. The lowest number of mite infested plant (22.67) was found in neem oil treatment having no significant difference with mahagoni seed extract (24.33), garlic paste extract (28.66) and green neem leaf extract (28.67), respectively after 3 days of spraying. While the highest number of mite infested plant was found in untreated control treatment, which was signigicantly different from that of the other treatments (Table 2). Considering percent plant infestation, neem oil showed the best performance having minimum mite infestation (11.01%) followed by mahagoni seed extract having 12.71% mite infestation of plant. Similarly after 7 days of spraying with neem and other plant extracts, the number of mite infested plant (9.00) and percent plant infestation (4.36%) were the lowest in neem oil, which were statistically identical with mahagoni seed extract (10.33) and (5.40%), respectively regarding these parameters but significantly different from other treatments. On the other hand, the number of mite infested plant (81.00) and percent plant infestation (41.80%) were the highest in untreated control, which were significantly different from other treatments (Table 2).

Figure 2 illustrated that all the plant material extracts significantly reduced the mite infestation over control.

However, the best results were found by application of neem oil and mahagoni seed extracts. Neem oil showed the best efficacy against yellow mite attack and reduced mite infested plants 77.79% and 91.26%, respectively after 3 days and 7 days of application. Among the other plant extracts, garlic showed better performance in reducing yellow mite infestation of jute. On the other hand, the lowest results (58.94%) and (75.48%) were found in green neem leaf extract and allamonda leaf extract after 3 days and 7 days of application, respectively (Figure 2). However, the efficacy of neem oil and neem leaf extracts have been reported by other researchers against mite. Banu and Singh (2007) reported the efficacy of neem oil and green neem leaf extracts against yellow mite which supported this findings.

The data in Table 3 expressed that the lowest percent leaf infestation (4.99%) was recorded from neem oil having no significant difference with green neem leaf extract (8.24%), dry neem leaf extract (8.70%), garlic paste extract (9.81%), and mahagoni seed extract (6.61%) at early stage but significantly different from other treatments. The highest percent of leaf infestation (39.83%) was observed in untreated control and was significantly different from other treatments. At middle stage of the crop growth, the lowest percent leaf infestation (3.80%) was observed in neem oil, which was significantly similar with green neem leaf extract (5.99%), mahagoni seed extract (5.00%) and allamonda leaf extract (5.67%). On the other hand, the highest percent of leaf infestation (39.83%) was observed in untreated control, which was significantly different from other treatments. At late stage of crop growth, the lowest percent of leaf infestation (0.53%) was observed in neem oil, which was significantly similar with green neem leaf extract (1.11%), and mahagoni seed extract (1.08%) treatment but significantly different from other treatments. In contrast, the highest percent of leaf infestation (15.20%) was observed in untreated control and was significantly higher than other treatments (Table 3). The similar effect of neem was reported by Rovesti and Desco (1990). Table 3 also indicated the effects of different plant extracts on the number of nodes plant^{-1} at different growth stages of plant. At early stage, the lowest number of nodes plant^{-1} (20.00) was observed in neem oil having no significant difference with mahagoni seed extract (21.67) while the untreated control had the highest number of nodes plant^{-1} (36.00), which was significantly different from other treatments. At middle stage, it was observed that neem oil had the lowest number of nodes plant^{-1} (35.67), which was statistically identical with mahagoni seed extract (37.00). On the other hand, the untreated control had the highest number of nodes plant^{-1} (75.00), and it was statistically different from other treatments. At late stage of the crop, the lowest number of nodes plant^{-1} (53.33) was observed in neem oil, which was statistically different from other treatments. On the other hand, the highest number of nodes plant^{-1} (95.00) was observed in untreated control, which was statistically different from other treatments.

