EFFECTIVENESS OF SOME PLANT MATERIALS AGAINST JUTE YELLOW MITE, *Polyphagotarsonemus latus* ON C*orchorus olitorius*

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Dedicated To
Almighty ‘Allah’
&
loving Parents and
Teachers

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CERTIFICATE

This is to certify that thesis entitled, **"EFFECTIVENESS OF SOME PLANT MATERIALS AGAINST JUTE YELLOW MITE, *Polyphagotarsonemus latus* ON *Corchorus olitorius*"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science (MS) in Entomology,** embodies the result of a piece of bona fide research work carried out by **Benjir Akter**, **Registration No 15-06873** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

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ABSTRACT

In order to study the effectiveness of some plant materials against jute yellow mite, *Polyphagotarsonemus latus* (Banks) on *Corchorus olitorius* (O-9897) experiments were conducted in the greenhouse premises and in the field of Bangladesh Jute Research Institute during the period from March to October 2016. In the greenhouse premises, the highest percent mortality 69.39%, 67.77%, 63.86%, 62.43% and 61.47% @ 1:20 were recorded from neem seed kernel extract, mehogony seed extract, pithraj seed extract, turmeric powder extract and green neem leaf extract, respectively. In field experiment, highest percent reduction of infestation over control (70.20%), lowest number of nodes per plant (52.50), highest plant height (3.10 m), and highest percentage of yield increased (38.60%) over control were observed in the plot treated with neem seed kernel extract. In conclusion, neem seed kernel extract, mahogany seed extracts, pithraj seed extract, green neem leaf extract and turmeric powder extract @ 1:20 can be used safely by the farmers as component of Integrated Pest Management (IPM) Program of jute.

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CHAPTER I

INTRODUCTION

Jute, a fibre crop of international eminence, is the most important cash crop and foreign exchange earner of Bangladesh. It is cultivated for its phloem fibre, which yields the strongest and most durable fibre of commerce. Jute fibre 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. Our agricultural community is dependent to a large extent on jute and jute products. Jute was 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. Jute ranks second only to cotton among all the natural fibre in case of production (Talukder *et al*. 1989). It has been reported that about 90% of World's jute produced in Bangladesh and India (Atwal, 1976). With respect to production, Bangladesh ranks second among the jute growing countries of the world. The land and climatic conditions of Bangladesh are congenial to the production of good quantity of jute and two species *Corchorus capsularies L.* and *Corchorus olitorius L*. are cultivated for fibre. In Bangladesh, about 6.73 lac hectares of land are under jute cultivation and the total yield is 1633152.65 metric ton (BBS, Agriculture 2015). It is worthy to note that 100 thousand traders and 250 thousand industrial labours earn their livelihood from the jute business (Khandaker, 1987).

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 (*Corchorus spp.).* In Bangladesh, jute crop is frequently attacked by yellow mite, and as a result of its infestation, the plant is severely affected. About 38% loss in fibre yield by yellow mite was estimated under field condition (Kabir, 1975). The yellow mite of jute commonly known as yellow tea mite is a very destructive pest and causes damage to both fibre and seed crops. 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 feet tall. The jute yellow mite becomes active in mid-May (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 males 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, alternative substances are now strongly felt in many developed countries. The biologically active natural plant products can play a significant role in this regard. These products may help to keep the drawbacks of conventional methods within bounds. Plant products are environmentally safe, less hazardous, less expensive, biodegradable and readily available.

Many plants exhibiting pesticidal properties have been known since time

of immemorial. 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). 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 antifeedant, repellent, toxicant, insect growth inhibitors, chemosterillant and anti oviposition activity (Gujar, 1992).

In Bangladesh, few studies have been conducted on the efficacy of different plant materials against yellow mite attack. Therefore, an attempt has been made to provide information for using plant materials as input for the control of yellow mite. Thus, the study was undertaken to fulfill the following objectives:

- To identify the effective plant materials for the control of jute yellow mite.
- To evaluate the efficacy of different plant materials against jute yellow mite and
- To determine the effective doses of selected plant materials against jute yellow mite infestation.

CHAPTER II

REVIEW OF LITERATURE

2.1 Yellow mite (Broad mite)

The yellow mite, *Polyphagotarsonemus latus*, was first described by Banks, (1904) as *Tarsonemus latus* from the terminal buds of mango in a greenhouse in Washington, D.C., USA (Denmark, 1980). This species has a large host range world-wide.

2.2 Description

Eggs: The eggs are colorless, translucent and elliptical in shape. They are about 0.08 mm long and are covered with 29 to 37 scattered white tufts on the upper surface (Denmark, 1980; Pena and Campbell, 2005; Baker, 1997).

Larvae: Young broad mites have only three pairs of legs. They are slow moving and appear whitish due to minute ridges on the skin (Peña and Campbell, 2005). As they grow they range in size from 0.1 to 0.2 mm long (Anonymous, 2005).

Nymph: After one day, the larva becomes a quiescent nymph that is clear and pointed at both ends. The nymphal stage lasts about a day. Nymphs are usually found in depressions. Female nymphs are often carried by males (Pena and Campbell, 2005).

Adults: Female mites are about 0.2 mm long and oval in outline. Their bodies are swollen in profile and a light yellow to amber or green in color with an indistinct, light, median stripe that fork near the back end of the body. Males are similar in color but lack the stripe. The two hind legs of the adult females are reduced to whip-like appendages. The male is smaller

(0.11mm) and faster moving than the female. The male's enlarged hind legs are used to pick up the female nymph and place her at right angles to the male's body for later mating (Pena and Campbell, 2005).

2.3 Biology and life cycle

The yellow mite has four stages in its life cycle: egg, larva, nymph and adult. Adult females lay 30 to 76 eggs (averaging five per day) on the undersides of leaf surface and in the depressions of small fruit over an 8 to

Plate 1: Egg and nymph of jute yellow mite

Plate 2: Magnified picture of mite

13-day period and then die. Adult males may live 5 to 9 days. While unmated females lay male eggs, mated females usually lay four female eggs for every male egg. The eggs hatch in two or three days and the larvae emerge from the egg shell to feed. Larvae are slow moving and do not disperse far. After two or three days, the larvae develop into a quiescent larval (nymph) stage. Quiescent female larvae become attractive to the males which pick them up and carry them to the new foliage. Males and females are very active, but the males apparently account for much of the dispersal of a mite population in their frenzy to carry the quiescent female

larvae to new leaves, when females emerge from the quiescent stage, males immediately mate with them (Anonymous, 2005; Baker, 1997; Pena and Campbell, 2005). There are also reports of the broad mite using insect hosts, specifically some whiteflies species, to move from plant to plant (Palevsky *et al*, 2001).

Female *P. latus* lays 30 to 76 eggs on the leaf surface over an 8- to 13-days oviposition period. The larvae hatch in 2 or 3 days and emerge from the egg shell to feed. Larvae are slow moving and do not disperse far. In 2 or 3 days, the larvae develop into a quiescent larval stage. Quiescent female larvae become attractive to the males which pick them up and carry them to the new foliage. Males live 5 to 9 days; females live 8 to 13 days.

2.4 Origin and distribution of yellow mite

P. latus has a worldwide distribution and is known by a number of common names. It is found in Australia, Asia, Africa, Europe, North America, South America, and the Pacific Islands. In India and Sri Lanka it is called the "yellow tea mite," while those in Bangladesh call it the "yellow jute mite." In some European countries it is called the "broad spider." In parts of South America it is called the "tropical mite" or the "broad rust mite" (Anonymous, 2005).

