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Eco- friendly Pest Control in Vegetable Fields Using Botanicals form Jute (Corchorus capsularies)

Sultana, Papia

University of Rajshahi

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Ph.D. THESIS

BY

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UNIVERSITY OF RAJSHAHI
RAJSHAHI, BANGLADESH

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June, 2015

DEDICATED

TO

MY HUSBAND

AND

SON

DECLARATION

I do hereby declare that the whole work submitted as a thesis entitled "**Eco-friendly Pest Control in Vegetable Fields Using Botanicals form Jute *(Corchorus capsularies)*"** in the institute of Environmental Science, Rajshahi University, Rajshahi for the degree of Doctor of Philosophy is the result of my own investigation. I carried out this research work under the supervisions of Dr. Md. Abul Kalam Azad, Associate Professor, Institute of Environmental Science, Rajshahi University, Rajshahi and Dr. Md. Jahangir Alam, Chief Scientific Officer, Head, Entomology Division, Bangladesh Institute of Nuclear Agriculture (BINA), BAU Campus, Mymensingh. The thesis has not been submitted in the substance for any other degree.

June, 2015

Rajshahi University   Papia Sultana

CERTIFICATE

We are pleased to certify that **Papia Sultana** has carried out her Ph.D. research work under our supervisions entitled "**Eco-friendly Pest Control in Vegetable Fields Using Botanicals from Jute *(Corchorus capsularies)*"**. She carried out this research work at Entomology Lab., Bangladesh Institute of Nuclear Agriculture (BINA), BAU Campus, Mymensingh and Botanical Pesticides lab., Institute of Environmental Science, Rajshahi University. She has fulfilled all the requirements for submission of thesis for the award of Doctor of Philosophy degree in Environmental Science.

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June, 2015 **Papia Sultana**

Eco-friendly Pest Control in Vegetable Fields Using Botanicals from Jute *(Corchorus capsularies)*

ABSTRACT

The study consists of two different types of experiments: screening of botanicals and evaluation of the comparative performances of siperin and botanicals including jute seed for the control of vegetables pest. This Ph.D. research work was carried out in three years (July, 2011-June, 2014) in the laboratory of the Entomology Division, Bangladesh Institute of Nuclear Agriculture, Mymensing and Botanical Pesticides Lab., Institute of Environmental Science, Rajshahi University. In the screening experiment, extracts of ten selected botanicals viz. jute seed (*Corchorus capsularies*), jute leaves (*Corchorus capsularies*), urmoi leaves (*Sapium imdicum*), arahar leaves (*Cajanus cajan*), custard apple leaves (*Annona reticuleta*), ganda leaves and stems (*Tagetes patula*), nisinda leaves (*Vitex negundo*), lantana leaves (*Lantana camara*), kalomegh leaves and stems (*Andrographis paniculata*) and holde hurhuri (*Cleome viscosa*) were applied on red pumpkin beetle, black bean aphid and okra jassid and ovserved the significamnt mortality (%) at the different days of intervals. In case of red pumpkin beetle, jute seed exerted the mortality upto 70% at 24 hours, which reached to 83.33% at 48, 72 and 96 hours, respectively. During this period, jute seed showed about 1.90, 1.49, 4.19, 1.10, 7.00, 3.00, 1.49, 4.19 and 5.25 times higher performances in comparison with jute leaves, urmoi leaves, arhar leaves, custard apple leaves, ganda leaves, nisinda leaves, lantana leaves, kalomegh and halde hurhuri, respectively. This trend of insecticidal efficiences were also almost applicable in black been aphid and okra jassid at 12, 24, 36 and 48 hrs. However, there was no significant variation between the botanicals but in most of the cases, jute seed showed the highest performance whereas custard apple leaves and urmoi leaves ranked in the 2nd and 3rd highest positions, respectively. After screening three best botanicals eg. jute seeds, custard apple leaves and urmoi leaves were applied on red pumpkin beetle, black bean aphid and okra jassid (@ 5%, 7.5% and 10%) along with chemical insecticide siperin (@ 0.05%, 0.10% and 0.2%) in the laboratory condition. This study identified significant effect of botanicals as well as siperin on the mortality (%) of red pumpkin beetle. Siperin caused 63.33% mortality after 96 hrs. In the same interval (96 hrs) jute seed and custard apple leaves as well as *urmoi* leaves showed mortality upto 46.50, 38.33 and 37.50%. The study also found that the significant effect of botanicals and siperin on % weight loss of cucumber leaves where siperin caused lowest (28.02%) and jute seed produced the 2nd minimum 29.74 % wt. loss, respectively. The study also measured the mortality (%) of black bean aphid upto 66.67% for siperin, 53.36 % from jute seed, 44.17% from custard apple leaves and 42.50% from urmoi leaves after 48 hrs intervals. On the other hand, mortality (%) of okra jassid found upto 62.08% in siperin whereas jute seed, custard apple and urmoi leaves revealed 48.75, 36.67 and 35.00% mortality, respectively at the same interval. However, the study confirmed that a higher concentration of botanicals and a long treatment time ensured more % mortality of red pumpkin beetle, black bean aphid and okra jassid. The study also estimated the significant effect of siperin (0.1%) and botanicals (10%) on growth parameters and yield of vegetables, cucumber (3.96 kg/plant as the highest yield such even than that of siperin), country bean (1.78 kg/plant as the 2nd highest pod yield just after siperin) and okra (0.854 kg/plant having no statistical differences with siperin). The study concluded that amongst the studied botanicals, jute seed mostly minimized the insect infestation, control treatment gave the lowest performences in respect to vegetative growth and yield as well as insect infestation in cucumber, country bean and okra fields.

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Chapter 1

INTRODUCTION

1.1 Agriculture in Bangladesh

Bangladesh has a primarily agrarian economy. Agriculture is the single largest producing sector of the economy since it comprises about 18.6% of the country's GDP and employs around 45% of the total labor force (CIA, 2011). The crop sub-sector dominates the agriculture sector contributing about 72% of total production, where vegetable cultivation is one of the most important and dynamic branches of agriculture in Bangladesh, a country with sub-tropical climate.

1.2 Importance of Vegetables Cultivation

Bangladesh is an overpopulated country. Food shortages and malnutrition have become general problems in Bangladesh. As a developing country, Bangladesh is adequately suffering from the problems of poverty, unemployment and malnutrition. Vegetable sub-sector can play important role to solve these problems in the shortest possible time. The importance of vegetable can be realized from two stand points such as, economic point of view and nutritional point of view. It creates a great opportunity of employment for the large number of unemployed women of Bangladesh. Although vegetables are considered as an indispensable part of our daily diet, yet it contributes a very little portion of our total food intake because of short supply and health unawareness. The problem of existing acute malnutrition and food shortages might be overcomed by producing more vegetables to a significant extent which will ultimately lead to build a healthy nation (Zaman, 2010).

Vegetables compared to other food items provide low cost nutrition source. It can be produced even small amount of land and also in homestead area. It can be grown within a short time period and more than one crop can be grown within a crop season. There are a large number of vegetables having different varieties, which can be grown throughout the year. However, the largest numbers of vegetables are grown in the winter season. Vegetables are generally labour intensive crops and thus offer a considerable promise for generating increased rural employment opportunities. Climate and soil of Bangladesh is very much suitable for growing vegetables round the year (Akter *et al*., 2011).

Nearly 100 different types of vegetables comprising both of local and foreign origins are grown in Bangladesh. Vegetable is important for nutrition, economy and food security. Vegetables can be identified as a significant one for this economy for its noteworthy contribution in raising the foreign exchange earnings and occupies an important position among the items exported from Bangladesh. Vegetables contribute 3.2% of the agricultural Gross Domestic Product (BBS, 2009). Bangladesh earned US $ 41.11 through exporting of agricultural products, which contributed 0.54% to total export earnings (BER, 2008).

Cucumber (*Cucumis sativus* L.) is an important vegetable and one of the most popular members of the gourd family. It contains 95% water; a 50-g portion provides 0.3 g of dietary fibre and supplies 5 kcal (20 kJ). It is very good for skin and contains anti-in flammatory properties (Azad *et al*., 2013).

Country Bean, *Dolichos lablab* Linn, renamed as *Lablab purpureus* (L)-a major species of fabaceae, is one of the major winter vegetable grown in all over Bangladesh. It also contains appreciable amount of vitamins, calcium, phosphate, sulphur and sodium (Gopalan *et al.,* 1982).

Okra (*Abelmoschus esculentus* L.) belongs to family *Malvaceae*. It is generally known as lady finger and is an important summer vegetable crop used all over the world. Besides its taste and consumer it is good source of vitamin A, B and C and also rich in protein, carbohydrates, minerals, iron and iodine (Akbar *et al*., 2012).

1.3 Pest and Insect Attack in Vegetables

Pests and insects are main problem of agriculture that damage many crop plants (Puripattanavong *et al*., 2013). In Bangladesh, pest-induced losses are a serious problem for higher production of vegetables. In pest surveys, as many as seven dozens of insect pests have been recorded on nine kinds of vegetables and 170 diseases on 27 vegetable crops. The major insect pests and diseases cause 30-40% yield losses to vegetable crops (Karim, 2004).

Attle *et al*. (1987) reported that the pest causes up to 40% reduction of crop yields in Asia and also as high as 100% yield reduction of different bean crops due to aphid infestation (Bahar *et al*., 2007).

1.3.1 Devastation Features of Red Pumpkin Beetle in Cucurbit

Cucurbits are attacked by a number of insect pests, including red pumpkin beetle. Red pumpkin beetle, *Aulacophora foveicophora* Lucas is the most serious pest of the cucurbits. It causes 35-75% damage to all cucurbits except bitter gourd at seedling stage and the crop needs to be re-sown. They feed underside the cotyledonous leaves by bitting holes into them. Percent may reach upto 35-75% at seedling stage, although percent damage rating gradually decreases from 70 to 15% as the leaf canopy increases (Saljoqi and Khan, 2007).

Red pumpkin beetle, *Aulacophora foveicollis* (Lucas), is one of the most important constraints to cucurbit production capable of causing 30-100% yield loss (Dhillon *et al*., 2005). Adult beetles feed voraciously on the leaf lamina by making irregular holes. The maximum damage is done when the crop is in the cotyledon stage (Osman *et al*., 2013).

1.3.2 Devastation Features of Black Bean Aphid in Country Bean

Aphids are small, soft-bodied insects that grow up to 1 to 4 mm long. They are sap suckers and form colonies on the new shoots of a wide range of crops (DAFWA, 2007). Uddin *et al*. (2013) reported that aphid, the most destructive pest, cause damage by sucking sap from flowers, buds, pods and tender branches of the plants and reduce the viability of plant. Beans suffer damage to flowers and pods which may not develop properly. But, early sown crops may avoid significant damage if they have already flowered before the number of aphids builds up in the spring (RIR, 2013). Aphids can stunt and distort the growth of plants and cause wilting and bud drop, resulting in poor flowering and fruit set. Aphids can also spread plant viruses. Aphid numbers are generally highest in favorable conditions during spring (Godfrey and Trumble, 2009).

Jahan *et al*. (2013) revealed that bean aphid, *Aphis craccivora* Koch and *Aphis medicaginis* are the major constraints of country bean production, which inflict a destructive damage to country bean throughout the country. In addition the young plants suffer heavily from the attack of bean aphid and may die (Alam *et al.,*1964). Beside this, aphid injects a toxin through salivary secretion into the plants during feeding causes chlorosis at the feeding site, yellowing of the veins and leaf curling, loss of vitality and reduction of growth (Jayappa and Lingappa, 1988).

Both nymphs and adults of the insect suck cell sap of infested plants and while feeding they inject a toxin along with the salivary secretion into host plants. Aphids also secrete honeydew, which, by enhancing the growth of sooty moulds, interferes with the photosynthetic ability of plants (Rizkalla *et al*., 1994).

1.3.3 Devastation Features of Okra Jassid in Okra

Jassid and whitefly are more serious (Atwal, 1994) and transmit certain viral diseases. Moreover, they cause a great damage by sucking the plant sap. Insect pests cause 35-40% crop yield losses and ultimately increase the level of damage up to 60-70% in optimal conditions (Akbar *et al*., 2012).

1.4 Pesticides Consumption in Vegetables Cultivation

Since the vegetable crops are highly prone to frequent pest attacks, farmers naturally resorted to the control measures that they considered more effective and easier to apply. Pesticide use has, therefore, been the common choice as no other effective control measures were available to them. As a consequence, the consumption of pesticides in the agricultural sector of the country has increased by 230% during the last 10 years starting from 1994 to 2003, where 76% possessed by insecticides (Karim, 2004).

Until recently insecticides were the major means of insect control in all crops including vegetables in Bangladesh. The use of insecticides in Bangladesh was started date back in 1957/58 with the grant receipt of 3 metric tons of endrin, which reached 14,312 metric tons in 2004 through import and marketing of several brands across 5 era of systems, and is still on the increasing trend. More than 80% of the insecticides are used in controlling the insect pests of rice. Such use of pesticides in rice caused several problems including insect pest resurgence, secondary pest outbreak etc. Recently, the use of insecticides has considerably increased in vegetables like eggplant, country bean, cucurbits, yard long bean etc. particularly in their intensive growing areas (Rahman, 2013).