Figure 3 illustrated that the percent reduction of nodes plant^{-1} over control was the highest (44.39%) in neem oil, which was

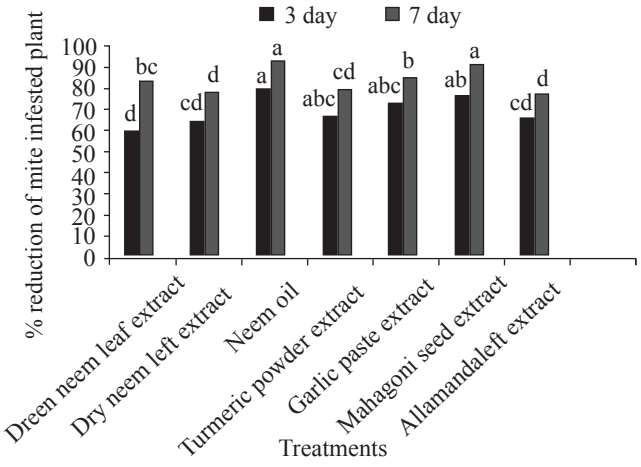

Figure 2: Average percent reduction of mite infested plants after 3 days and 7 days of spraying with neem and other plant extracts

Table 2: Average number of mite infested plant and percent plant infestation after spraying of neem and other plant extracts

Treatment	Before spray		3 days after spray		7 days after spray	
	No. of mite infested plant	% infestation	No. of mite infested plant	% infestation	No. of mite infested plant	% infestation
Green neem leaf extract	93.00^{ab}	48.76^{ab}	28.67^{bc}	15.15^{bc}	17.00^{c}	8.95^{bc}
Dry neem leaf extract	91.33^{ab}	43.50^{b}	33.33^{b}	15.87^{bc}	21.67^{bc}	10.31^{bc}
Neem oil	101.7^{a}	49.45^{ab}	22.67^{c}	11.01^{d}	9.00^{d}	4.36^{e}
Turmeric powder extract	93.33^{ab}	45. 67^{ab}	31.00^{b}	15.10^{bc}	19.67^{bc}	9.58^{bc}
Garlic paste extract	101.7^{a}	51.61^{a}	28.66^{bc}	14.55^{bd}	16.33^{c}	8.29^{cd}
Mahagoni seed extract	98.33^{a}	51.34^{a}	24.33^{c}	12.71^{cd}	10.33^{d}	5.40^{de}
Allamonda leaf extract	96.67^{ab}	50.06^{a}	34.67^{b}	17.97^{b}	23.67^{b}	12.28^{b}
Control	87.33^{b}	45.69^{ab}	83.33^{a}	43.00^{a}	81.00^{a}	41.80^{a}
CD (p=0.05)	9.67	5.57	5.57	3.44	5.12	3.08

Table 3: Mean percent leaf infestation by yellow mite and number of nodes plant^{-1} at early, mid and late stages of the crop under different treatments

Treatments	% leaf infestation			Number of nodes plant^{-1}		
	Early stage (35 DAS)	Mid stage (80 DAS)	Late stage (120 DAS)	Early stage (35 DAS)	Mid stage (80 DAS)	Late stage (120 DAS)
Green neem leaf extract	8.24^{c}	5.99^{bc}	1.11^{cd}	24.00^{e}	46.67^{d}	61.33^{e}
Dry neam leaf extract	8.70^{c}	7.24^{b}	3.01^{b}	28.00^{c}	50.67^{c}	66.00^{cd}
Neem oil	4.99^{c}	3.80^{c}	0.53^{d}	20.00^{f}	35.67^{e}	53.33^{g}
Turmeric powder extract	11.07^{b}	7.70^{b}	3.19^{b}	26.00^{d}	50.67^{c}	66.33^{c}
Garlic paste extract	9.81^{bc}	6.98^{b}	2.93^{b}	26.00^{d}	49.33^{cd}	64.33^{d}
Mahagoni seed extract	6.61^{c}	5.00^{bc}	1.08^{cd}	21.67^{f}	37.00^{e}	56.00^{f}
Allamonda leaf extract	14.95^{b}	5.67^{bc}	3.84^{b}	31.33^{b}	55.67^{b}	68.67^{b}
Control	39.83^{a}	26.00^{a}	15.20^{a}	36.00^{a}	75. 00^{a}	95.00^{a}
CD (p=0.05)	5.64	2.46	1.08	1.82	2.94	1.85

significantly similar with mahagoni seed extract (39.73%) treatment at early stage. On the other hand, the lowest percent reduction of nodes plant^{-1} over control was observed in allamonda leaf extract (12.94%)), which was significantly different from other treatments. Similarly, at middle stage, neem oil treatment had better performance in percent reduction of nodes plant^{-1} (52.4%) over control and other treatments also showed significantly reduced number of nodes plant^{-1} over control. At late stage of the crop, neem oil at 3% concentration had better performance in reduction of nodes plant^{-1} (43.85%) over control and other treatments also had significant effect on nodes plant^{-1} reduction over control. Therefore, all the plant extracts had the significant effect in controlling nodes plant^{-1} but their effect was varried with concentration. Among different plant materials, neem oil at 3% concentration had the better performance for reducing nodes plant^{-1} at all the three stages. Severe infestation of mite on jute plant causes defoliation and stunting of plant growth. As a result growth stunting, number of nodes increased and the quality of the fibre decreased. Application of neem and other plant extracts reduced mite infestation and increased plant height that decreased the number of nodes within a unit area. The effectiveness of neem products in the present study was in accordance with the findings observed by Pande et al. (1987).