2.5 Host range

The yellow mite has a wide host range in tropical areas. It attacks greenhouse plants in temperate and subtropical regions (Pena and Campbell, 2005). Crops listed as hosts include: apple, avocado, cantaloupe, castor, chili, citrus, coffee, cotton, eggplant, grapes, guava, jute, papaya, passion fruit, pear, potato, sesame, string or pole beans, mango, tea, tomato (Pena and Campbell, 2005). It was identified for the first time on

watermelons in the U.S.A in 2006 (Pons, 2007). Broad mites infest many ornamentals, including African violet, ageratum, azalea, begonia, chrysanthemums, cyclamen, dahlia, gerbera, gloxinia, ivy, jasmine, impatiens, lantana, marigold, peperomia, pittosporum, snapdragon, verbena, and zinnia (Baker, 1997).

The broad mite is considered a serious pest of *Pittosporum* spp. in Florida (Johnson and Lyon, 1991).

2.6 Nature and extent of damage

This mite is considered a sub-major pest at low elevations in summer months. Mites feed by piercing plant cells and sucking up the sap that oozes from the wound (Waterhouse and Norris, 1987). Reduction in photosynthesis and instability of water balance are some of the damaging effects to plants. Feeding damage also causes terminal leaves and flower buds to become cupped and distorted. As a result of feeding injury, corky brown areas appear between the main veins on the underside on the leaf. Young foliage sometimes becomes rust colored and nearly always is deformed. Blooms abort, and the plant growth is stunted. Damaged leaves often become discolored, thickened and brown (Lacob, 2007).

Damage of flowers and fruits differ among plants. On macadamia, flowers and leaves may appear corky brown or bronze colored. On lemon fruits, feeding results in silvering of the fruit that greatly reduces the market value even though the fruit is otherwise unaffected (Waterhouse and Norris, 1987). On beans, extensive feeding on fruit results in a purplish or dark brown appearance of the pods.

The broad mite does not vector of any known plant virus diseases (Waterhouse and Norris 1987; Higa and Namba, 1970).

2.7 Behavior of broad mite

Larvae and adults prefer to feed on the undersides of leaves usually in the vicinity of the egg. The adult males have a specialized last pair of legs and are often seen carrying a female pupa over its body. Male pupae are usually not moved, but migrate to new leaf growth carrying a developing female pupa soon after the adult male emerges (Hill, 1983). The males often carry the pupae to newly opened leaves. Copulation occurs immediately after the female has emerged from the pupal skin.

Relative to the males, females are relatively sedentary (Waterhouse and Norris, 1987), but the species is generally considered fast moving (Brown and Jones, 1983).

2.8 Effect of different plant extracts for controlling mite pest

Banu (2007) conducted an experiment to compare some non-chemical approaches to control jute yellow mite and jute hairy caterpillar in greenhouse and field condition during 2004-2006, In greenhouse condition, double spray of green neem leaf extract @ 1:20 and dry neem leaf @ 1:50 was found to be effective and gave 74.63% and 70.83% mortality 72 hr after treatment on potted plants. However, in field condition, double spray of green neem leaf extract and dry neem leaf extract gave 67.70 % and 72.20% reduction of infestation 7th day after spray. The fibre yield was also increased by 19.9% for green leaf extract and 35.9% for dry neem leaf over the control treatment, respectively. In addition, hand picking method was found to be effective, easiest, economic and eco-friendly.

Banu and singh (2007) studied the effect of neem leaf extracts (dry and green) in green house and field condition during the period from 2003-05

against jute yellow mite. Dry neem leaf @ 1:50 and green neem leaf @ 1:20 gave 62% and 64% mortality, respectively. Fibre yield was increased by 39.95% and 35.93% over the control treatment.

Pasini el al. (2003) Observed that the effect of a commercial formulation of neem oil at different stages of the life cycle of red mite of paraguaytea showed that the formulation was efficient in controlling adults. Azadirachiin also affected the fecundity of the female mites.

Palaniswamy and Ragini (2003) sprayed 5% aqueous extracts of *Adathoda vasica. Vi/ex negundo, Azadirachta indica, Aristolochia bracteata, Lippia nodi (flora, Argemone inexicana sansevieria* sp. and *Aloe* sp. on chilies 30 days after transplanting in Tamil Nadu, India. The polyphagotersonemus latus populations were reduced and Aloe sp. also recorded to be the lowest population at 0.67 mites leaf^{-1}.

Sanguanpong and Sehmutterer (1992) found that pentanc extract and cold pressed neem oil reduced the fecundity of the mites on treated plants and the survival of nymph hatched from treated eggs. Application of pentane extract or neem oil in sublethal concentration caused growth disrupting effects on the nymphal stages and ovieidal effects.

Pande *et al.* (1987) they found neem leaf extract 1% and neem seed kernel 5% to be effective against tetranychus neocaledonicus and Tetranychus urticae respectively.

2.9 Effect of different plant extracts on different insect pests

Jagjeet *et al* (2005) treated pigeon pea seeds with 11 seed protectants, i.e. neem seed kernel powder at 20g, neem oil at 10 ml, mustarded oil and groundnut oil each at 7.5ml, turmeric powder at 3.5g, mustard oil+turmeric powder at 3.75ml+l.75g, groundnut oil+turmeric powder at 3.75ml+l.75g each per one kg of seed, covering 4m with each of seed, dung cake ash,

sawdust and wheat husk and mixed them with half kg of seed by shaking it manually All the seed protectants, except for sawdust and turmeric powder, recorded significantly higher adult mortality than the control after the first day of treatment. Neem oil was effective (64.33% adult mortality) up to 35 DAT and it were followed by mustered oil+turmeric powder; which recorded only 16.33% adult mortality While other treatments were not effective.

Zhu *et al* (2004) observed biological activity of azadirachtin on rice stem borer, *Chilo suppressalis*. After feeding on water-oats treated with 0.75 and 0.50mg azadirachtin/litre, the third instar larvae were completely dead in 3 and 6 days respectively Mortality of the newly hatched *C. suppressalis* reached 100% within 24h after treatment with 6, 3, and 2mg azadirachtin/lit.

Maisary *et al.* (2004) examined the effect of neem oil on the 2nd and 4th instars and eggs of Culex pipiens under laboratory condition. 46.98% of C. pipiens were killed upon exposure to 1000ppm of neem oil. The lower concentration (10ppm, 100ppm) showed little efficiency on the eggs. The continuous treatment of the 2nd and 4th instars with neem oil (100ppm) caused high mortality and complete inhibition of the formulation of mature instars. It is concluded that in general, exposure to neem oil for a short period (24 and 48 hours) is less effective as compared with continuous.

Rahman *et al* (2003) conducted an experiment to evaluate five indigenous plants seed oils viz Castor, Neem, Pithraj, Safflower and Sesame at concentration of 1, 2, 3, 4, and 5% revealed that al the plant seed oils have grain protectant value against lesser meal worm The results showed that sesame and neem oil were more effective than Castor, Pithraj and Safflower oils The tested seed oils provided good protection for wheat grains.

Eungwijarupanya *et al.* (2002) tested neem extracts containing 0.185% azadirachtin at 3 concentrations 100ml, 200ml and 300ml diluted in 5 litres of water, These were applied using a thermal fogger to a 15 years old teak (*Tectona grandis*) for control of teak defoliator, *Hybiaea puera*. After application larvae were collected and reared in the laboratory to observed mortality. One day after fogging mortality started to increase for these treated with 200ml and 300ml/5L concentrations and all larvae died within 6 days when treated with 300ml/5L.

Padmasheela and delvi (2002) tested a commercial formulation of neem oil EC (Nimbex, 0.03%) at different concentration viz. 25ppm, 50ppm, 75pmm, and l00ppm for mortality effects against grubs of *Oryctes rhinoceros* (a coconut pest) at laboratory conditions In feeding toxicity test, neem oil at concentrations of 50ppm, 75ppm, and l00ppm caused 20%, 45% and 90% mortality respectively on exposure up to 96hr and l00ppm caused 90.67% mortality of *Oryctes rhinoceros* grubs.