Vegetable growers tended to use more pesticides in order to preserve their crops or vegetables to pest alteration for more economic benefits. The frequency of applications of pesticides is higher. Any farmer did not report the correct knowledge regarding pesticides application interval. Their attitudes could be explained by empirical effect-dose relationship that may lead to better harvests often appreciated by customers. A considerable amount of pesticides application was reported in others countries: in Benin, some farmers spray insecticides every 3–5 days; in Brazil, pesticide spraying frequency ranged from once every 3 days to once a week (Adjrah *et al*., 2013).

Aphid cause up to 100% yield loss in different varieties of country bean (*Lablab purpureus*), barbate (*Vigna sesquipedalis*), black gram (*Vigna mungo*), mung bean (*Vigna radiata*) and cowpea (*Vigna unguiculata*) in different places (Attle *et al.,* 1987). Farmers are generally depending on chemical insecticide for controlling bean aphid but fail in the most cases causing damage the ecological balance. A wide range of insecticides with various formulations are used to control aphids, (Jackai and Daoust, 1986, Hill, 1987, Singh and Jackai, 1985).

1.5 Hazards of Pesticides

Though, pesticides are a major technological tool used successfully throughout the world. An adverse consequence of persistent application has been the emergence of resistant populations. Pesticide resistance is a global phenomenon that has occurred with fungicides, bactericides, insecticides, rodenticides, nematicides and herbicides (Powles and Holtum, 1991).

Pesticide poisoning is a major global health problem, and it is more prevalent in countries like Bangladesh. The harmful effects on human beings in the form of acute and chronic toxicity exposed to insecticides are well established. The incidence of pesticides poisoning is increasing according to the existing reports, and it is estimated that about 5 million people die every year as a result of intentional, accidental and occupational exposure worldwide (Singh and Gupta, 2009). The effective and responsible uses of pesticides bring significant positive contributions to the crop production. However, their irrational and unprotected uses are threatening our ecosystem, health and environment (Dey, 2010).

Resistant populations occur when the same chemical, same family of pesticides or pesticides with a similar mechanism of activity is used repeatedly at the same location. When a few naturally resistant organisms remain after a treatment, they contribute to the development of a larger population of resistant organisms. Eventually the population that develops may contain mainly resistant organisms and will not be controlled with the recommended rates of the pesticide. To help minimize the development of pest resistance, all fungicides, insecticides and herbicides sold in Australia are grouped according to their mode of action, indicated by a letter number code on the product label. The mode of action label allows the user to identify pesticides that work by similar means and which share a common resistance risk (Crop Life Australia Limited, 2008).

Resistance is the ability in individuals of a species to withstand doses of toxic substances that would be lethal to the majority of individuals in a normal population. Excessive and indiscriminate use of pesticides not only increases the cost of production but also results in many human health problems and environmental pollution. The most damaging ecological disturbance of injudicious use of pesticides is the existence of high concentration of pesticide residues in food chain, including cereals, pulses, vegetables, fruits, milk and milk products (including mother's milk), fishes, poultry, meat products and water (Jeyanthi1 and Kombairaju, 2005).

The frequent and indiscriminate use of insecticides as a substitute rather than as a supplement to nonchemical management techniques has resulted in the failure of these chemicals to effectively control storage insect pests

(Subramanyam and Hagstrum, 1996). Almost all the economically important storedproduct insect pests throughout the world are resistant to most of the insecticides commonly used to protect commodities against inset infestation and damage (Subramanyam and Hagstrum, 1996).

The use of insecticides, however, carries several dangers. The yield loss varies in different environment conditions but can exceed 65% in Bangladesh. Non-optimal and non judicious use of insecticides may result in serious problems related to crop production and certain externalities like pollution and health hazards. Modern seeds are more susceptible to insect pests and diseases. Both overuse and misuse of insecticides may lead to the loss of effectiveness of insecticides due to the development of resistance and could cause human health hazards and environmental pollution (Mohiuddin, 2009).

Paul (2003) reported that intensified use of insecticides can cause a serious public health hazards especially in the form of residues in food. Inappropriate selection of insecticides and doses, improper spray scheduling and inadequate spray coverage may cause to the failure in controlling insect pests. For vegetables in general, Sabur and Mollah (2000) observed an increase in use of pesticides by farmers in combating pests throughout Bangladesh.

The misuse of synthetic pesticides has led to accidental poisoning, the development of insect resistance and other adverse environmental and health hazards. Furthermore, the development of synthetic insecticide-based techniques for grain protection in traditional stores in Asia and Africa has been partially caused by the high cost, unavailability or erratic supply of safe insecticides (Obeng-Ofori, 2007).

1.6 Importance of Botanicals Pesticides

In order to support sustainable vegetable production, it is important to develop alternative method of pest control (Ahmed, 2000).

Botanical pesticides are becoming popular day by day. Now a day, these are being used against many insects. Use of botanical extract against insect pest control is however, a recent approach to insect pest management and it has drawn special attention to the entomologist all over the world (Rahman, 2011).

Crude plant extracts often consist of complex mixtures of active compounds, they may show greater overall bioactivity compared to the individual constituents (Chen *et al*., 1995). The deleterious effects of crude plant extracts on insects were manifested in several ways, including toxicity, feeding inhibition (Wheeler and Isman, 2001).

The wide-scale commercial use of plant extracts as insecticides began in the 1850s with the introduction of nicotine from *Nicotiana tabacum,* rotenone from *Lonchocarpus* sp, derris dust from *Derris elliptica* and pyrethrum from the flower heads of *Chrysanthemum cinerariaefolium* (Golob *et al*., 1999).

The plant preparations and constituents of many aromatic plants used for flavoring or medicinal purposes have been found to possess insecticidal properties (Tanzubil, 1986; Bell *et al*., 1990; Obeng-Ofori *et al.,* 1997). The use of locally available plants avoids the need to establish complex mechanisms and structures for pesticide distribution and other related issues (Golob *et al*., 1999).

1.7 Benefits of Plant derived Botanicals

Botanical insecticides tend to have broad spectrum activity, are relatively specific in their mode of action, and easy to process and use in farm levels. They are also safe for higher animals and the environment. Botanical insecticides can often be easily produced by farmers and small-scale industries, indigenous plant materials are cheaper and hazard free in comparison to chemical insecticides (Saxena *et al*., 1980). Plants are rich sources of natural substances that can be utilized in the development of environmentally safe methods for insect control (Sadek, 2003).

Botanicals are traditional and non-synthetic protectants derived from plants. Traditionally, many different types of plant parts are used for the protection of agricultural produce. These plants are available in many developing countries and contain several active ingredients and act in different ways under different circumstances (Isman, 2006). Botanicals break down rapidly to harmless metabolites and appear less likely to build up genetic resistance in targeted species. They can also less harmful to mammals and other beneficial organisms.

Bhaga and Kulkarni (2012) stated that realizing the adverse effect of chemical insecticides, attention has now been diverted in favor of non-chemical methods for pest management. Plant derived insecticides encompasses an array of chemical compounds which act concertedly on both behavioral and physiological processes.

1.8 Efficacy of Botanicals Plant Extracts

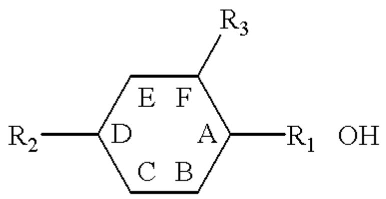
The use of plant species to control pest insects has been in practice for centuries to a limited extent, the interest has been renewed in the pest management potential of natural products. Plants are natural chemical factories, providing the richest source of organic chemicals on earth. Approximately 42 families of plants carry some medicinal and insecticidal qualities (Feinstein, 1952). Plant products have several uses in insect control (Mamoon-ur-Rashid *et al*., 2012).

The natural products of plants come as an alternative ecologically more compatible in substitution to the synthetic insecticides (Rupp *et al.* 2006). The use of botanical pesticides to protect plants from pests is very promising because of several distinct advantages. Pesticidal plants are generally much safer than conventionally used synthetic pesticides. In addition, plant-based pesticides are renewable in nature and cheaper (Parugrug and Roxas 2008). Haryadi, and Yuniarti (2012) tested the insecticidal properties of custard apple (*A. reticulata*) and mindi (*M. azedarach*) leaf powder against maize weevil, *S. zeamais*. The experiment was conducted under laboratory conditions using oligidic diet in the form of artificial grains. To the diet, 10 levels (0.0 to 4.5% w/w) of the dry, powdered plant materials were added. The results showed that the presence of the plant materials in the diet significantly reduced the number of progeny, prolonged the developmental period, and reduced the developmental index.

1.9 Jute Seed Extracts for Pest Control

In Bangladesh *Corchorus capsularis* Linn grows abundantly, which have more or less toxic materials (Talukder and Khanam, 2009). Many workers mentioned the presence of the bio-pesticide ingredients such as glucoside, corchorin, corchsularin in the jute seed oil (Saha and Choudhury 1922, Khan *et al.* 2006). Khuda *et al.* (1963) describes the presence of strophanthidin 0.5% raffinose 4.5% and several glucosides one of which indentical with β-sitosterol-d-glucoside in the *C. capsularis* seed powder. Hossen *et al.* (2008) suggested that the extracted jute seed oil may use as insecticides due to its bitter test. Most insecticide products contain a synergist whose role is to amplify the chemical activity of the other compounds in the formulation (Wanyika *et al.* 2009). It has also been suggested that vegetable oils act as synergists in bio-pesticide formulations (Tembo and Murfitt 1995).

A method for controlling insects and arachnids using a composition which is non-toxic to humans. The composition may be a dust, an aerosol or a solvent solution of at least one neurally effective substance. The neurally effective substance has the following general chemical structure (Bessette and Knight, 2002).



R_1 is any of the following: CH_2, C_2H_4, C_3H_6, C_3H_4, C_4H_8, or C_4H_4

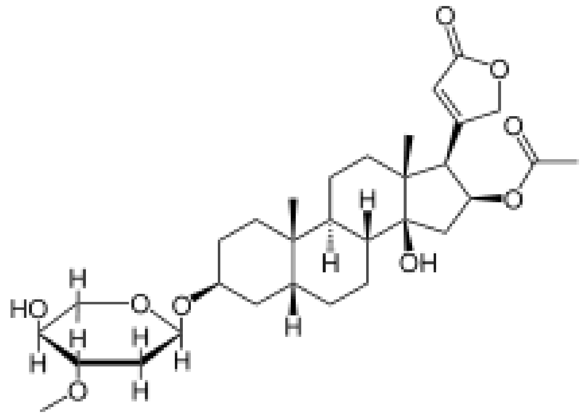
R_2 is any of the following: H, H_2, CH_3, C_2H_5, C_3H_7, C_3H_5, C_4H_9, or C_4H_5

R_3 is any of the following: H, H_2, or OCH_3

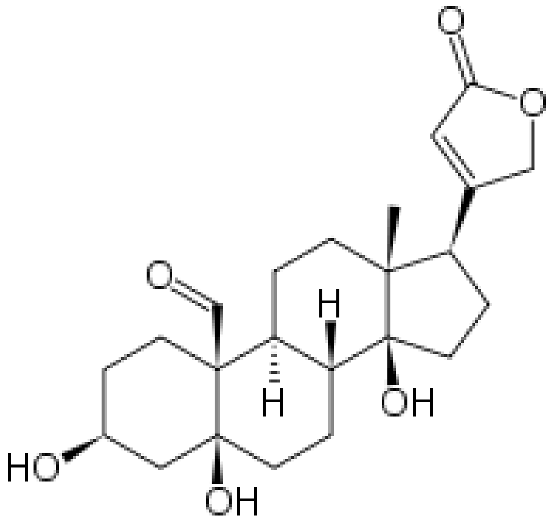
Here, the six member ring ABCDEF has at least one unsaturated bond therein. The neurally active substances may also be an ester of the hydroxyl group on R_1. Specific active compounds encompass terpineol, phenylethyl alcohol, benzylacetate, benzyl alcohol, eugenol, cinnamic alcohol and mixtures thereof. The invention relates to the control of pests such as insects and arachnids and, more particularly, to a non hazardous pest control agent that eliminates pests through either neural effects of a component or mechanical puncture of the exoskeleton and also, through the neurally effective component entering the puncture (Bessette and Knight, 2002). The following substances have been found to be active ingredients, useful as neurally effective substances:

- ✓ Benzyl alcohol
- ✓ Benzyl acetate
- ✓ Phenyl ethyl alcohol
- ✓ Terpineol
- ✓ Cinnamic alcohol
- ✓ Phenol and
- ✓ Eugeno.

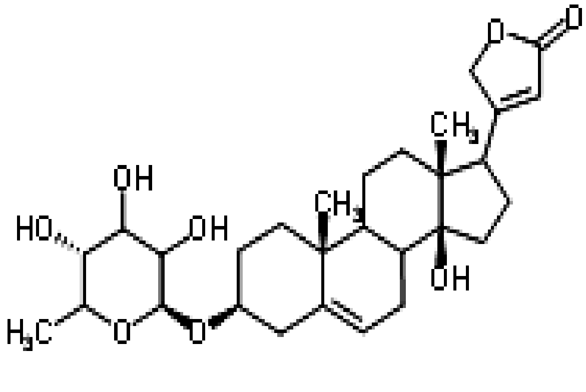
The seeds of *Corchorus capsularis* contain cardic glycosides (strophanthidin glycoside, corchoroside A and corchoroside B) and sterol eg. β-Sitosterol (R=H). The seeds of *Corchorus capsularis* on auto fermentation followed by extraction with methanol give monosides (corchoroside A and helveticoside), biosides, olitoriside, erysimoside, trioside as well as a glycoside of strophanthidin having boivinose and two glucose units as sugars (Khan *et al.,* 2006).