The data (Table 4) revealed that the highest plant height (2.95 m) was observed in neem oil, which was significantly different from other treatments. On the other hand, the lowest plant height (2.37m) was observed in untreated control, which was significantly different from other treatments. Percent increase of plant height over control was presented in Table 4. The highest percent increase of plant height over control (24.64%) was observed in neem oil treatment, which was significantly different from other treatments. On the other hand, the lowest percent increase of plant height over control (8.75%) was observed in allamonda leaf extract, which was significantly different from other treatments. The effect of neem oil on increasing plant height as observed in the present study being

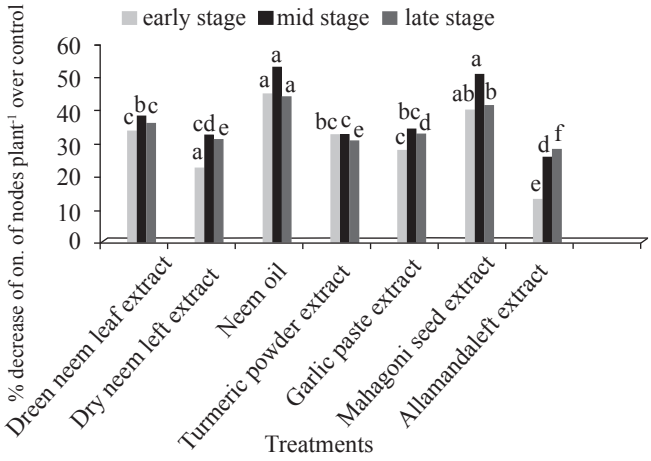

Figure 3: Mean percent reduction of number of nodes plant^{-1} over control at early, mid and late stages of the crop under different treatments

in confirmity with findings reported by Palaniswamy and Ragini (2003) against yellow mite on chilli. They observed that 5% aqueous extract of neem leaf reduced mite population on chilli and increased plant height. Table 4 also indicated that the highest base diameter (15.68 mm) was found in neem oil, which was significantly similar with mahagoni seed extract (15.08 mm) but significantly different from other treatments. In contrast, the lowest base diameter (12.27 mm) was found in untreated control, which was significantly different from other treatments. Percent increase of base diameter over control (27.87%) was observed in neem oil, which was significantly different from other treatments while the lowest percent increase of base diameter over control (12.65%) was observed in allamonda leaf extract, which was significantly different from other treatments.

3.3. Effect of neem and other plant extracts on fibre yield of jute

The highest yield of fibre (2.68 t ha^{-1}) was obtained in neem oil, which was significantly different from other treatments. Mahagoni seed extract gave the fibre yield 2.6 t ha^{-1}, which

Table 4: Mean plant height and base diameter of jute stem at harvesting stage, yield of jute fibre and their percent increase over control under different treatments

Treatments	Plant height (m)		Base diameter		Yield	
	At harvest	Increase over control (%)	At harvest	Increase over control (%)	Fiber yield t ha^{-1}	Increase over control (%)
Green neem leaf extract	2.80^{c}	18.16^{c}	14.58^{b}	18.90^{c}	2.50^{c}	35.17^{c}
Dry neam leaf extract	2.72^{de}	14.67^{d}	14.10^{bc}	14.96^{e}	2.26^{e}	24.33^{e}
Neem oil	2.95^{a}	24.64^{a}	15.68^{a}	27.87^{a}	2.68^{a}	44.76^{a}
Turmeric powder extract	2.67^{e}	12.89^{e}	14.22^{bc}	15.91^{de}	2.18^{f}	18.07^{f}
Garlic paste extract	2.73^{d}	15.35^{d}	14.37^{bc}	17.14^{d}	2.40^{d}	29.74^{d}
Mahagoni seed extract	2.87^{b}	20.97^{b}	15.08^{ab}	22.99^{b}	2.60^{b}	40.60^{b}
Allamonda leaf extract	2.58^{f}	8.75^{f}	13.82^{c}	12.65^{f}	2.05^{g}	10.88^{g}
Control	2.37^{g}	--	12.27^{d}	--	1.83^{h}	--
CD (p=0.05)	0.06	1.47	0.19	1.36	0.05	3.58