Qureshi *et al* (2002) investigated the direct effect of neem extracts on the adult glass beetle, *Costelytra zealandica* where laboratory bioassay showed that neem caused only low mortality even at the highest dose.

Karmakar and Bhole (2001) observed the efficacy and persistent toxicity of some neem products- neem oil, and nimbicidine against adult of *Epilachna dodecastigma*, the treatments with 2% neem oil and 2% nimbicidine resulted 90.69% and 71.90% mortality respectively.

Shaminathan and Jayaraj (2001) conducted two experiments to evaluated botanical pesticides like Ipomoea leaf extracts, neem oil and madhuca oil (at 0.3% or 3.0% each) against *Perrisia virgate*. The leaf dip method was used in both experiments and pest mortality was recorded at 24hr, 48hr and 72 hr after treatments. In experiments 1, treatments with 3% neem oil

recorded the highest mortality (43.13%). Neem recorded 50% mortality at 72hr, and in experiment 2, at 48hr, fortified (0.3%) neem oil recorded a maximum mortality of 49.3% and at 72hr, fortified neem recorded 63.6% mortality. Arcos *et al.* (2001) conducted that the effect of neem oil was evaluated by using concentrations of 0.5, 1.0, 1.5, 2.0, and 3.0%. They mainly showed that mortality recorded by ingestion was attributed to starvation. Filter paper soaked with neem oil inhibited feeding of *I. marginipennis*.

Rani *et al.* (2000) investigated the efficacy of cotton seed, neem, palm, rice bran and soybean oils as seed coating against pulse beetle, *Callosobruchus chinensis* infesting Chickpea and found that neem oil at 1 ml/kg of seeds gave the highest adult mortality (65%) three days after treatment.

Ranjana *et al.* (2000) tested five plant extracts from *Azadirachta indica* karnels, Bulbs of *Allium sativum* and *Citrus sinensis* rech, *Citrus limm* peels and *Mangirfera indica* leaves each having three concentration (1%, 1.5% and 2%) against pulse beetle, *C. maculatus*. The petroleum ether extract of neem kernel was most effective as 1.5% and 2% level showed 50% and 61.11% mortality.

Sharma (1999) reported that neem seed (*Azadirachtin indica*) kernel powder at 4% and neem leaf powder at 5% protected maize for 5 moths against *Sitophilus oryzae*, *Sitotroga cerealella*, *Rhyzopertha dominica* and *Trogoderma granarium*. Neem oil (Neembicidine 2%) effectively reduced the emergence of F1 and F2 progeny of all the pests and completely protected maize up to 9 months and suggested that neem products can be mixed with stored maize to protect the grains up to 9 months from the attack of this major pest.

Reddy *et al* (1999) stated that application of neem oil (Azadirachtin), Karanja oil (*Pongamia glubra*), Mahua oil (*Madhuca lalifolia*) and palmolein oil (*Elaeis gaineenis*) at dosages of 0.5% and 1.0% level effectively protected green gram from *C.chinensis*. Neem oil at 1% level was the best protected followed by palmolein, Karanja and mahua oils. These oils also exhibited contact toxicity and no adults could survive in neem treated green gram at 5% concentration.

Mayabini (1997) studied the efficacy of neem bark decoction, neem based chemicals and neem derivatives (neem oil, leaf extract and leaf decoction) against rice leaf folder *Cnaphalocrosis medinalis*. Ail were applied as foliar sprays to pot-grown rice plants Leaf area fed by the larvae was recorded after 48 hours. Neem bark decoction appeared to be a very effective botanical for controlling the rate of feeding and reducing the rate of population.

Naganagouda *et al* (1997) conducted a field study to determine the efficacy of various insecticides and neem products for the control of *Nilapaevata lugens, Sogatella furcifera, Cnaphalocrosis medinahs* and *Scirpophaga incertulas* on rice Monocrotophos was the most effective insecticide in terms of giving the highest yield followed by neem oil and Nimbicidin.

Deka and Hazarika (1997) observed that neem (*Azadirachta indica*) seed oil (NSO) acted as a potential antifeedant against adult of the chrysomelid, *Dicladispa armigera* Under laboratory conditions, daily consumption of fresh rice leaves was 1.05 g, 0.08 mg, which was reduced by 50% when leaves were treated with 6.46% NSO.

Raguraman and Rajasekaran (1997) stated the effect of neem oil and neem seed bitters applied at different concentrations as either high volume, low volume or ultra-volume sprays to the rice brown plants hopper,

Nilaparvata lugens. All neem products affected the orientation, probing and feeding time, food ingested and growth and development of *Nilaparvata lugens*.

In a laboratory study Haque *et al* (1996) found that when first and third instars larvae and adults of *Epilachna dodecastigma* were expresed to 0.25, 0.50, 1.0 or 2.0% neem (*Azadirachta indica*) oil applied on brinjal leaf discs, all the first instar larvae were killed at the concentrations before feeding and the feeding activity of third instar larvae and adults decreased with increasing oil concentration.

Braman (1993) observed antifeedant effects of azadirachtin in nymphal tawny mole crickets, *Scapteriscus vicinus* Scudder, in laboratory tests. Crickets surviving treatment grow more slowly and tunneled less than their untreated counterparts.

Islam (1993) determined the comparative efficacy of azadirachtin, the major active ingredient in neem, as a feeding deterrent for six species of noctuidae of economics importance, the black army worm, *Actebta femtica* Tansch, bertha army worm, *Manestra configweata* Walker, variegated cutworm, *Peridroma sancia* Hubner, *zebra caterpillar, Melancra picta* Harr, Asian armyworm, *Spodoptera litura* Fab and the cabbage looper, *Trichoplusia ni* Hubner Fourth instar larvae of *Spodoptera litura* was the most sensitive to the antifeedant effects of azadirachtin whereas *Actebia fermica* was the least.

Nesseh *et al.* (1993) tested the repellent effect of neem oil on adults of *Schistocerca gregaria*. They found that *Schistocerca gregraria* consumed 100% of the leaves of the untreated plant, while the adults started feeding on treated plant after 24 hours of the application.

The antifeedant properties of the seeds of some meliaceous plants were reported by Chiu-ShinFoon and Qiu-Yu-Tong (1993). In their experiments with neem seed oil and petroleum ether extracts of the seed kernels of two species of china berry they demonstrated their potentials as strong antifeedant against nymphs of brown plant hopper, *Nilaparvata lugens.*

Salsoloy and Embuido (1992) evaluated neem oil for its insecticidal action on cotton boll worm, *Helicoverpa armigera* Hubner The oil applied along sprayed on cotton and the effects were compared Neem oil; sprayed on cotton gave poor control of the pest

Salem (1991a) found that 100 ppm concentration of neem oil extract was the most effective extract against larval feeding of potato tuber moth, *Phthorimaea operculella* Zell.

Salem (1991b) tested pure neem seed oil against the cotton boll worms, *Pectinophora gossypiella* Saund and *Earias insulana* Boisd. The most active concentration caused reduction in the percentage of infestation nearest to 150 ppm. The percentages of infestation decreased with the increase of neem seed oil concentrations.

Rovesti and Deseo (1990) stated that neem, (*Azadirachta indica*) and its oil, extracts and derivatives including azadirachtin are used as antifeedants, repellents, ovicides and growth regulators, they can also reduce adult fecundity and egg viability.

Gonzalez-Gomez *et al.* (2006) conducted an experiment to evaluate the acute toxicity of crude neem seed extract and neem based commercial product (0, 1, 2, 3 and 4%) on Varroa destructor (Aceri: Varroidae) and *Apis mellifera* and repellence of varroa mites. They found neem based products had a persistent rcpellency effect that lasted approximately 48 h.