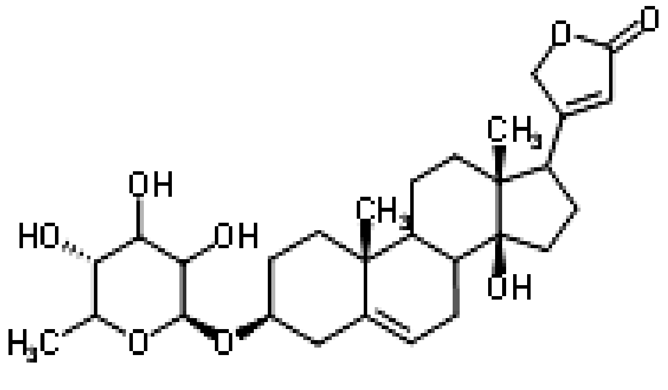
Chemical structure of cardic glycosides



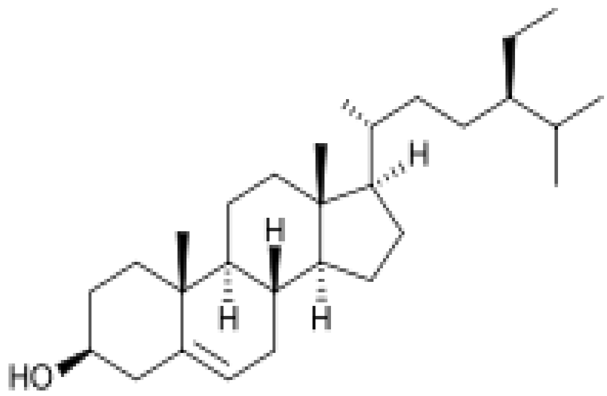
Chemical structure of glycoside of strophanthidin



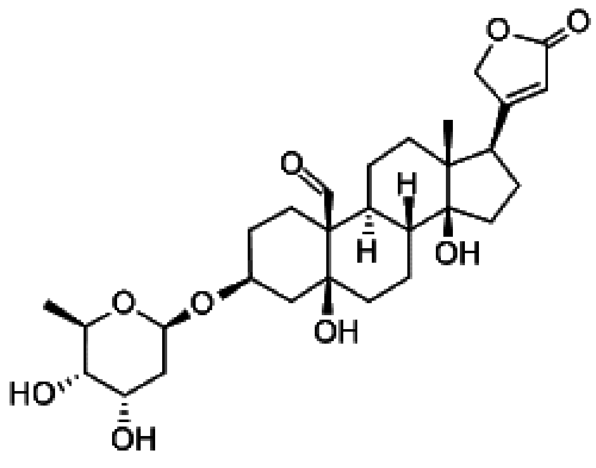
Chemical structure of corchoroside A



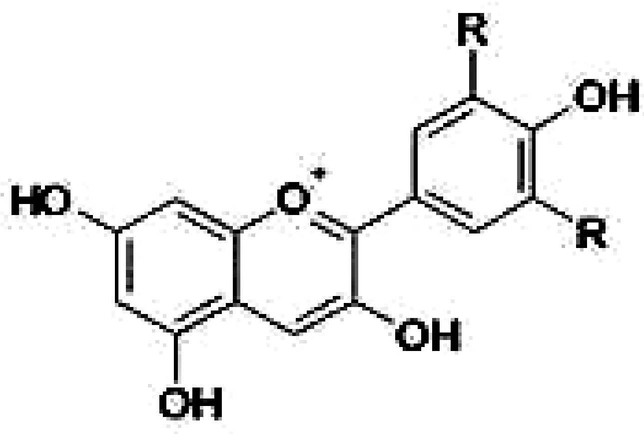
Chemical structure of corchoroside B



Chemical structure of β-Sitosterol



Chemical structure of helveticoside



Chemical structure of glucose units

Hence it can be humbly cited that the jute (*Corchorus capsularis* Linn.) plant has pesticidal properties. The dusts or extracts of jute may repel many pests in respect of crops like paddy, wheat and other crops (Ghosh, 2000). Miah *et al.* (2010) revealed that jute seed powder @ 40 kg/ha and jute seed extract (10:1 water: seed powder) posed positive effects in controlling different sugarcane pests. Mahfuz and Khanam (2007) reported that methanol extracts of *C. capsularis* showed tremendous toxicity against *T. confusum* adults. Rahman *et al.* (2012) also exercised the jute extracts in controlling the vegetables pest.

1.10 Essentiality the Study Oriented with Jute Seed Extracts for Pest Control

Eco-friendly management of pest such as use of botanical extracts has a great chance to save the beneficial soil microorganisms. Most of the botanical extracts are also cost effective and readily available near to the farmers in time. As a result botanical pesticides are becoming popular day by day. Now a day, these are being used against many insects. Use of botanical extract against insect pest control is however, a recent approach to insect pest management and it has drawn special attention to the

Entomologist all over the world. In Bangladesh, only a few attempts have been made to evaluate botanical extracts against insect's pest (Rahman *et al*., 2011). It would help to avoid environmental pollution caused by chemicals and thus become most rewarding one in our existing socio-economic conditions and environmental threat. Considering the above conditions, this research work has been undertaken to know insecticidal efficacy of jute for controlling the vegetables pests in Bangladesh.

1.11 Location of the Present Study

The experiments of the study were conducted both in the laboratory and experimental field of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh belonging to the Bangladesh Agricultural University (BAU), Mymensingh-2202 campus. This experimental site is situated on the western site of the Old Brahmaputra river located at 24.75^0 N latitude and 90.5^0 E longitudes at a mean elevation of 7.9 to 9.1m above the sea level. The specific experimental site showed through Fig. 1.1-1.3.

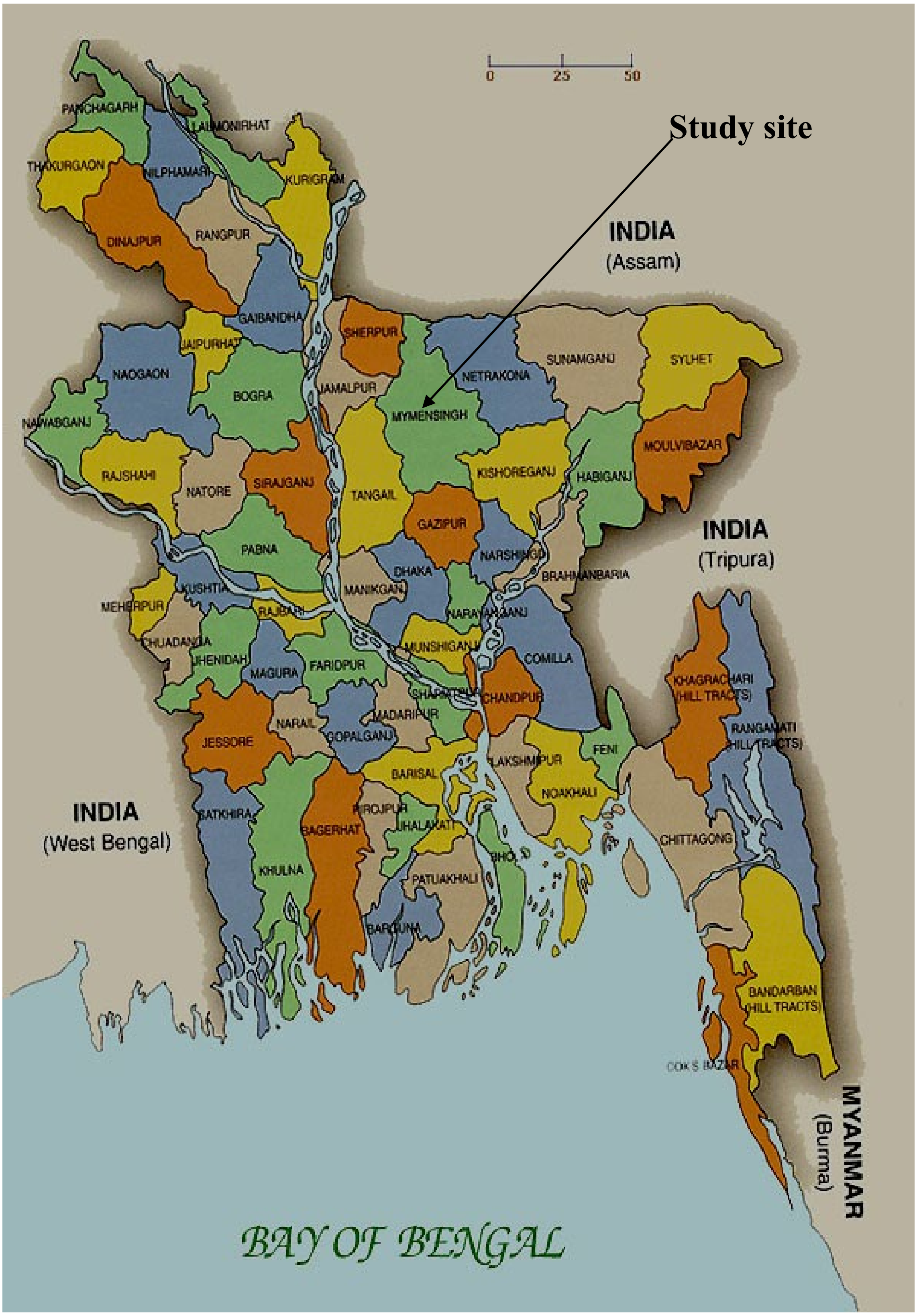


Fig. 1.1 A general map of Bangladesh showing the study site

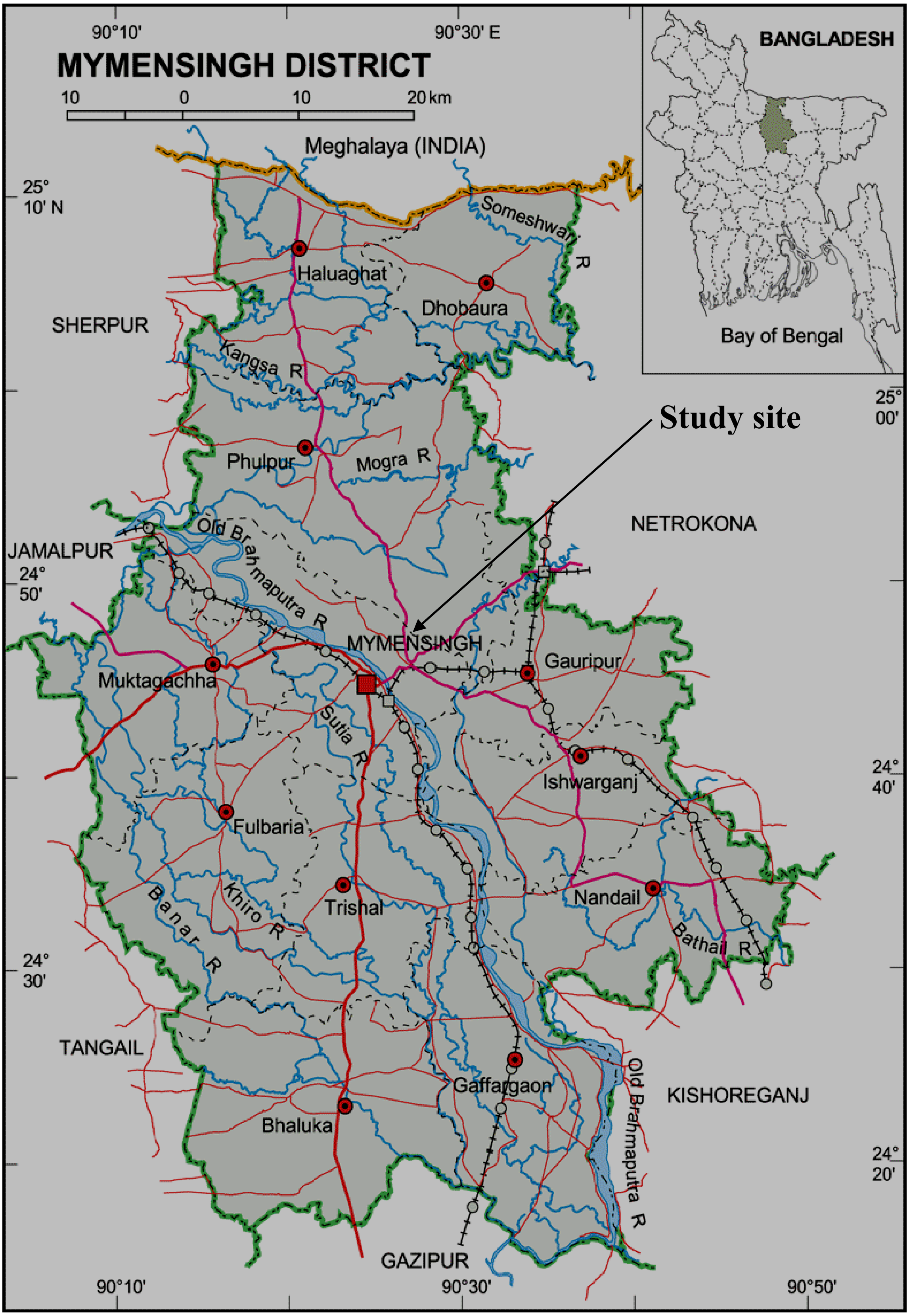


Fig. 1.2 A general map of the studied district (Mymensingh)