was significantly lower than neem oil but higher than other treatments. The lowest fibre yield (1.83 t ha^{-1}) was obtained from untreated control. Similarly, the highest fibre yield was increased (44.76%) in neem oil treated plots followed by mahagoni seed extract (40.60%) and significant difference was observed between them. Allamonda leaf extract showed the lowest efficacy (10.88%) regarding this parameter (Table 4).

The results clearly demonstrated that application of all the plant extracts significantly increased fibre yield of jute. However, neem oil followed by mahagoni seed extract showed the best performance. These results supported the findings of Banu and Singh (2007) who reported the highest efficacy of neem oil against jute mite. The efficacy of mahagoni seed extract could not be compared due to lack of available information. However, these results may vary with that of others due to extraction procedure, application methods, environmental factors etc.

4. Conclusion

From the above results, it might be concluded that the neem oil at 3% concentration had significant effect on reduction of yellow mite and increased yield contributing characters of jute as well as produced the highest fibre yield.

5. References

Adityachaudhury, N.A., Bhattacharyya, A., Chowdhury, Pal, S., 1985. Chemical constituents of plants exhibiting insecticidal, anti-feeding and insect growth regulating activities. Journal of Scientific Industrial Research 44, 85-101.

Atwal, A.S., Dhaliwal, G.S., 2007. Agricultural pests of South Asia and their management. Kalayani publishers, Ludhiana, India, 235.

Banu, H., Singh, P.K., 2007. Integrated Management of Jute Pest. Appllied Environmental Ecology 28(2), 186-203.

Crosby, D.G., 1971. Naturally occurring insecticide. Marcel Dekker, New York, 73-100.

Gomez, K.A., Gomez, A.A., 1984. Statistical Procedures for Agricultural Research. 2nd edition. International Rice Research Institute, John Willey and Sons, Inc. Singapore, 139-240.

Gujar, G.T., 1997. Neem (*Azadirachta indica*, A. Juss), a natural insecticide: Status and need for bioassay standards. Journal of Pesticide Research 4(2), 69-79.

Isman, M.B., 199. Growth inhibitory and antifeedant effects of azadirachtin on six noctuids of regional economic importance. Pesticide Science 38(1), 57-63.

Kabir, A.K.M.F., 1975. Jute pest of Bangladesh. Annual Report. Bangladesh Jute Research Institute, Dhaka, Bangladesh, 28-33.

Mariappan, V., Saxena, R.C., 1983. Custard apple oil and neem oil mixture: effect on survival of *Nephotettix virescens* and on rice tungro virus transmission. *Abstract* 2nd International Neem Conference, Raisch Holzhausen Castle, May 25-28.

Miah, M.M., Jahiruddin, M., Islam, M.F., Razia, S., 2005. Fertilizer Recommendation Guide-2005. Bangladesh Agricultural Research Council, Dhaka, Bangladesh, 78-81.

Palaniswamy, S., Ragini, J.C., 2003. Influence of certain plant extracts on yellow mite *polyphagotarsonemus latus* (Banks) on chillies. Insect Environment 6(1), 25-26.

Pande, Y.D., Majumdar, M., Roy, H.L., 1987. Laboratory evaluation of various concentration of neem (*Azadirachta indica*) leaf extract against *Tetranychus neocaledonicus* Andre infesting okra in Tripura. First Natural Seminar on Acarology, Kalyani, West Bengal, Oct. 29-31.

Sanguanpong, U., Schmutterer, H., 1992. Laboratory stydies on the effect of neem oil and neem seed extracts on the spider mite *Tetranychus urticae Koch* (Acari: Tetranychidae). Zeitschrift Fiupfanzenkrankheiten Pflanzenschutz. 99(6), 637-646.

Saxena, R.C., 1989. In: Insecticides of plant origin Philogene B.J.R., Morand, P., ASC Symposium Series 387, Washington, D.C., 110-135.