Islam (2006) conducted the experiment on the exploration of plant materials extracts for the control of jute yellow mite, *Polyphagotarsonemus latus* (Banks) was conducted at the Department of Entomology, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka, during the period from May to August, 2005. The treatments were green neem leaf extract (1:10), green neem leaf extract (1:20), neem oil 1%, neem oil 0.5%, onion bulb extract (1:10), onion bulb extract (1:20), green mahua leaf extract (1:10), green mahua leaf extract (1:20), green nayantara leaf extract (1:10), green nayantara leaf extract (1:20), green karabi leaf extract (1:10), green karabi leaf extract (1:20) and untreated control. Neem oil was emulsified at 0.5 & 1.0% with 0.1% Nikalin. The minimum number of yellow mite was observed in T_3 (neem oil at 1%) during all stages of the plant and it reduced the height percent of mite population over control. Neem oil (1%) significantly reduced the population of yellow mite, increased plant height and numbers of leaves per plant and decreased the number of increased leaves and nodes per plant.

Gupta (2003) examined the efficacy of neem products viz., neem kernel extract in water or cow urine, neem leaf extract in cow urine and neem oil in controlling the major pests *(Antigastra catalaunalis* and *Dasineura seasami)* of sesame cv. Flower. The capsule damage was the lowest with the application of neem oil and endosulfan, respectively. Application of neem oil resulted lowest bud and flower damage (13.3%) and highest grain yield (6.55 kg/ha) gave net profit (Rs. 2633/ha).

Jyothi and Sannaveerappanavar (2003) conducted an experiment on contact toxicity of aqueous neem seed kernel extract and neem seed oil emulsion to egg, larval, pupal and adult stages of *Chellomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae) under laboratory condition. Neem oil emulsion at 2 and 4% and NSKE at 2 and 4% significantly affected the

egg hatching (80.0, 75.0 and 82.5%, respectively) compared to the control (95.0%). Aqueous NSKE at 4% was relatively more toxic (22.0% mortality) to the 3rd instar larvae.

Imtiaz *et al* (2001) studied the effects of neem leaf extracts on adult rice weevil, *Sitophilus oryzae*. Glass film method was adopted to determine the LC_{50} rate. After plotting a graph between mortality and concentration, the LC_{50} was found to be 0.44 µg/sq. cm.

Jeyakumar and Uthamasamy (1997) carried out an experiment in the laboratory to study the efficiency of some botanicals against *Liriomyza trifoli* on cotton. Application of some botanicals insecticides such as neem oil (3%) and neem seed kernel extract (5%) resulted higher larval mortality. Whereas *Pongamia pinnata* oil (3%), neem oil (2%), neem seed kernel extract (2.5%) were found least effective.

Behera and Satapathy (1996) evaluated 7 plant materials viz**.** *Azadirachta indica***,** *Armona reticulate, Dutura anoxia, Callophyllum inophyllum, P. pinnata, Calotropis gigantean, Thevelia peruviana***.** They found that aqueous extract of neem seed kernel was the most effective causing 100% mortality of *Spodoptera litura* at 10 days after treatment among other 6 indigenous plant extract.

Kareem and Durairaj (1987) showed that extracts of Neem Seed Kernel (NSK) when evaluated at field, 4% NSK significantly reduced Green Leaf Hopper (GLH), Brown Plant Hopper (BPH) and White Backed Plant Hopper (WBPH) population and Leaf Folder (LF) damage. This crude water extract caused greater BPH and LF feeding inhibitor and WBPII nymphal emergence.

Kareem and Durairaj (1987) evaluated crude extracts of neem seed kernel (NSK) and neem cake (NC) in water and neem oil (NO) emulsion along with two synthetic insecticides in fields as foliar sprays for the control of

major insect pests of rice. NSK 4% significantly reduced green leafhopper (GUI). Brown Plant Hopper (BPH) and White Backed Plant Hopper (WBPH) populations and leaf folder (I J^r) damages in two fields trials proving either as per with or next in efficacy to fethion and phosphamidon spraying.

Jotwani and Srivastava (1984) reported that antifeeding properties of neem seed kernel suspensions against desert locust, *Schitocerca gregaris* Forsk; Castor hairy caterpillar, *Cuproctis lunata* W,, Tobacco caterpillar, *Spodoptera litura* F., Bihar hairy caterpillar, *Utethesia pulchella* L. Grasshoppers, *Acrida exaltata* W. Antifeedant properties of *A. indica, M. azadirach, M. toosendan* were investigated by Shin-Foon and Zhang (1984) on fifth instar larvae of *S. litura* and were sensitive to neem treated leaf discs in choice tests.

Islam (1993) revealed that oil neem, extracts of leaves and seeds of *A. indica, M. azedirach, A. ruhituka* and *A. reticulate* with haxen diethyl ether. 95% ethanol and acetone showed potential as antifeedant or feeding deterrents for the control of brown rice plant hopper (BPH), rice green leaf hopper (RGLH), rice hispa (RH) and lesser rice weevil (LRW). The young seedling of rice sprayed with 8-12% of crude and emulsified neem oil also significantly reduced feeding in brown hopper and green rice leaf hopper. Aqueous and methanol extracts of neem and chinaberry also deterred feeding in adult pulse beetle & early instar larvae of jute hairy caterpillar.

2.10 Effect of neem oil on insect growth responses

Sudipta and Sanjib (1998) reported that larvae of rice moth, *Corcyra cephalonica* (Stainton) were maintained in neem oil (Azadirachtin, 0.03%) absorbed crushed jowar (sorghum) grains in four doses (0.25, 0.50, 0.75,and 1.0 ml, each dose in 20 g of food), with an initial population of 50 newly hatched larvae/100 g of neem absorbed food in each replication

Deformed adults with a prolonged period of development were obtained Growth inhibition, developmental disturbances and mortality increased markedly with increased doses

Lowerry *et al.* (1996) reported that neem (*Azadirachta indica*) seed oil (NSO) added to meridic diet at concentration as low as 0.016% reduced pupation and prevented adult eclosion rate of obliquebanded leaf roller (*Choristoneura rosaseana*). At a rate of 0.0016% NSO reduced the fitness of *Choristoneura rosaceana*, resulting in longer developmental times, lower adult eclution rates, and reduced egg production compared with controls Pupation was completely inhibited at concentration of 0.25 and 1.0% for larvae exposed in the fifth or sixth instar, respectively; rates as low as 0.016% reduced pupal weights and elution rates For larvae transferred to treated diet in the fifth instar, physical abnormalities in the wings of adults occurred at a rate of 0.004% NSO and increased with increasing treatment rates.

Nauman and Islam (1995) found that applications of 3 concentration of oil-free neem seed extracts to cabbage plates in cages did not deter oviposition by individuals of 3 species of noctuid moths, *Trichoplusia sp*, *Peridroma saucia* and *spodoptera litura* 1% crude oil emulsion significantly reduced the proportion of eggs laid by *S. litura* on treated plants.

Freisewinkel (1993) found the contact effects of neem oil topically sprayed on third instar nymph of *Locusta migratoria* migratorioides. In parallel experiment neem oil was applied directly to the abdomen of the nymphs Feeding larvae at the beginning of the third instar with maize leaves treated with neem oil tested the effectiveness of neem oil given orally The mortality in feeding experiments was much higher than in spraying or direct application experiments. Treated locusts showed prolonged nymphal developmental and reduced increase in weight.

Nicol (1993) studies the effects of the neem seed oil in third instar nymphs of *Schistocerca gregrana*. In cages, which were sprayed with neem oil, the locust showed higher mortality rates, delayed nymphal development and morphogenetic effects of antennae, eyes and wings Moreover, the adults derived from treated nymphs were smaller in size than those in the control.

In laboratory experiments Venkateswarlu *et al.* (1993) studied the effect of neem oil (0.1, 0.25, 0.50, 1.0 and 1.25%) on growth and development of *Lipaphis erysimi*. At concentration of 1.0, 1.25 and 1.50% all the nymphs reared on treated Indian mustard leaves diet before reaching the adult stage.At the lower concentration nymphal survival, fecundity and growth index of the aphid decreased and developmental period increased.