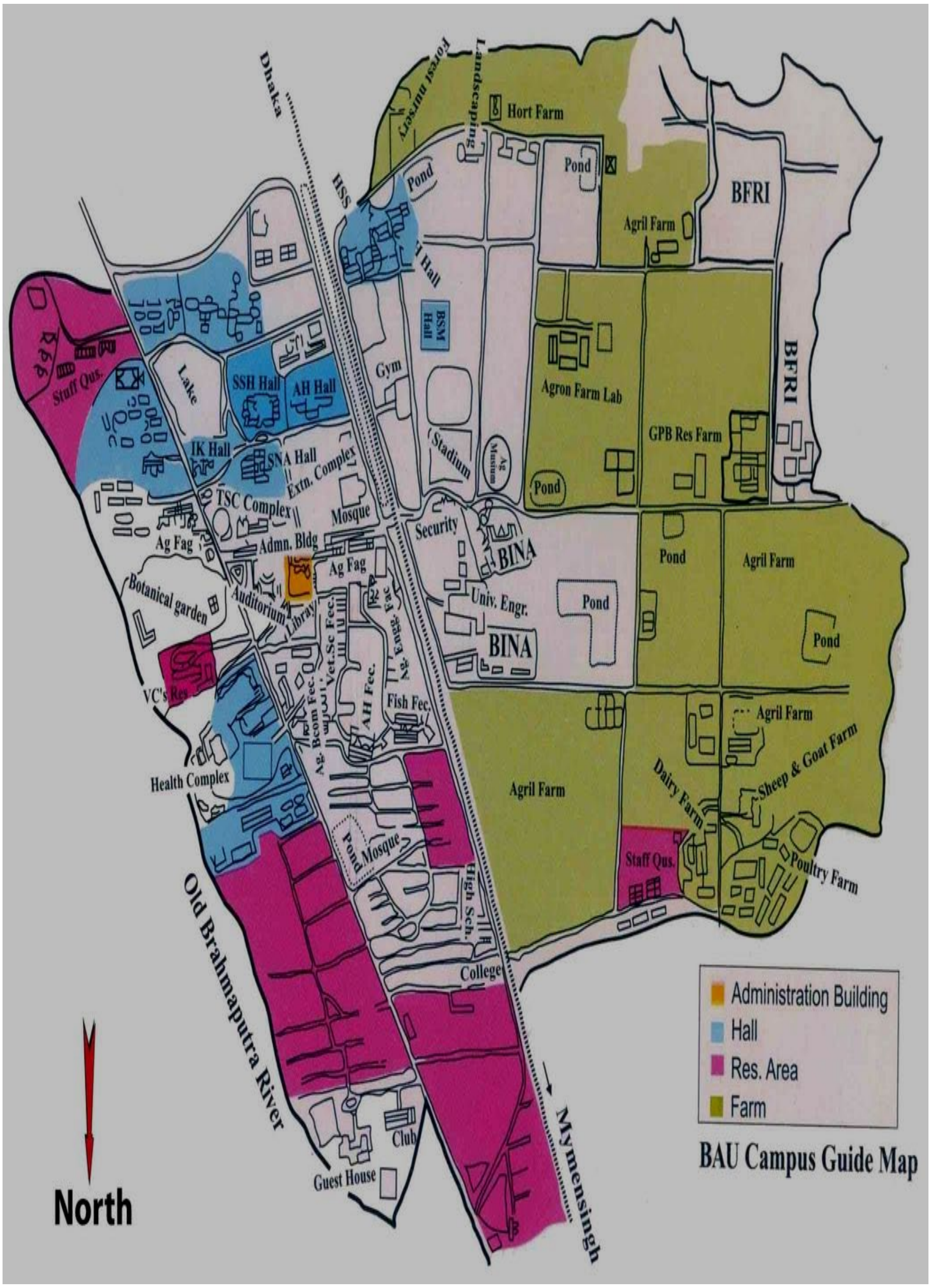


Fig. 1.3 A general map of the studied site (BINA in BAU campus)

1.12 Climatic Features of the Experimental Site

The experimental area was under the sub-tropical climate, which is characterized by high temperature, high humidity and heavily precipitation with occasional gusty winds in kharif season (April–September) and scanty rainfall associated with moderately low temperature during the rabi season (October–March). Data on weather conditions viz. temperature, relative humidity (RH), sunshine and rainfall during experimental period were collected from weather yard located in the western side nearest from the experimental field. Monthly average temperature, relative humidity, sunshine and total rainfall is presented in Appendix I.

1.13 Soil Properties of the Experimental Site

The soil of the experimental area was under the Brahmaputra alluvial tract with sandy loam soil and texture having good irrigation and drainage facilities. The pH of the soil was between 6.3 to 7.6 with an organic matter content of 0.8 to 1.6% (Rahman, 2009).

1.14 Test Crop of the Experiment

Three selected vegetables under three distinguish family viz. cucumber (*Cucumis sativas*) from cucurbitaceae, country bean (*Dolicos lablab*) from fabaceae and okra (*Abelmuscus esculentus*) from malvaceae were cultivated with a view to evaluating the insecticidal performances of Jute (*Corchorus capsularies*) against the selected insect attack, leaf as well as fruit infestation in vegetables field.

1.15 Target Insects

In the study following enlisted insect were studied:

- Red pumpkin beetle (*Aulacophora foveicollis*) on cucumber
- Black bean aphid (*Aphis fabae*) on country bean and
- Jassid (*Amrasca beguttula*) on okra.

1.16 Botanicals

Ten botanicals (Fig.1.4) were used in the laboratory for the selection of three best botanicals against the infestation of insects in cucumber, country bean and okra. The selected botanicals were used in the screening test are enlisted here:

- Jute seed (*Corchorus capsularies*),
- Jute leaves *(Corchorus capsularies*),
- Urmoi leaves (*Sapium imdicum*),
- Arahar leaves (*Cajanus cajan*),
- Custard apple leaves (*Annona reticuleta*),
- Ganda leaves and stems (*Tagetes patula*),
- Nisanda leaves (*Vitex negundo*),
- Lantana leaves (*Lantana camara*),
- Kalomegh leaves and stems (*Andrographis paniculata*) and
- Holde hurhuri (*Cleome viscosa*).

Jute Seed

Jute Leaves

Urmoi Leaves

Ahar leaves

Custard Apple Leaves

Ganda Leaves & steams

Nisinda

Lantana

Kalomegh

Holde Hurhuri

Fig.1.4.Ten selected botanicals used in the screening test

1.17 Extract Preparation

Botanicals were collected from BAU campus and air dried for one week at room temperature (30 $\pm$ 2º C). Dried leaves and seeds were then ground to powder using an electric grinder at the laboratory of the Entomology Division, BINA, Mymensingh. About 100 gm leaves and seeds dust were dissolved in 300 ml methanol and kept for 48 hours. Then plant extract was filtered through a thin cotton cloth and finally from the extracts methanol was evaporated upto 5 ml using a rotary evaporator at 50^0C to prepare crude extract. Crude extracts were kept under low temperature (-4^0C) in the freezer until receiving the solid extracts and further use. These solid extracts and siperin were diluted with methanol and water, respectively before use. A general and standard extract preparation flow chart is shown below in Fig.1.5.

Collection of plant parts

↓

Air dried for 7 days

↓

Cutting/Grinding

↓

Dissolve in Methanol

↓

Filtration

↓

Rotary Evaporation

↓

Botanical Extract

↓

Preserved in a refrigerator at - 4°C until used

Fig.1.5 A general and standard flow chart for extract preparation from botanicals

1.18 Uses of Botanicals

In the study, ten selected botanicals @ 10.0% were used for conducting the mortality test of red pumpkin beetle, black bean aphid and okra jassid. Then the three best botanicals were selected from the results of mortality test conducted in the laboratory. This mortality test also screened the appropriate doses of botanicals.

1.19 Objectives of the Study

1. To screen the effective botanical for controlling vegetables pest;
2. To study the effect of botanicals on mortality on red pumpkin beetle, black bean aphid and okra jassid;
3. To investigate the effect of botanicals on anti-feedant activity of red pumpkin beetle;
4. To show the effect of botanicals on insect infestation as well as vegetables production, and
5. Finally to suggest the botanicals of jute extract as the potential and eco-friendly tools for sustainable vegetables field management.

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Chapter 2

SCREENING OF BOTANICALS FOR CONTROLLING OF VEGETABLES PEST

ABSTRACT

A screening test of botanicals for controlling the vegetables pest was conducted during June, 2012 to May, 2013. In the study, three test insects viz. red pumpkin beetle, black bean aphid and okra jassid were collected from the Bangladesh Agricultural University campus (BAU), Mymensingh. Ten selected botanicals such as jute seed (*Corchorus capsularies*), jute leaves *(Corchorus capsularies*), urmoi leaves (*Sapium imdicum*), arahar leaves (*Cajanus cajan*), custard apple leaves (*Annona reticuleta*), ganda leaves and stems (*Tagetes patula*), nisinda leaves (*Vitex negundo*), lantana leaves (*Lantana camara*), kalomegh leaves and stems (*Andrographis paniculata*) and holde hurhuri (*Cleome viscosa*) were collected from BAU campus for extract preparation. These extracts were applied for determining the % mortality on three insects. The study revealed that botanicals showed significant adult mortality (%) of red pumpkin beetle at different hours after treatment i.e. 24, 48, 72 and 96 hours. In case of jute seed, the mortality (%) found 70% at 24 hours, which reached to 83.33% at 48, 72 and 96 hours, respectively. In this period, jute seed showed about 1.90, 1.49, 4.19, 1.10, 7.00, 3.00, 1.49, 4.19 and 5.25 times higher performances in comparison with jute leaves, urmoi leaves, arhar leaves, custard apple leaves, ganda leaves, nisinda leaves, lantana leaves, kalomegh and halde hurhuri, respectively. Here ganda leaves gave the worst insecticidal performances at all the studied intervals. The study also found somewhat same performances of the studied botanicals on black been aphid and okra jassid as like as red pumpkin beetle. However, in the case of black bean aphid and okra jassid, significant mortality (%) also achieved by the studied botanicals at different hours after treatment i.e. 12, 24, 36 and 48 hours. The mortality (%) ranged from 5.00 to 26.67 % at 12 hours, which recorded as 21.67 to 78.33; 30.00 to 91.67 and 33.33 to 100% at 24, 36 and 48 hours, respectively in the case of black bean aphid. On the other hand, the mortality (%) ranged from 3.33 to 26.67, 21.67 to 80.00, 25.00 to 81.67 and 30.00 to 88.33% at 12, 24, 36 and 48 hours, respectively in okra jassid. After all, in some cases, there was no significant variation between two or among more botanicals but always, the jute seed showed the highest performance than that of other studied botanicals. The custard apple leaves ranked in the 2nd highest position whereas urmoi leaves and lantana jointly placed in the 3rd highest position in the case of red pumpkin beetle. In respect of black bean aphid and okra jassid, the jute seed, custard apple leaves and urmoi leaves ranked as the 1st, 2nd and 3rd best position of the studied botanicals. The study also found that the percent (%) mortality increased with passing time of treatment up to a certain period in red pumpkin beetle, black bean aphid and okra jassid.

2.1 Introduction

Indiscriminate use of chemical pesticides on vegetables has created many health and environment oriented problems like genetic resistance of pest species, toxic residues in stored products, increasing costs of application, environmental pollution, hazards from handling etc. (Khanam *et al*., 1990). Agro-chemicals pollution in soil and water has created a worldwide awareness in the development of alternative type of insecticides and usage of traditional botanical pest control agents (Heyde *et al*., 1984). There is an urgent need for safe and biodegradable pesticide, which does not affect the health, environment as well as non-target organisms. Botanical insecticides have broad-spectrum activity and specific mode of action. These insecticides are easy to process and use. It is safe to human, animals and environment (Anonymous, 1991). Locally available plant materials have been widely used in the past to protect stored produce against damage by insect infestation (Golob and Webley, 1980). The advantages of botanical pesticides are less expensive and easy production technique. Farmers can apply this technique easily at home. The application of simple crude botanicals, such as botanical extracts and cake are suited for crop protection by resource limited farmers in developing countries like Bangladesh. Botanical materials can be processed at village level and crude fractions can be extracted using simple method. Bangladesh is rich in plant biodiversity and has a good scope to produce botanical pesticides using suitable formulations of different indigenous botanicals for eco-friendly pest management in crop fields. In this study ten botanicals were collected from Bangladesh Agricultural University campus area and minutely investigated in terms of mortality of red pumpkin beetle, black been aphid and okra jassid with a view to select the best botanicals in associated with jute seeds.

Specific objectives of this piece study:

I. To collect the botanicals available in the Bangladesh Agricultural University campus area in associated with jute seed,

II. To preserve the botanicals for extract preparation,

III. To conduct the insect mortality test with botanical extract in lab. condition,

IV. To compare the efficiency of the botanicals in respect of insect mortality and

V. To screen the minimum two botanicals in associated with jute seed.

2.2. Materials and Methods

2.2.1 Duration the Screening Test

The screening test of botanicals for controlling the vegetables pest was conducted during the period from June, 2012 to July, 2012 for red pumpkin beetle, November, 2012 to December, 2012 for black bean aphid and March, 2013 to May, 2013 for okra jassid.

2.2.2 Collection and Rearing of Insect

The test insects, red pumpkin beetle, black bean aphid and okra jassid were collected from the Bangladesh Agricultural University campus, Mymensingh. In this study red pumpkin beetle was reared in net house, whereas black bean aphid and okra jassid were reared under laboratory condition in the Entomology Division, BINA, Mymensingh.

2.2.3 Collection of Botanicals

Selected ten botanicals such as jute seed (*Corchorus capsularies*), jute leaves *(Corchorus capsularies*), urmoi leaves (*Sapium imdicum*), arahar leaves (*Cajanus cajan*), custard apple leaves (*Annona reticuleta*), ganda leaves and stems (*Tagetes patula*), nisanda leaves (*Vitex negundo*), lantana leaves (*Lantana camara*), kalomegh leaves and stems (*Andrographis paniculata*) and holde hurhuri (*Cleome viscosa*) were collected from BAU campus of Mymensingh district. After collection, fresh plant parts were washed in running tap-water and air dried in the shade for 1 (one) week at room temperature 30 $\pm$ 2ºC.

2.2.4 Preparation of Botanical Extracts

Botanical extracts were prepared in the laboratory of the Entomology Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh-2202. Firstly, air dried botanicals plant parts were ground to powder in an electric grinder. A 25 mesh diameter sieve was used to obtain fine dust. Hundred gram of each category of dust were taken in a 600 ml beaker and separately mixed with 300 ml of selected solvents (methanol). Then the mixture was stirred for 30 minutes by a magnetic stirrer (at 6000 rpm) and left to stand for next 48 hours. The mixture was then filtered through a thin cotton cloth.

Nine General Precautions followed during Preparing and Using the Botanicals Extracts:

I. Selection of disease free plant parts.
II. Collection of fresh plant parts.
III. Use of clean glass wares for preparation of botanical extracts.
IV. Make sure that the place of the plant extract out of reach of ordinary people while leaving it overnight.
V. Try out different strengths of the botanical extracts to determine effective dosages for specific pests.
VI. Always test the plant extract formulation on a few infested plants first before going into large scale spraying.

VII. Wear protective clothing while preparing, handling as well as applying the extract.

VIII. Properly wash the hands after handling the plant extract.

IX. Additional extracts kept in safe place as well as save condition.

2.2.5 Mortality Test for Red Pumpkin Beetle

Fresh and young cucumber leaves were collected, treated by 10% botanical extracts and air dried. Then the each treated cucumber leaves separately were placed upside down in a petri dish 7.5 cm (dia). 10 beetles were released on each leaf after collapse through minor freezing (Fig. 2.1). The experiment was laid out in a Completely Randomized Design with three replications. The numbers of dead beetles were counted after 24, 48, 72 and 96 hours and expressing in percentage.

Fig.2.1 Determination the mortality (%) of red pumpkin beetle

2.2.6 Mortality Test for Black Bean Aphid

The collected fresh young twigs of country bean were treated by 10% concentrated botanical extracts and air dried. Then the twigs were placed also in a petri dish, 7.5 cm (dia). Then 20 aphids were transferred in the petri dish individually by using a camel hair brush (Fig. 2.2). The experiment was laid out in a Completely Randomized Design with three replications. Insect mortalities were recorded at 12, 24, 36 and 48 hours after treatment. Observed mortalities of the insects were analyzed by ANOVA.

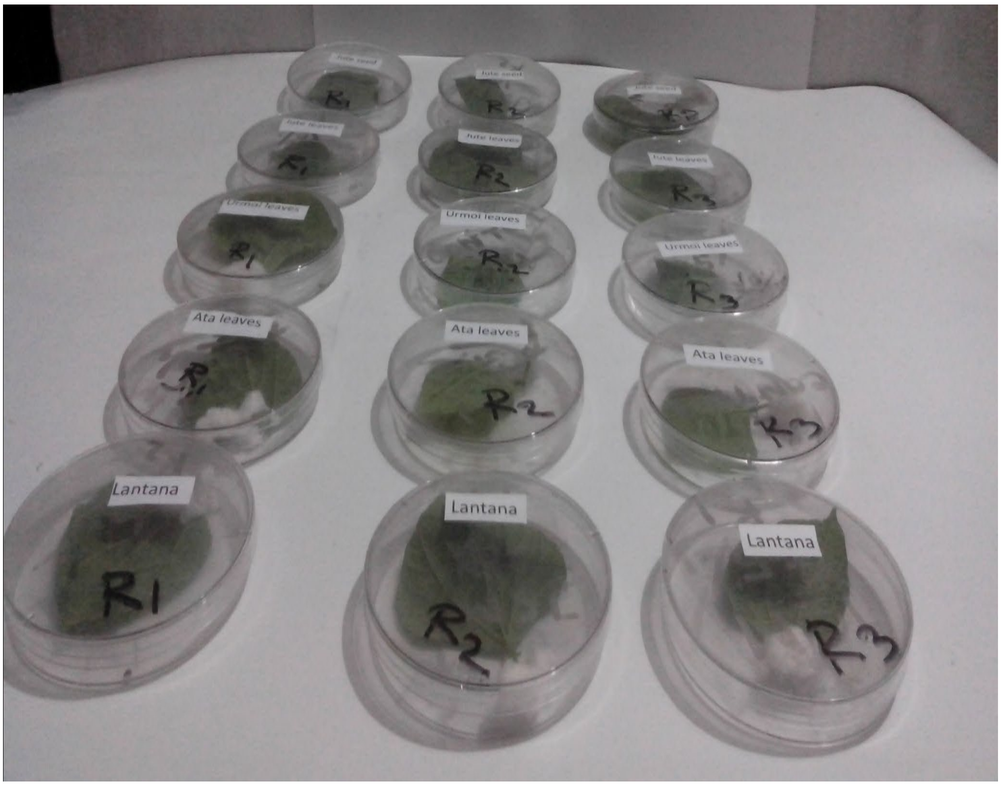

Fig.2.2 Determination the mortality (%) of black bean aphid

2.2.7 Mortality Test for Okra Jassid

The fresh and young leaves collected form okra plants were treated by 10% concentrated botanical extracts. Then the treated leaves were air dried and placed also in a petri dish, 7.5 cm (dia). In the okra leaves containing petri dish 20 jassids were transferred in the petri dish individually by using a camel hair brush (Fig. 2.3). The experiment was also laid out in a Completely Randomized Design with three replications. Insect mortalities were recorded at 12, 24, 36 and 48 hours after treatment, which were expressing in percentage.

Fig.2.3 Determination the mortality (%) of okra jassid

2.2.8 Screening the three best Botanicals

In the study based on the efficacy of ten selected botanicals on mortality of red pumpkin beetle, black bean aphid and okra jassids, the best three botanicals were selected to conduct the further study in the laboratory as well as in the vegetables field. Here the selected best three botanicals are as follows:

- Jute seed (*Corchorus capsularies*),
- Urmoi leaves (*Sapium indicum*) and
- Custard apple leaves (*Annona reticulata*).

Short details of jute seed, urmoi leaves and custard apple leaves are illustrated in Table 2.1.

Table 2.1 Short details of jute seed as well as custard apple and urmoi leaves

Identification criteria	**Jute**	**Custard apple**	**Urmoi**
I. Scientific name	*Corchorus capsularies*	*Annona reticulata*	*Sapium indicum*
II. Family	Tiliaceae	Annonaceae	Euphorbiaceae
III. Plant parts used	Seeds	Leaves	Leaves
IV. Features of the used plant parts	Small, chocolate brown, 4-5 faced and about 300 seeds per gram.	The slender leaves are hairless, straight and pointed at the apex (in some varieties wrinkled), 10 cm (3.9 in) to 20 cm (7.9 in) long and 2 cm (0.79 in) to 7 cm (2.8 in) wide.	The leaves are willow-like, and at their point of union with the stalk have two round glands.
V. References cited regarding bio-pesticidal evidences	Miah *et al.* (2010) Khan *et al.,* 2006). Hossen *et al.* (2008	Prakash and Rao, 1997 Vijayalakshmi; *et. al.*, 1998	Rahman *et al.* (2004)

2.2.9 Statistical analysis

The experimental data were statistically analyzed by Completely Randomized Design using MSTAT statistical software in a micro computer. The mean values were separated by Duncan's Multiple Range Test (DMRT).

2.3 Results and Discussion

2.3.1 Results

2.3.1.1 Screening of Botanicals for Controlling Red Pumpkin Beetle in Cucumber

The ten tested botanicals showed the significant adult mortality (%) of red pumpkin beetle at different intervals after treatment i.e. 24, 48, 72 and 96 hours (Appendix II and Table 2.2). In case of jute seed, 70% mortality was found at 24 hours, which reached in 83.33% at 48 hours after that the increasing trend was not visible, i.e. the same mortality (%) estimated at 48, 72 and 96 hours, respectively. In 24 hours, mortality (%) ranged 10.00 to 70.00% for ten different selected botanicals. In this period, jute seed showed 1.90, 1.49, 4.19, 1.10, 7.00, 3.00, 1.49, 4.19 and 5.25 times higher performances in comparison with jute leaves, urmoi leaves, arhar leaves, custard apple leaves, ganda leaves, nisinda leaves, lantana leaves, kalomegh and halde hurhuri, respectively. Here ganda leaves gave the worst insecticidal performances. In 48 hours, the studied botanicals ensured 16.67 to 83.33% mortality of red pumpkin beetle. In this treated periods, the efficiency of botanicals ranked as jute seed>custard apple leaves>urmoi leaves> lantana>jute leaves>nisinda>kalomegh>holde hurhuri & ganda leaves>arhar leaves (Table 2.2). In 72 hours, the mortality (%) ranged 20.00 to 83.33%, where jute seed showed the highest performances and arhar leaves as well as holde hurhuri jointly showed the lowest (worst) insecticidal performances. The studied botanicals showed the more efficiency gradually with passing time up to a certain period. Here mortality (%) increased at 48 hrs than that of 24 hours and also at 72 hours than that of 24 and 48 hours except jute seed at 48 and 72 hours; arhar leaves at 24 and 48 hours; custard apple leaves at 24 and 48 hours as well as holde hurhuri at 48 and 72 hours, respectively.

After 72 hours, mortality (%) was not prominent i.e. some botanicals gave same mortality % both in the 72 and 96 hours periods. Some botanicals increased the mortality % in 96 hours than that of 72 hours but the increasing trend is very negligible (Table 2.2). In some cases there was no significant variation between two or among more botanicals but always jute seed showed identically significant performance than that of others except in case of custard apple leaves at 24 and 96 hours, respectively (Table 2.2).

Table 2.2 Screening the methanol extracted botanicals against red pumpkin bettle

Plant extracts	Adult mortality at different time intervals (%)			
	24 hrs	**48 hrs**	**72 hrs**	**96 hrs**
Jute seed	70.00 a	83.33 a	83.33 a	83.33 a
Jute leaves	36.67 c	43.33 c	46.67 c	46.67 c
Urmoi leaves	46.67 b	53.33 c	63.33 b	63.33 b
Arahar leaves	16.67 de	16.67 d	20.00 e	23.33 e
Custard apple leaves	63.33 a	63.33 b	70.00 b	76.67 a
Ganda leaves	10.00 e	20.00 d	20.00 e	23.33 e
Nisanda	23.33 d	26.67 d	36.67 d	36.67 d
Lantana	46.67 b	50.00 c	53.33 c	56.67 b
Kalomegh	16.67 de	23.33 d	26.67 e	30.00 de
Holde harhar	13.33 e	20.00 d	20.00 e	23.33 e
$LSD_{0.05}$	7.61	9.83	9.32	9.91
Level of significance	**	**	**	**
CV (%)	13.03	14.43	12.45	12.57

* Means in a column followed by the same letter are not significantly different at ($P<0.01$) by DMRT.

2.3.1.2 Screening of Botanicals for Controlling Black Bean Aphid in Country Bean

The significant mortality (%) of black bean aphid achieved by ten selected botanicals at different hours of treatment i.e. 12, 24, 36 and 48 hours

(Appendix III and Table 2.3). The mortality (%) of black bean aphid increased gradually passing the treated hour, where 3.00 to 4.20 times higher mortality recorded at 24 hours than that of 12 hours. The estimated mortality (%) at 36 hours showed about 1.30 times higher mortality (%) than that of 24 hours and 1.20 times higher at 48 hours than that of 36 hours. Ultimately 5 times higher mortality (%) attained in last reading period (at 48 hours) than that of initial reading period i.e. at 12 hours. The mortality (%) ranged from 5.00 to 26.67 % at 12 hours, which recorded as 21.67 to 78.33; 30.00 to 91.67 and 33.33 to 100% at 24, 36 and 48 hours, respectively.