Rao *et al.* (1993) tested, Neemark, Biosol, Repelin and neem oil at 0.5-3.0% against larvae of *Spodoptera litura* in the laboratory. Repellency, antifeedant activity and developmental period increased with increase in concentration of all pesticides Adult's emergence, growth, survival, larval and pupal weight, number of eggs laid and hatchability of eggs decreased with increase in concentration Neem oil had the greatest effect, followed by Neemark, Biosol and Repelin.

Islam (1993) stated the efficacy of azadirachtin, the major active ingredient in the botanical insecticide neem, as a larval growth inhibitor and feeding deterrent for six species of noctuids of economic importance the black army cutworm, *Actebia fennica*, Tansch, the bertha army worm, *Mamestra configurata* Walker, the variegated cutworm, *Pendroma saucia* Hubner, the zebra caterpillar, *Melanchra pieta* Harr, the Asian armyworm, *Spodoptera litura* Fab And the cabbage looper, *Trichoplasia ni* Hubner When added to an artificial diet, azadirachtin inhibited normal growth of all species in a dose dependent fashion.

Becker *et at.* (1992) observed that natural insecticides, neem, contains the active chemical azadirachtin, which disrupt the hormonal changes in *Bemisia tabaci* causing death during moulting.

In laboratory experiments Schmutterer (1992) applied concentration of 10 and 20 ppm/litre of azadirachtin, of an azadirachtin-free fraction and of 100 ppm/litre or an enriched, formulated seed kernel extract of *Azadirachta indica*, against the 5th larval of Pieries brassicae. Application of neem products against young (lst-3rd) larval instar of *Pieries brassica*, which may be typical under practical conditions, led to the death of the caterpillars.

Freisewinkel and Schmutterer (1991) showed that the topical application of neem extract at 0.25 to 1.0 ml/m2 to the 5 nymphal instars of the gregrarious phase of *Iocusta migratoria migratorioides* led to increased mortality during moults, prolonged development and reduced fitness Morphogenetic effects were observed on the legs, wings and antennae A reduction in weight corresponded to reduced feeding activity. Color changes and supernumerary moults suggested tendencies towards soliterization.The earlier the nymphs treated, and the higher the amounts applied, the more distinct the effects.

Salem (1991a) found that larval mortality ranged between 14.28% to 78.57% and the percent of eggs hatching ranged between 57.5% to 89.4% when different concentratration from neem seed oil extract, were tested against the potato tuber moth, *Phthorimaea operculella* Zell.

Loke *et al.* (1990) evaluated six concentrations (1.25, 2.25, 5 0, 10.0, 20.0, and 40.0 percent) of neem oil in acetone, for contact toxicity against 2nd and 3rd larval instars of *Plutella xylostella* L. Significant mortalities of both larval stages were observed with neem oil concentration of 10 percent

and above Although the lower concentration of neem oil appeared to be sub lethal with regard to contact toxicity effect, physiological and growth disruptive effects, such as retardation of growth (prolonged), delayed adult emergence and abnormal adults but the effects were more pronounced in the younger instar Subsequent treatment of pupae and adults of *Plutella xylostella* with neem oil concentrations of 1.25, 2.25. 5.0 And 10.0 percent showed that pupae were generally not affected by the concentrations tested. However, male and female adult moths treated with 2.5 percent and higher concentrations of neem oil had significantly higher mortalities in 48 hours and shorter longevities than the adults in control.

Mishra *et al.* (1990) reported that brinjal leaves treated with 0.025 and 0.05% neem oil to *Epilachna vigintioctopunctata* increased the duration of life stages in the subsequent generation.

Saxena (1985) found that insects fed far less, grew poorly and laid fewer eggs on rice plants treated with the oil, cake, extracts such as azadirachtin, and their formulation Contact with or ingestion of neem seed derivatives disrupeted growth of insect pests Neem oil alone or in combination with seed oil of custered apple (*Annona squamosa* L.) was effective in reducing the survival of *N. virescens* and its transmission of grassy and ragged stunt viruses.

Schmutterer *et al.* (1984) investigated that topical application of neem oil on last instars *N. lugens, S. furcifera* and *N. virescens* nymphs resulted in their premature death Seventy seven to 100% mortality of S. furcifera was caused by neem oil (Saxena *et al.* 1983).

Mariappan and Saxena (1983) reported that custard-apple oil, neem oil and their mixtures were effective in reducing the survival of the green leaf

hopper, *N. virescens* Distant and its transmission of the rice tungro virus (RTV).

Heyde *et al.* (1983) found that 2 to 4 days exposure of *Sogatella furcifera* to plants treated with 500 ppm of neem seed kernel extracts resulted in 75% mortality whereas in the control, mortality was only 5%. On third instar, *N. lugens* nymphs, a combination of foliar and topical application induced higher mortality (75%) than either application alone (30%).

Schmutterer *et al.* (1983) studied the morphogenetic effects of four partially purified fractions of neem seed extracts and two methanolic seed extracts on larvae of rice ear cutting caterpillar, *Mythimna separata* Walker, and the rice leaf folder, *C. medinalis*, larvae fed for 24 hours On rice leaf cuts dipped in different solution of the partially purified fractions and methanolic extracts exhibited pronounced development abnormalities and mortalities in succeeding larval instars and in pupal and adults stages.

CHAPTER III

MATERIALS AND METHODS

The experiments were carried out in laboratory, greenhouse and in the field during March to October, 2016. The details of different materials used and methodology followed during the experimental period are described below.

3.1 Experimental site

The research work was carried out at laboratory and Greenhouse premises of BJRI, Dhaka and in the experimental field of Dhaka.

3.2 Soil

The experimental area belonging to the Agro-Ecological Zone (AEZ-7) "Active Brahmaputra and Jamuna Floodplain". The soil texture was sandy loam.

3.3 Climate

The experimental area was under the subtropical climate. Usually the rainfall was heavy during Kharif season and scantly in Rabi season. The atmospheric temperatures increased as the growing period proceeded towards Kharif season. The weather conditions of crop growth period such as monthly mean rainfall (mm), mean temperature (^{0}C), sunshine hours and humidity (%) were collected.

3.4 Land preparation

The land was prepared at 'JOE' condition by deep ploughing and harrowing followed by laddering and leveled properly. The seeds were sown alter final preparation of land.

3.5 Experimental design and layout

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications following the methods described by Gomez and Gomez. (1984).

3.6 Plot size

The size of the individual plot was 3 m × 2.1 m. The space between plot to plot and line to line was 0.75 m and 0.3 m, respectively.

3.7 Fertilizer Application

The following fertilizers (As prescribed fertilizer recommendation of Soil science department of BJRI) were used.

Name of the fertilizers	Rate (kg/ha)
Urea	200
TSP	50
MP	60
Gypsum	95
$ZnSO_4$	11

The total amount of TSP, MP, Gypsum, Zinc sulphate and the half of urea were applied at the time of final land preparation. The remaining half of the urea was applied after 45 days of seed sowing.

3.8 Planting materials

The variety 0-9897 of *Corchorus olitorius* L. was used. The seeds were collected from the Breeder Seed Department of BJRI. Before sowing, seeds were tested for germination in the laboratory and the percentage of germination was found to be over 90%.

3.9 Pot preparation

Earthen pots (12" diameter) were brought from the market and filled with dairy soil and sand.

3.10 Inter cultural operation

Weeding, mulching and irrigation were done as and when necessary but no plant protection measures were taken.

3.11 The test pests

Test pests was jute yellow mite, *Polyphagotarsonemus latus* (Order: Acarina, Family: Tarsonemidae).