Table 2.3 Screening the methanol extracted botanicals against black bean aphids

Plant extracts	Adult mortality at different time intervals (%)			
	12 hrs	**24 hrs**	**36 hrs**	**48 hrs**
Jute seed	26.67 a	78.33 a	91.67 a	100.0 a
Jute leaves	10.00 cd	31.67 de	40.00 d	50.00 d
Urmoi leaves	16.67 b	58.33 b	71.67 b	78.33 b
Arahar leaves	5.000 f	21.67 f	30.00 d	33.33 e
Custard apple leaves	18.33 b	61.67 b	75.00 b	80.00 b
Ganda leaves	8.333 de	25.00 ef	30.00 d	36.67 e
Nisanda	8.33 de	28.33 ef	33.33 d	45.00 d
Lantana	11.67 c	40.00 cd	50.00 c	58.33 c
Kalomegh	11.67 c	41.67 c	51.67 c	58.33 c
Holde harhar	6.667 ef	21.67 f	30.00 d	33.33 e
$LSD_{0.05}$	1.72	8.37	9.83	6.60
Level of significance	**	**	**	**
CV (%)	8.37	12.04	11.47	6.76

* Means in a column followed by the same letter are not significantly different at ($P<0.01$) by DMRT.

The study screened the jute seed also as the best botanicals comparatively about 2.00, 1.28, 3.03, 1.25, 2.78, 2.22, 1.72, 1.72 and 3.03 times higher than that of jute leaves, urmoi leaves, arhar leaves, custard apple leaves, ganda leaves, nisinda leaves, lantana leaves, kalomegh and halde hurhuri, respectively at 48 hours. Here in some cases there was no significant variation between two or among more botanicals but always jute seed showed identically significant performance than those of other botanicals (Table 2.3).

2.3.1.3 Screening of Botanicals for Controlling Okra Jassid in Okra

The studied ten selected botanicals showed significant mortality (%) of okra jassid at different hours of treatment i.e. 12, 24, 36 and 48 hours (Appendix IV and Table 2.4). The mortality (%) of okra jassid recorded 3.00-5.00 times higher at 24 hours than that of 12 hours (Table 2.4). The estimated mortality (%) estimated about 1.2 times higher at 36 and 48 hours than that of 24 hours where as 6.00 times higher than that of initial reading.

Table 2.4 Screening the methanol extracted botanicals against okra jassids

Plant extracts	Adult mortality at different time intervals (%)			
	12 hrs	24 hrs	36 hrs	48 hrs
Jute seed	26.67 a	80.00 a	81.67 a	88.33 a
Jute leaves	10.00 cd	41.67 b	46.67 c	55.00 c
Urmoi leaves	16.67 b	48.33 b	58.33 b	68.33 b
Arahar leaves	5.000 e	25.00 d	30.00 ef	36.67 e
Custard apple leaves	16.67 b	48.33 b	58.33 b	66.67 b
Ganda leaves	6.667 de	28.33 cd	33.33 e	38.33 e
Nisanda	10.00 cd	33.33 c	40.00 d	46.67 d
Lantana	5.000 e	23.33 d	28.33 ef	33.33 e
Kalomegh	13.33 bc	45.00 b	50.00 c	60.00 bc
Holde harhar	3.333 e	21.67 d	25.00 f	30.00 e
$LSD_{0.05}$	3.81	6.22	6.60	8.23
Level of significance	**	**	**	**
CV (%)	19.73	9.24	8.57	9.23

* Means in a column followed by the same letter are not significantly different at (P<0.01) by DMRT.

The mortality (%) ranged from 3.33 to 26.67, 21.67 to 80.00, 25.00 to 81.67 and 30.00 to 88.33% at 12, 24, 36 and 48 hours, respectively. The study screened also the jute seed as the best botanicals comparatively about 1.60, 1.29, 2.44, 1.33, 1.32, 1.91, 2.67 1.47 and 2.93 times higher than that of jute leaves, urmoi leaves, arhar leaves, custard apple leaves, ganda leaves, nisinda leaves, lantana leaves, kalomegh and halde hurhuri, respectively at 48 hours (Table 2.4). In some cases there was no significant variation between two or among more botanicals but always jute seed showed identically significant performance than that of other studied botanicals.

2.3.2 Discussion

Insect pests attack in vegetables cause considerable quantitative and qualitative losses throughout the world and here many tools are also available for managing insects and pests. Amongst them the use of plant and inert materials may be a safe, cost-effective and environmentally friendly method (Obeng-Ofori, 2010).

Botanicals are plant-derived compounds with different modes of action (Weaver and Subramanyam, 2000). Many of these plants are widely used in traditional medicine by local communities for the treatment of several ailments. A number of excellent publications provide useful information regarding the types of plants used in different parts of the world (Golob and Webley, 1980; Golob *et al*., 1999; Weaver and Subramanyam, 2000; Obeng-Ofori, 2007). Bangladesh and many other Asian countries are rich in plant products and traditionally used by the rural inhabi- tants for medicinal purpose and in some instance as pre- parations for insect control (Talukder and Howse, 1993). Bio-insecticides being environment friendly seems to have some superiority over synthetic insecticides; in this respect more than 2400 plants have been identified with pest control properties (Grainge and Ahmed, 1988). Plant extracts showed deleterious effect on the growth and development of insects and reduced larval pupal and adult weight significantly, lengthened the larval and pupal periods, and reduced pupal recovery and adult eclosion of insect (Khanam *et al*., 1990). Plant derivatives also reduce the survival rates of larvae and pupae and adult emergence (Koul *et al*., 2008). The crude extract also retarded development and caused mortality of larvae, cuticle melanisation, and high mortality in adults of insect (Jamil, 1984).

Detailed information on the reliability and efficacy of botanicals with respect to where and when the plant materials are collected is also lacking. Many plant species contain secondary metabolites that are potent against several pest species. Not only are some of the plants of major interest as sources of phytochemicals for more environmentally sound crop protection. Plant secondary metabolites are well-known to vary according to climatic, seasonal, geographical location and genetic effects. For example, in Ghana materials derived from neem collected from Upper East Region were generally found to be more potent than those from Northern Region (Belmain *et al.,* 1999).

Here the efficiency of 10 selected botanicals (jute seeds, jute leaves, urmoi leaves, arhar leaves, custard apple leaves, ganda leaves, nisinda leaves, lantana leaves, kalomegh and halde hurhuri) widely and intensively tested against the mortality (%) of red pumpkin beetle on cucumber leaves treated by above botanicals. The present study screened the jute seed as the superior as well as the best botanicals. Custard apple leaves ranked in the 2nd highest position, whereas urmoi leaves and lantana jointly placed in the 3rd highest position. The studied botanicals after all showed the mortality (%) upto 83.33% in case of jute seed and 2nd highest mortality (%) as the value 76.67% in case of custard apple leaves. On the other hand urmoi leaves ensured the mortality (%) upto 63.33%. These three botanicals showed the mortality (%) above 60.00%; only one botanical (lantana) showed the mortality (%) above 50.00% but less than 60.00% and other botanicals ensured mortality (%) upto 46.67% which is less than 50.00%. Here the lowest mortality (%) estimated as 23.33% jointly from arhar leaves and holde hurhuri (Table 2.2). The screening test of the selected 10 botanicals was also performed in case of black bean aphid. Here the insecticidal activity of botanicals revealed the jute seed, custard apple leaves and urmoi leaves as the 1st, 2nd and 3rd best botanicals among the studied ones. The screening test for okra jassid was also conducted where insecticidal activity of botanicals also revealed the jute seed, custard apple leaves and urmoi leaves as the 1st, 2nd and 3rd best botanicals among the studied ten botanicals in case of okra jassid.

A few trials have been undertaken in the field in some developing countries which partially simulate on-farm conditions. The use of jute bags impregnated with 10% concentration of aqueous extracts from *Chenopodium ambrosiodes* and *Lantana camara,* to reduce infestation to cowpea and broad bean seeds by *C. maculatus* and *Acanthoscelides obtectus* (Say) was compared with direct seed treatment using plant powders at 4% (w/w) (Koona *et al.,* 2007). After 6 months storage, the jute bags impregnated with plant extracts were found to be more effective than seed treatment with plant powders in terms of reduction in seed damage. It is, however, the transfer of such technology to other environments or the extension of the use of these methods to other communities within the same areas that have not been feasible to date. There is therefore the need for more systematic studies to determine how farmers utilize plant protectants, the methods employed and their effectiveness in the field (Obeng-Ofori, 2010).

Conclusion

The studied 10 selected botanicals (jute seeds, jute leaves, urmoi leaves, arhar leaves, custard apple leaves, ganda leaves, nisinda leaves, lantana leaves, kalomegh and halde hurhuri) tested against the mortality (%) of red pumpkin beetle, black bean aphid and okra jassid. Here mortality (%) achieved upto 83.33-100.00% in case of jute seed and 2nd highest mortality (%) as the value 76.67-78.33% in case of custard apple leaves. On the other hand urmoi leaves ensured the mortality (%) upto 63.33-80.00%. These three botanicals showed the mortality (%) above 60%; another botanical (lantana) showed the mortality (%) above 50% but other botanicals ensured mortality (%) below 50%**.** Hence, the screening test of this study selected the jute seed, custard apple leaves and urmoi leaves as the 1st, 2nd and 3rd best botanicals for controlling the vegetables pest viz. red pumpkin beetle in cucumber, black bean aphid and country bean and okra jassid in okra.

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Chapter 3

COMPARATIVE PERFORMANCES OF SIPERIN AND BOTANICALS INCLUDING JUTE SEED FOR THE CONTROL OF RED PUMPKIN BEETLE IN CUCUMBER FIELD

ABSTRACT

The study consisted of three types of botanical such as jute seeds, custard apple leaves and urmoi leaves and one chemical insecticide namely siperin which were aplied against red pumpkin beetle during the period from June 2012 to September 2013. Different concentrations of botanical extracts (5%, 7.5% and 10%) and three concentration of siperin (0.05%, 0.10% and 0.2%) were applied to carry out % mortality test as well as antifeedant test of red pumpkin beetle in the laboratory of the Entomology Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh. In the field condition only the best doses of siperin (0.10%) and botanicals (10.00%) were used based on the laboratory results. In the study, mortality was assessed after 24, 48, 72 and 96 hrs of treatment. The study detected significant effect of botanicals as well as siperin on mortality (%) of red pumpkin beetle where siperin ensured 63.33% mortality at 96 hrs. On the other, in the same period, jute seed, custard apple leaves as well as urmoi leaves showed 46.50, 38.33 and 37.50% mortality, respectively. The study ensured more mortality (%) in higher doses, 2.1-2.2 times higher mortality in 10% concentration than that of 5% and 1.3- 1.4 times higher in case of 7.5 % concentration of botanicals. The study also showed that significant effect of botanicals and siperin on % weight loss of cucumber leaves where siperin ensured lowest 28.02% and jute seed produced the 2nd minimum 29.74 % weight loss. The study also revealed that higher concentration increased the % mortality of red pumpkin beetle than that of lower one. The study investigated also that the jute seed extract showed the highest plant height (222.30 cm), more number of leaves/plant (69.33 nos.), highest number of fruit per plant (24.67 nos.) and fruit yield (3.96 kg/plant). On the other hand, control treatment gave the shortest plant, less number of leaves/plant, lowest number of fruits/plant and cucumber yield. The study however also stated that amongst the studied botanicals jute seed showed 1.33 and 1.63 times better performances than that of custard apple leaves and urmoi leaves, in respect to % leaf infestation of cucumber leaves. Even jute seed showed 1.20 times higher performances than chemical insecticide, siperin.

3.1 Introduction

Red pumpkin beetle, *Aulacophora foveicollis* (Lucas) is a serious and destructive pest of cucurbits (Rathod *et al.,* 2009). On hatching, the larvae of *A. foveicollis* start boring in to the roots. It causes damage in various ways along with the underground stem portion as well as by feeding on the leaves and fruits line in contact with the soil (Srivastava and Butani, 1998; Rahman, 2013). The adults feed on cotyledons, flowers and foliage causing holes when creepers are very young and the early sown cucurbits are severely damaged that they may have to be re-sown (Atwal and Dhaliwal, 2002). The cucurbit plant sometimes becomes completely defoliated in the early stages due to attack of red pumpkin beetle (Rajak, 2002; Parsad and Kumar, 2002; Mahmood *et al*., 2005).

Cucumber (*Cucumis sativus* L.), the member of cucurbitaceae family is an important vegetable and thought to be one of the oldest vegetables cultivated by man with historical records dating back 5000 years (Wehner and Guner, 2004). The fruit of cucumber is used primarily for pickling and for slicing as a salad. Besides being widely used for culinary purposes, cucumber is also used in facial creams, lotions, and cleansers. This anti-inflammatory agent is known for its astringent and soothing properties (Azad *et al.*2013).

The insect pests infest cucumber varying to some extent. Here red pumpkin beetle is one of the major destructive insect ones (Rahman *et al*., 2013). Singh *et al*. (2000) studied the host preference of red pumpkin beetle on different cucurbit crops and reported cucumber as medium in preference. Two more species are also reported to attack cucurbit crops in Indian subcontinent (Nayar *et al*., 1996). The farmers always give priority to protect such a high value vegetable crop from any kind of damage caused by insects and pests. However, for the control of the beetle, many methods have been adopted but synthetic insecticides are still playing a key role from the last fifty years. But there are problems of pesticide resistance and negative effects on non-target organisms including man and the environment. Botanicals are promising source of pest control compounds. These have generated extraordinary interest in recent years as potential sources of natural insect control agents (Rahman *et al.,* 2007). In the present study, three best botanicals including jute seeds, screened from ten studied ones were tested against the red pumpkin beetle to investigate the insecticidal effectiveness as well as determination of the suitable doses for control of red pumpkin beetle *A. foveicollis* (Lucas) in comparison with siperin used as the test insecticide in partial fulfillment for the controlling of red pumpkin beetle in cucumber field as the tool of sustainable agriculture as well as the build-up component of the sound environment .

Specific Objectives of this Study:

I. To investigate the effectiveness of siperin and botanicals on mortality (%) of red pumpkin beetle,
II. To detect the antifeedant performances of siperin and botanicals on the red pumpkin beetle,
III. To identify the effectiveness of botanical extracts on growth and yield of cucumber,
IV. To observe the efficacy of botanical extracts in controlling the infestation caused by red pumpkin beetle in cucumber, and
V. To compare the efficiency of jute seeds as the botanical insecticide for eco-friendly controlling the red pumpkin beetle in cucumber field.

3.2. Materials and Methods

The study for red pumpkin beetle was conducted during the period from June, 2012 to September, 2013, where mortality (%) and antifeedent test were performed in July, 2012 to August, 2012 and field experiment was carried out in the period of May, 2013 to September, 2013.

3.2.1 Collection of Insect

The red pumpkin beetles were collected from the net house of BINA for conducting the mortality (%) as well as antifeedant test, whereas in cucumber field test on red pumpkin beetles were carried out in open environment.

3.2.2 Insect Rearing

Red pumpkin beetle was reared in the net house of the Entomology Division, BINA, Mymensingh (Fig 3.1). The rearing of red pumpkin beetle was done for conducting the mortality and antifeedant test in the laboratory.

Fig.3.1 Rearing of red pumpkin beetle in BINA, Mymensingh

This laboratory tests evaluated the efficacy of the studied botanicals and also selected the appropriate doses of botanicals against the damages caused by red pumpkin beetle in cucumber (Fig. 3.1).

3.2.3 Collection of Siperin and Botanicals

During this study one chemical insecticide namely siperin (10 EC) was collected from dwellers of insecticides in Mymensingh town. On the other hand three selected botanicals (jute seed, custard apple leaves and urmoi leaves) were collected from BAU campus of Mymensingh district. These three botanicals were fixed based on conducting the screened test during the time of June, 2012 to July, 2012. After collection of the botanicals, fresh plant parts were washed in running tap-water and air dried in the shade for 1 (one) week at room temperature 30 $\pm$ 2ºC. On the other hand siperin was preserved in the laboratory of Entomology Division, BINA, Mymensingh.

3.2.4 Formulation of Siperin

Siperin (10 EC) formulation was prepared by adding the tap water, when necessary as per fulfillment the requirement in conduct of laboratory as well as field experiment.

3.2.5 Preparation of Botanical Extracts

Botanical extracts of jute seeds, custard apple leaves as well as urmoi leaves were prepared in the laboratory of the Entomology Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh following the procedures stated below (Fig. 3.2-3.3) in flow chart.

Collection of packed jute seed

↓

Grinding using electric grinder

↓

Dissolve 100g dust in 300 ml methanol for 48 hours

↓

Filtering the solution using a thin cotton cloth

↓

Evaporated using rotary evaporator for 5 hours to achieve the solid extracts

↓

Collection of the extracts

↓

Preserve in refrigerator until use.

↓

Apply on red pumpkin beetles

Fig. 3.2 A flow chart for extract preparation from jute seed

Collection of custard apple/urmoi leaves

↓

Washing the leaves

↓

Air dried in the laboratory

↓

Grinding using electric grinder

↓

Dissolve 100g dust in 300 mL methanol for 48 hours

↓

Filtering the solution using a thin cotton cloth

↓

Evaporated using rotary evaporator for 5 hours to achieve the solid extracts

↓

Collection the extracts

↓

Preserve in refrigerator until use

↓

Apply on red pumpkin beetles

Fig. 3.3 A flow chart for extract preparation from leaves of custard apple and urmoi plant

3.2.6 Treatment of the Experiment

3.2.6.1 Treatment for Conducting the Laboratory Test

In the laboratory, doses of siperin and botanicals were used along with a control stated below. The formulation of siperin was made by adding water as per requirement. On the other hand, botanicals extracts were diluted in methanol (due to acts as the good solvent).

Table: Three doses of sipenin and Botanicals used in lab.

Insecticides and Botanicals	**Concentration (%)**
Control (using methanol)	0
Siperin	0.05
	0.10
	0.20
Custard apple	5.00
	7.50
	10.00
Urmoi	5.00
	7.50
	10.00
Jute seed	5.00
	7.50
	10.00

3.2.6.2 Treatment for the field experiment

In the field condition only the best doses of siperin and botanicals were used based on the laboratory results. Details are presented here with.

Table: Best doses of siperin and Botanicals used in Field

Insecticides and Botanicals	Concentration (%)
Control	0
Siperin	0.10
Custard apple	10.00
Urmoi	10.00
Jute seed	10.00

During field experiment formulation of siperin was made by adding water but botanicals extracts were diluted at first with 0.5% detergent for proper mix-up and then added water as per requirement for the field experiment.

3.2.7 Design of the Experiment

The laboratory experiment was laid out in a Completely Randomized Design (CRD) with three replications. On the other hand in case of field experiment Randomized Complete Block Design (RCBD) was followed with also three no. of replications.

3.2.8 Mortality Test for Red Pumpkin Beetle

Fresh and young cucumber leaves were collected and treated by siperin as well as botanicals then kept for airdried. Then each treated cucumber leave was separately placed upside down in a petri dish 7.5 cm (dia). Ten (10) beetles were released on each leaf after collapse through minor freezing (Fig. 3.4).

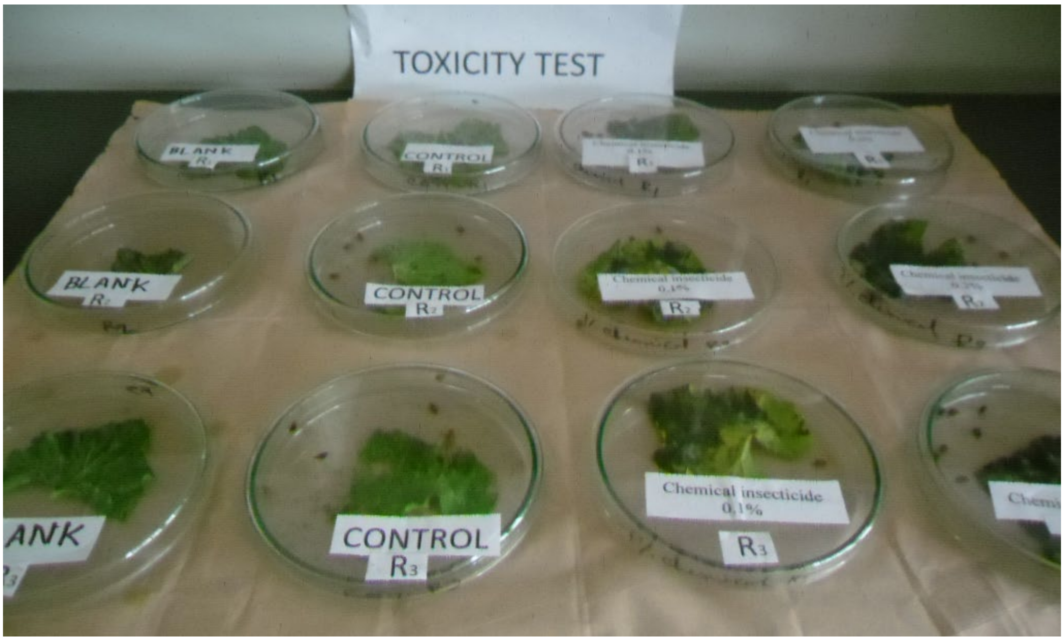

Fig. 3.4 Determination of mortality (%) of red pumpkin beetle

3.2.9 Anti-feedant Test in the Laboratory

Antifeedant test were practiced only for red pumpkin beetle. This test was studied following the methods of Keita *et al.* (2001) and Mahdi and Rahman (2008) with some modifications. Fresh, healthy and nearly same size of cucumber leaves were collected from the field. The leaves were sprayed with 5%, 7.5% and 10% of jute seed, custard apple leaves and urmoi leaves crude extracts and 0.05%, 0.1%, 0.2% of siperin separately. These treated leaves were air dried and weighted before providing to RPB in a growth chamber. In control treatment, the leaves were sprayed with methanol. Ten adults red pumpkin beetle were used for each replication to conduct this experiment. Three replications were made for each treatment. After 96 hours of feeding leaves were again weighted and weight loss percentage was measured by using the following formula.

$$\%\ \text{WL} = \frac{\text{IW - FW}}{\text{IW}} \times 100$$

Where, WL stands for weight loss, IW is the initial weight, and FW is the final weight.

3.2.10 Data Collection in Laboratory

In the study, data were collected from laboratory are as follows:

- Adult mortality at 24, 48, 72 and 96 hrs (%) in different concentration of botanicals as well as siperin and
- Detection the weight loss of cucumber leaves through antifeedant test.

3.2.11 Preparation of Land for Vegetables Cultivation

Land of experimental field was first opened with a country plough. Ploughed soil was then brought into desirable final tilth condition by five operations of ploughing followed by laddering. The stubbles of the crops and uprooted weeds removed from the field and the land was properly leveled. Finally pit preparation was completed for planting of cucumber seeds.

3.2.12 Fertilizer Application

The cucumber crop was fertilized by cow dung, urea, TSP, MP and Tricompost @1 5 kg, 70 g, 60 g, 50 g and 500.00 g/pit, respectively. The whole amount of cowdung and fertilizers were used as the basal dose during pit preparation.

3.2.13 Cultivation of Vegetables in Field

In the study, cucumber crop was cultivated in the standard manner selecting the suitable time (May, 2013 to September, 2013). The photographic overview of the cultivated vegetable is shown in Fig. 3.5. The cultivation procedures are also outlined herewith below (Table 3.1).

Table 3.1 Cultivation procedures of cucumber in the experimental field

Name of crop	:	Cucumber
Date of planting	:	20th May 2013
Practiced intercultural operations	:	• Earthing up, • Stalking, • Weeding (3 times) and • Supply irrigation water (kept in furrow).
Harvesting period	:	Started in 20th July 2013 and continued up to 25th September 2013

Fig. 3.5 The field experiment with cucumber conducted in BINA, Mymensingh

3.2.14 Application of Botanicals and Siperin in Field

The plants of the experimental plots were sprayed with three studied botanical extracts (extracts @10% with 0.5% detergent) and Siperin (@ 0.1% concentration) twice a week with the help of a sprayer. After application of botanicals and siperin, the pest attack was also monitored daily and number of cucumber leaves attacked by red pumpkin beetle was recorded three days in a week.

3.2.15 Data Collection from Field

- Plant length,
- No. of beetle/plant,
- No. of leaves/plant,
- Leaf infestation (%),
- No. of fruits/plant and
- Fruit weight/plant

3.2.16 Data Analysis

i) Laboratory: The collected data were statistically analysed by Completely Ranomized Design (CRD). Mean values were ranked by Duncan's Multiple Range Test, DMRT (Duncan, 1951).

ii) Field: The observed values were statistically analyzed by RCBD. Mean values were adjusted by one way ANOVA and the significant level was tested by Duncan's Multiple Range Test (Duncan, 1951).

3.3 Results and Discussion

3.3.1 Results

3.3.1.1 Effect of botanicals and siperin and their interaction effect on mortality (%) of red Pumpkin Beetle

3.3.1.1.1 Effect of botanicals and siperin on mortality (%) of red Pumpkin Beetle at different intervals

The study detected the significant effect of botanicals as well as siperin on mortality (%) of red pumpkin beetle at different intervals i,e. 24, 48, 72, 96 hrs (Fig. 3.6 and Appendix V). Siperin ensured 63.33% mortality after 96 hrs. On the other hand, jute seed showed 46.50% mortality, which remarked as 75% efficient as compared to siperin. Jute seed botanical showed about 1.31, 1.39, 1.37 and 1.24 times better performances than that of custard apple leaves at 24, 48, 72 and 96 hrs, respectively, which also estimated as 1.31, 1.36, 1.30 and 1.27 times higher efficiency in case of urmoi leaves. The study also detected the increasing trend in mortality (%) of red pumpkin beetle in respect of all the studied botanicals and siperin (Fig. 3.6).