Plate 3: A partial view of field experiment

Plate 4: Egg & nymph of yellow mite under sterio microscope

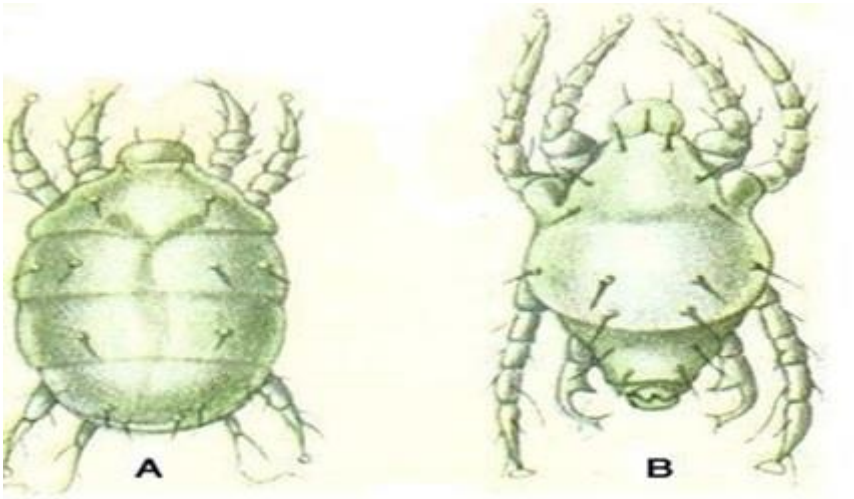

Plate 5: Adult Female (A) and male (B) jute yellow mite

Plate 6: Yellow mite infested plant

Plate 7: Pot experiment

3.12 Details of the treatments

Effectiveness of some indigenous plant materials were evaluated against yellow mite of jute in potted plants grown in green house premises. The selected plants were neem, mahogany, pithraj and turmeric. Mortalities of jute yellow mite were calculated by observing under microscope in greenhouse experiment. In the field condition, infestation level was determined by calculating deformed leaves.

A) Efficacy of specific plant part of a selected plants with three doses (Aqueous extraction) was determined. The treatments were as follows:

T_1 = Green neem leaf extract @1:10

T_2 = Green neem leaf extract @1:20

T_3 = Green neem leaf extract @1:30

T_4 = Pithraj seed extract @1:10

T_5 = Pithraj seed extract @1:20

T_6 = Pithraj seed extract @1:30

T_7 = Mahogany seed extract @1:10

T_8 = Mahogany seed extract @1:20

T_9 = Mahogany seed extract @1:30

T_{10} = Turmeric powder extract @1:10

T_{11} = Turmeric powder extract @1:20

T_{12} = Turmeric powder extract @1:30

T_{13} = Neem seed kernel extract @1:10

T_{14} = Neem seed kernel extract @1:20

T_{15} = Neem seed kernel extract @1:30

T_{16} = Control (untreated)

B) Field experiments was conducted with the following treatments:

T_1 = Green neem leaf extracts @ 1:20

T_2 = Pithraj seed extracts @ 1:20

T_3 = Mahogany seed extracts @ 1:20

T_4 = Turmeric powder extracts @ 1:20

T_5= Neem seed kernel extracts @ 1:20

T_6= Control (untreated)

3.13 Extraction and formulation of some plant materials

3.13.1 Preparation of green neem leaf extract

Fresh green leaves were collected from the campus of BJRI, Dhaka. The collected leaves were washed under running tap water. Hundred grams of Air dried leaves were taken into an electric blender with 1000 ml of water. After blending the leaves well, the mixture were filtered through a fine cloth then the extract was considered as 1:10 neem leaf extract. Similarly 1: 20 and 1:30 neem leaf extracts were prepared by adding 2000 ml and 3000 ml of water with 100g of leaves, respectively.

3.13.2 Preparation of mahogany seed extracts

Matured mahogany fruits were collected from BJRI campus. Mahogany fruits were dried in the sun. Then seeds were separated from fruits. One hundred gram of seeds were crushed and dissolved in 1000 ml, 2000 ml and 3000 ml of water separately for overnight for the concentration of 1:10, 1:20 and 1:30 of mahogany seed extracts. The suspensions was filtered through linen cloth.

3.13.3 Preparation of neem seed kernel extract

Matured neem fruits were collected from neem plants of BJRI, Dhaka then they dipped in water for 48 hours for easy removal of the shell. After removing the hard shell the seed kernels were dried in air which was then made into dust with the help of a grinder. Then the whole dust was passed through a sieve (25-mesh diameter) to obtain fine and uniform dust. One hundred gram of dusts was dissolved in 1000 ml, 2000 ml and 3000ml of water separately for overnight to prepare the neem seed kernel extract of concentration 1:10, 1:20 and 1:30. The suspensions were filtered through linen cloth for spraying.

3.13.4 Preparation of pithraj seed extract:

Matured pithraj seeds were collected from Manikganj. Pithraj seeds were dried in the sun. One hundred gram of seeds water crushed and dissolved in 1000 ml, 2000 ml and 3000 ml of water separately for overnight to for the concentration of 1:10, 1:20 and 1:30 of pithraj seed extracts. The suspensions were filtered through linen cloth.

3.13.5 Preparation of Turmeric powder extracts:

One hundred gram of turmeric powder were soaked separately in 1000 ml, 2000 ml and 3000 ml of water and kept for 2 hours, then filtered through linen cloth to prepare 1:10, 1:20 and 1:30 (materials : water) turmeric powder extracts.

Aqueous extraction of seeds and leaves of different indigenous plants were prepared as described by Zebitz (1986) with few modifications.

Plate 8: Green neem leaf extract.

Plate 9: Pithraj seed extract.

Plate 10: Mahogany seed extract.

Plate 11: Turmeric Powder extract

Plate 12: Neem seed Kernel extract.

3.14 Experimental details

3.14.1 Pot experiment

Pot experiment was conducted to determine the optimum dose for field experiment with aqueous extraction of plant materials. When sufficient infestations of yellow mite infestation were built up in all the pots, then extracts of green neem leaves, pithraj seed, mahogany seed, turmeric powder and neem seed kernel were sprayed on the infested plants. Each treatment was replicated three times. Yellow mite population were recorded by examining the leaf samples under binocular microscope before spray and after 24, 48 and 72 hrs. After spray for calculating % mortality. Percent mortality was calculated as per following formula:

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

Where,

Ta= No. of mites after treatment

Tb=No. of mites before treatment

Ca= No. of mites after treatment in control

Cb= No. of mites before treatment in control

3.14.2 Experiment in field conditions

The efficacy of plant materials (aqueous extraction) were evaluated in field. After sufficient natural infestations built up in all the plots, green neem leaf, pithraj seed, mahogany seed, turmeric powder and neem seed kernel extracts were sprayed on infested plots with a repetition of 2nd spray

after 20 days of 1st spray. The control plots were kept untreated and each treatment was replicated 3 times. Number of infested plants were recorded before spray and at 7th day after spray for calculation of % reduction of infestation over control. Percent reduction was calculated as per following formula:

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

3.15 Statistical analysis

The experiment were conducted in RCBD & CRD. The data were statistically analyzed to obtain the level of significance using the MSTAT software for analysis of variance developed by Russel (1986). The treatment means were separated by Duncan's Multiple Range Test (DMRT).

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Effect of aqueous extraction of plant materials on jute yellow mite

Experiments were conducted to study 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 on percent mortality of yellow mite in pot. Results are shown in Table 1. Among the three different concentrations of neem seed kernel extract, the highest percent mortality (69.39%) was recorded in neem seed kernel extract @1:20 (T_{14}) followed by (T_{13}) 1:10 (65.34%) and (T_{15}) 1:30 (64.08%), respectively. In case of mahogany seed extract, the highest percent mortality (67.77%) was recorded at the dose 1:20 (T_8) followed by (T_7) 1:10 (65.31%) and (T_9) 1:30 (64.36%) respectively. Pithraj seed extract@ 1:20 (T_5) provided the highest mortality (63.86%) followed by (T_6) 1:30 (61.40%). In green neem leaf extract, the highest percent mortality (61.47%) was recorded at the dose 1:20 (T_2) followed by T_3 (60.59%). In case of Turmeric powder extract, all dose provided similar percent mortality T_{11}, T_{10}, T_{12} (62.43%, 60.97% and 60.61%) respectively. 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, Mahogany seed extract @ 1:20, Pithraj seed extract@1:20, green neem leaf extract **@** 1:20 and turmeric powder extract @ 1:20 were selected for field trial.

Table 1: Effect of plant materials (aqueous extraction) on percent mortality of jute yellow mite in the pot

Treatment	No. of mite/sq. cm leaf before treatment	% mortality over control at		
		24 hrs	48 hrs	72 hrs
T1	51	55.48 f	56.49 d	58.31 b
T2	48	59.43 cdef	60.58 abcd	61.47 ab
T3	52	56.16 f	57.59 cd	60.59 ab
T4	49	58.98 cdef	58.43 bcd	60.13 ab
T5	48	61.40 bcd	61.48 abcd	63.86 ab
T6	45	56.80 ef	58.07 bcd	61.40 ab
T7	54	65.34 ab	62.44 abcd	65.31 ab
T8	50	63.30 bc	65.71 ab	67.77 ab
T9	43	60.52 cde	63.19 abcd	64.36 ab
T10	45	58.72 def	60.59 abcd	60.97 ab
T11	45	62.35 bcd	62.52 abcd	62.43 ab
T12	52	63.33 bc	61.95 abcd	60.61 ab
T13	51	65.07 ab	65.96 ab	65.34 ab
T14	52	68.56 a	67.96 a	69.39 a
T15	49	65.56 ab	64.89 abc	64.08 ab
T16	40	_	_	_
LSD(0.05)	_	**3.811**	**6.651**	**7.962**
CV (%)	_	**4.65**	**8.05**	**9.47**

Means within a column followed by same letter(s) are not significantly different at 5% level.
T_1 = Green neem leaf extract @1:10, T_2 = Green neem leaf extract @1:20, T_3 = Green neem leaf extract @1:30, T_4 = Pithraj seed extract @1:10, T_5 = Pithraj seed extract @1:20, T_6 = Pithraj seed extract @1:30, T_7 = Mahogany seed extract @1:10, T_8 = Mahogany seed extract @1:20, T_9 = Mahogany seed extract @1:30, T_{10} = Turmeric powder extract @1:10, T_{11} = Turmeric powder extract @1:20, T_{12} = Turmeric powder extract @1:30, T_{13} = Neem seed kernel extract @1:10, T_{14} = Neem seed kernel extract @1:20, T_{15} = Neem seed kernel extract @1:30, T_{16} = Control.

4.2 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 spray, all different plant materials reduced considerable amount of plant infestation. The highest reduction of plant infestation was 68.65% recorded in neem seed kernel extract (T_5) treated plots followed by mahogany seed extract, T_3 (63.07%) treated plots. Pithraj seed extract (T_2) provided reduction of plant infestation (57.38%). The lowest plant infestation reduction was recorded in turmeric powder, T_4 (53.54%) followed by green neem leaf extract, T_1 (54.68%). 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.

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. Karecm and Durairaj, 1987, Naganagouda et al. 1997).

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.

4.3 Effect of different plant materials on yellow mite (2nd spray) under field condition

After 2nd spray in the field (20 days after 1st spray) the effect of different plant materials of percent reduction of plant infestation over control was studied and results are shown in Table 3. It was found that all different plant materials reduced remarkable amount of plant infestation significantly over control. The highest reduction of plant infestation (70.20%) was recorded from neem seed kernel extract (T_5) treated plot followed by mahogany seed, T_3 (68.46%). Pithraj seed extract, T_2 treated plots provided 65.38% reduction. The lowest plant infestation reduction 61.72% and 62.37% were recorded in green neem leaf extract (T_1) and turmeric powder extract (T_4) over control. Which were statistically similar. These results indicated that neem seed kernel extract and mahogany seed extract were most effective, while Pithraj seed extract was moderately effective. Islam (2006) showed 1% neem oil and green neem leaf extract at the dose 1:20 is very much effective for reducing mite population in jute.

4.4 Effect of different plant materials on internodes of jute plant

The effect of different plant materials on number of internodes per plant at three growth stages of jute plant are presented in (Table 4). At early stage, the lowest number of nodes/plant (20.05) was recorded in neem seed kernel

extract (T_5) followed by 21.30 (mahogany seed extract, T_3) which were statistically similar but significantly different from other treatment. The untreated control, T_6 (36.00) had the highest number of nodes per plant, which was significantly different from other treatments. At the middle stage, the lowest number of nodes per plant 33.85 was recorded from treatment neem seed kernel extract (T_5) followed by 35.85 mahogany seed extract (T_3) which was statistically similar but different from other treatment. The highest number of nodes per plant 80.25 was observed in untreated control (T_6) which was significantly different from other treatments.

On the other hand, the late stage of plant, the lowest 52.50 number of nodes per plant was recorded from neem seed kernel extract (T_5) which was statistically similar to 54.50 (T_3) and 57.50 (T_2). The highest 92.50 number of nodes per plant was observed in treatment T_6 (untreated control), which was significantly different from other treatments. The results indicate that neem seed kernel extract was most effective followed by mahogany seed extract, pithraj seed extract, green neem leaf extract and turmeric powder extract. It was also clear that different plant materials showed the better performance on reducing the number of nodes per plant 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 per plant (Plate 13) and decreased the fibre quality. Because application of different plant materials reduced mite infestation and increased plant height that decreased the number of nodes with in a unit area. The effect of different plant materials in the present study was in accordance with the findings observed by Pande *et al.* (1987) and Devraj (1990). They found that, neem leaf extract 1% and neem

seed kernel extract at 5% were effective against mites. So the effectiveness of different plant materials against mites proved promising in the present study. Therefore different plant materials can be used for the control of yellow mite on jute.

Table 2: Effect of different plant materials on % reduction of yellow mite in field condition (First spray) over control

Treatment	Average no. of mite infested plant/plot before spray	No. of mite infested plant after 7days of spray	% reduction over control
T_1	74.25	26	54.68 C
T_2	62.5	23	57.38 BC
T_3	81	21	63.07 ab
T_4	88.5	25	53.54 C
T_5	68.25	20	68.65 A
T_6	75	67.25	0.000 D
LSD(0.05)	-	-	4.897
CV (%)	-	-	6.6

Means within a column followed by same letters are not significantly different at 5% level.

T_1=Green Neem Leaf Extract @1:20

T_2=Pithraj Seed Extract@1:20

T_3=Mahogany Seed Extract@1:20

T_4=Turmeric powder extract@1:20

T_5=Neem Seed Kernel Extract@ 1:20

T_6=Control

Table 3: Effect of different plant materials on % reduction of yellow mite in field condition (2nd spray) over control

Treatment	Average no. of mite infested plant/plot before spray	No. of mite infested plant after 7days of spray	% reduction over control
T_1	48.75	15.75	61.72 c
T_2	43	14.25	65.38 bc
T_3	37	13	68.46 ab
T_4	34.25	15.5	62.37 c
T_5	35.25	12.25	70.20 a
T_6	49.25	41.25	0.000 d
LSD(0.05)	-	-	4.216
CV (%)	-	-	5.12

Means within a column followed by same letters are not significantly different at 5% level.

T_1=Green Neem Leaf Extract @1:20

T_2=Pithraj Seed Extract@1:20

T_3=Mahogany Seed Extract@1:20

T_4=Turmeric powder extract@1:20

T_5=Neem Seed Kernel Extract@ 1:20

T_6=Control

Table 4: Effect of different plant materials on number of inter nodes of Jute plant

Treatment	No. of inter nodes at		
	Early stage (35 DAS)	Middle stage (80 DAS)	Late stage (120 DAS)
T_1	25.50c	46.50b	62.25b
T_2	24.25cd	37.70c	57.50c
T_3	21.30de	35.85c	54.50c
T_4	27.25b	47.50b	66.25b
T_5	20.05e	33.85c	52.50c
T_6	36.00a	80.25a	92.50a
LSD(0.05)	2.71	4.19	4.09
CV (%)	8.95	5.83	4.18

Means within a column followed by same letter(s) are not significantly different at 5% level.

T_1=Green Neem Leaf Extract @1:20

T_2=Pithraj Seed Extract@1:20

T_3=Mahogany Seed Extract@1:20

T_4=Turmeric powder extract@1:20

T_5=Neem Seed Kernel Extract@ 1:20

T_6=Control

Plate 13: Severely yellow mite infested jute plant showing internodes and increased number of nodes

4.5 Effect of different plant materials on plant height.

The effect of different plant materials on height of jute is presented in Table 5. At the time of harvest, the highest plant height 3.10 m. was recorded in the treatment neem seed kernel extract (T_5) followed by mahogany seed extract, T_3 (3.03) and pithraj seed extract, T_2 (3.02 m) respectively. These are statistically similar. The lowest plant height was recorded from untreated control plot, T_6 (2.90m) which was significantly lower than all other treatments treated plots. The above results indicate that different plant materials had significant effect on increasing height of jute plant.

Mite infestation causes growth stunting and finally reduces the plant height. Application of different plant materials decreased mite infestation and ultimately increased plant height. Therefore, different plant materials were reduced yellow mite infestation are increased plant height. Islam (2007) reported that the plant height 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 in conformity with finding reported by Palaniswamy and Ragini (2000) against yellow mite on chili. They observed that 5% aqueous extract of neem leaf reduced mite population on chili and increased height.

4.6 Effect of different plant materials on base diameter of jute

The effect of different plant materials on base diameter of jute is presented in Table 6. At the time of harvest, the highest base diameter 15.93mm was recorded in the treatment neem seed kernel extract (T_5) followed by mahogany seed extract, T_3 (15.86) which was statistically similar. The lowest plant base diameter was recorded from untreated control plot, T_6 (14.50mm) which was significantly lower than all other treatments treated plots. The above results indicate that different plant materials had significant effect on increasing base diameter of jute plant.

4.7 Effect of different plant materials on fibre yield of jute

Effect of different plant materials on yellow mite has influence on yield of jute fibre. The highest , (38.60%) fibre yield was increased over untreated control, T_6 as shown in Table 7 followed by 37.04% from mahogany seed extract, T_3 treated plot which was statistically similar. The lowest (27.12%) fibre yield was recorded from turmeric powder extract, T_4 treated plots, which were significantly different from other treatment, pithraj seed extract

(T_2) and green leaf extract (T_1) significantly increased fibre yield by 33.25% and 29.41% respectively over control having no significant difference between them. It was reported by anonymus (2009) that 27% fibre increased over control was from magony seed extract treated plot and 23.5% fibre yield increased over control was reported from jute seed extract treated plot. The present study indicate that plant materials performed increased fibre yield over control. Similar findings were reported by Banu *et al.* (2007). They reported that the use of green neem leaf extract and dry neem leaf extract against yellow mite gave increased fibre yield over control.

Table 5: Effect of different plant materials on plant height.

Treatment	Plant Height (m.)
T_1	3.00b
T_2	3.02ab
T_3	3.05ab
T_4	2.98b
T_5	3.10a
T_6	2.90c
LSD(0.05)	8.025
CV (%)	4.77

Means within a column followed by same letter(s) are not significantly different at 5% level.

T_1=Green Neem Leaf Extract @1:20

T_2=Pithraj Seed Extract@1:20

T_3=Mahogany Seed Extract@1:20

T_4=Turmeric powder extract@1:20

T_5=Neem Seed Kernel Extract@ 1:20

T_6=Control

Table 6: Effect of different plant materials on base diameter

Treatment	Plant Base Diameter (mm)
T_1	15.24 b
T_2	15.34 b
T_3	15.86 a
T_4	15.39 b
T_5	15.93 a
T_6	14.50 c
LSD(0.05)	0.452
CV (%)	1.94

Means within a column followed by same letter(s) are not significantly different at 5% level.

T_1=Green Neem Leaf Extract @1:20

T_2=Pithraj Seed Extract@1:20

T_3=Mahogany Seed Extract@1:20

T_4=Turmeric powder extract@1:20

T_5=Neem Seed Kernel Extract@ 1:20

T_6=Control

Table 7: Effect of different plant materials on fibre yield

Treatment	Yield (t/ha)	% Increased yield over control
T_1	2.629 cd	29.41 bc
T_2	2.706 bc	33.25 ab
T_3	2.782 ab	37.04 a
T_4	2.581 d	27.12 c
T_5	2.815 a	38.60 a
T_6	2.033 e	0.000 d
LSD(0.05)	0.095	5.29
CV (%)	2.57	12.73

Means within a column followed by same letter(s) are not significantly different at 5% level.

T_1=Green Neem Leaf Extract @1:20

T_2=Pithraj Seed Extract@1:20

T_3=Mahogany Seed Extract@1:20

T_4=Turmeric powder extract@1:20

T_5=Neem Seed Kernel Extract@ 1:20

T_6=Control

CHAPTER V

SUMMARY AND CONCLUSION

In order to study the effectiveness of plant materials against yellow mite of jute, several experiments were conducted in the pot and field condition of Bangladesh Jute Research Institute during the period of March 2016 to October 2016.

Initially, aqueous extraction of different doses of plant materials including green neem leaf, neem seed kernel, mahogany seed, pithraj seed and turmeric powder were evaluated against yellow mite in the pot of greenhouse premises to find out suitable dose for the field experiment. The highest percent mortality 69.39%, 67.77%, 63.86%, 62.43% and 61.47% @ 1:20 were selected for field trial.

In case of first and second spray (field experiment), the highest percent reduction of infestations over control (68.65 and 70.20) were observed by neem seed kernel extract. However, they were statistically different than other treatments. The lowest percent reduction of infestations over control (53.54 and 61.72) were recorded by turmeric powder extract (1:20) and green neem leaf extract.

At the late stage of plants, highest number of nodes (92.50) per plant was found in control plots due to shortening of internodes caused by severe mite infestation which was statistically different than other treatments. The lowest number of nodes (52.50) per plant was found in neem seed kernel which was statistically similar with mahogany seed extract. Plant height

was found to be the highest (3.10 meter) in the plot treated by neem seed kernel extract and the lowest (2.90 meter) in control plot. The highest 15.86mm base diameter was found in neem seed kernel treated plot and the lowest 14.50 mm base diameter was recorded in control plot. Maximum percent yield increase over control (38.60) was found in the plot treated with neem seed kernel extract and the lowest percent yield increase over control (27.12) was found in the plot treated with turmeric powder extract.

As the dose 1:20 of different plant materials showed efficacy, it was used for further field trial. The result of field trial clearly indicate that neem seed kernel extract, mahogany seed extracts were highly effective plant materials while pithraj seed extract, green neem leaf extract and turmeric powder extract were moderately effective against jute yellow mite. These plant materials can be safely used by the farmers as components of IPM, a low cost alternative and a promising known botanical pest control agent and to save the crops from different insect pests effectively and economically without hampering the ecological balance agro-ecosystem. The present study will presumably help in future research to improve the effectiveness of plant materials as pesticides for the benefit of farmers and it can be used as a components of IPM program.

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