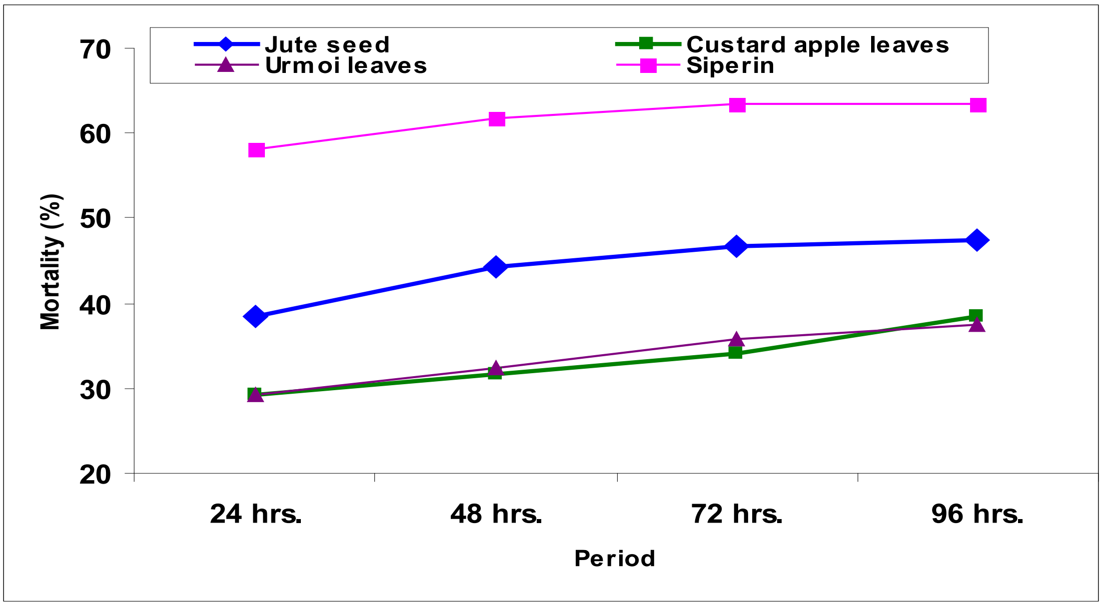

Fig. 3.6 Effect of botanicals and siperin on mortality (%) of red pumpkin beetle at different intervals

3.3.1.1.2 Effect of doses on mortality (%) of red Pumpkin Beetle at different intervals

The effect of the doses of botanicals caused significant mortality (%) at different intervals (Appendix V). The botanicals consisted of 3 doses along with control ones. Here control treatment did not show any mortality (%) of red pumpkin beetle (Table 3.2). The study showed a high mortality (%) in higher doses at all the intervals, which 2.1-2.2 times higher in 10% concentration than that of 5% and 1.3- 1.4 times higher in case of 7.5 % concentration of botanicals. For a high dose (10%), the study found 70.91% mortality in 24 hrs and 84.17% after 96 hrs.

Table 3.2 Effect of the doses of botanicals on mortality (%) of red pumpkin beetle at different intervals

Concentration (%)	Adult mortality at different time intervals (%)			
	24 hrs	**48 hrs**	**72 hrs**	**96 hrs**
0	0.0000 d	0.0000 d	0.0000 d	0.0000 d
5	31.67 c	34.99 c	38.33 c	40.83 c
7.5	52.33 b	59.16 b	60.83 b	61.66 b
10	70.91 a	75.83 a	80.83 a	84.17 a
$LSD_{0.05}$	1.92	1.62	1.79	1.56
Level of significance	**	**	**	**
CV (%)	5.96	4.59	4.81	4.04

* Means in a column followed by the same letter are not significantly different at (P<0.01) by DMRT.

3.3.1.1.3 Effect of botanicals and siperin as well as doses of botanicals on mortality (%) of red Pumpkin Beetle at different intervals

The interaction effect of botanicals and siperin along with their doses expressed the significant mortality (%) of red pumpkin beetle at different intervals (Appendix V). Siperin caused 96.66% mortality at 24 hrs and it reached to 100% at 48, 72 and 96 hrs, respectively (Table 3.3). The jute seed ensured 53.33% mortality at 24 hrs reaching 86.66% at the ended intervals. The study expressed 63.33 and 53.66% mortality from custard apple leaves and urmoi leaves after 24 hrs. The mortality (%) for these two botanicals was recorded as 76.69 and 73.33% at 96 hrs, respectively (Table 3.3). Here jute seed showed excellent effect on the mortality (%) of red pumpkin beetle just after siperin at 72 hrs. This botanical gave better performances over the custard apple leaves and urmoi leaves during all four intervals (Table 3.3).

Table 3.3 Interaction effects of botanicals as well as siperin and their doses on mortality (%) of red pumpkin beetle at different intervals

Plant extracts	Concentration (%)	Adult mortality at different time intervals (%)			
		24 hrs	48 hrs	72 hrs	96 hrs
Control	0	0.000 j	0.000 k	0.000 j	0.000 m
Jute seed	5	30.00 gh	33.33 h	36.66 h	39.99 j
	7.5	53.33 e	59.99 e	63.33 ef	63.33 f
	10	70.00 c	83.33 c	86.66 c	86.66 c
Custard apple leaves	5	20.00 i	20.00 j	23.33 i	29.99 l
	7.5	33.33 fg	43.33 g	43.33 g	46.66 h
	10	63.33 d	63.33 d	69.99 d	76.69 d
Urmoy leaves	5	26.66 h	29.99 i	33.33 h	33.33 k
	7.5	36.66 f	43.33 g	43.33 g	43.33 i
	10	53.66 e	56.66 ef	66.66 de	73.33 e
Siperin 10EC	0.05	50.00 e	56.66 f	59.99 f	59.99 g
	0.10	86.00 b	89.99 b	93.33 b	93.33 b
	0.20	96.66 a	100.0 a	100.0 a	100.0 a
$LSD_{0.05}$	-	3.84	3.24	3.59	3.13
Level of significance	-	**	**	**	**
CV (%)	-	5.96	4.59	4.81	4.04

* Means in a column followed by the same letter are not significantly different at (P<0.01) by DMRT.

3.3.1.2 Effect of botanicals and siperin on % weight loss of cucumber leaves

3.3.1.2.1 Effect of botanicals and siperin on % weight loss of cucumber leaves

This study showed significant effect of botanicals and siperin on % weight loss of cucumber leaves (Appendix VI). Both botanicals and siperin caused % weight loss of cucumber leaves as minimum 38.07% (in siperin) which reached up to 47.21% (in urmoi leaves). Here jute seed showed about 93% efficiency as compared to siperin. Amongst the botanicals jute seed, custard apple leaves and urmoi leaves ranked in the 1st, 2nd and 3rd highest positions, respectively (Fig 3.7).

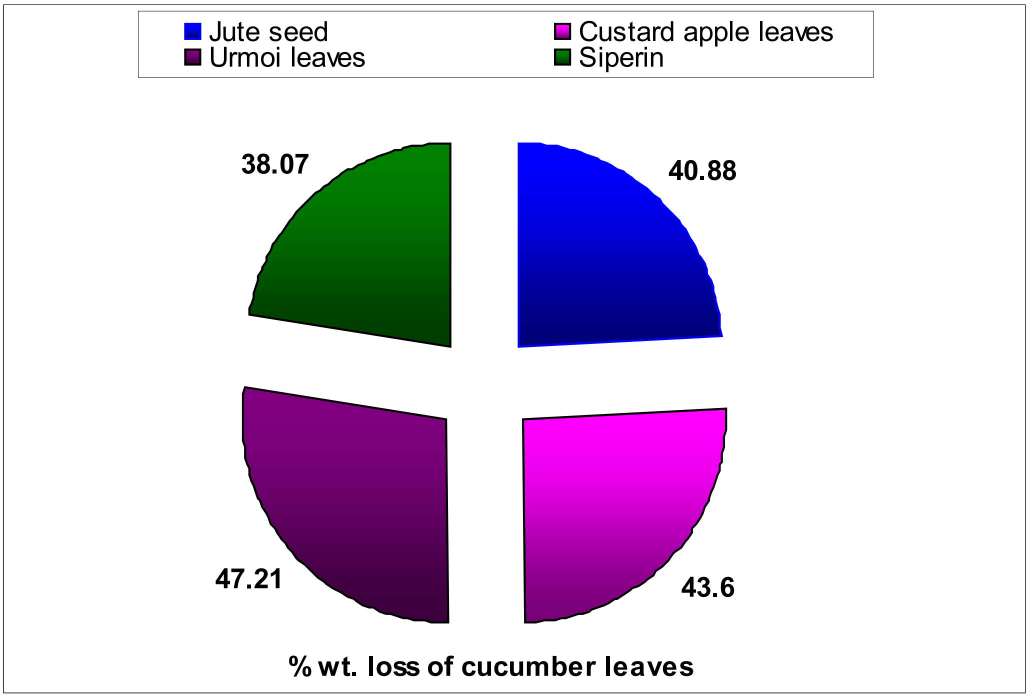

Fig. 3.7 Effect of botanicals and siperin on % weight loss of cucumber leaves

3.3.1.2.2 Effect of doses on % weight loss of cucumber leaves

Fig 3.8 revealed that % weight of cucumber leaves significantly increased in lower concentration than that of higher ones (Appendix VI). The study revealed 1.80% more weight loss in control than that of 10% concentration, which estimated as 1.44 and 1.49% than that of 5.00 and 7.50 % concentration of botanicals (Fig. 3.8).

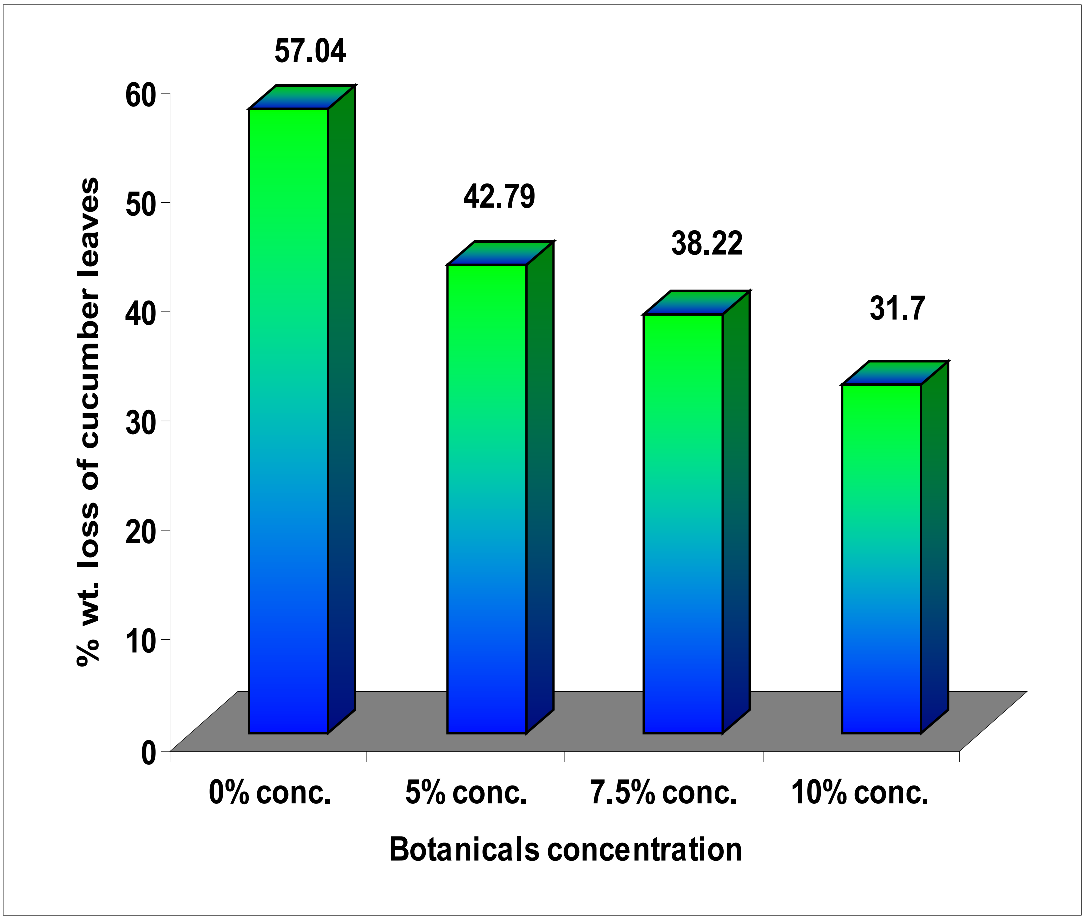

Fig. 3.8 Effect of the doses of botanicals on % weight loss of cucumber leaves

3.3.1.2.3 Effect of botanicals and siperin on % weight loss of cucumber leaves

The study detected the significant effect of botanicals as well as there their doses on % weight loss of cucumber (Appendix VI). Siperin caused 28.02% weight loss due to keep the best insecticidal efficiency against red pumpkin beetle. Here jute seed gave the 2nd minimum % weight loss as 29.74% which regarded 94% effective as compared to siperin. Always control treatmrnt adjusted with the higher weight loss as the value 57.04%. The study also revealed that % weight loss decreased with increasing the doses of botanicals as well as siperin (Table 3.4).

Table 3.4 Interaction effects of botanicals as well as siperin and their doses on % weight loss of cucumber leaves

Name of the plant extract	Dose	Weight loss (%)
Control	0%	57.04 a
Jute seed	5%	41.33 c
	7.5%	35.40 d
	10%	29.74 ef
Custard apple leaves	5%	46.10 b
	7.5%	40.50 c
	10%	30.74 ef
Urmoi leaves	5%	48.22 b
	7.5%	45.28 b
	10%	38.29 cd
Siperin 10 EC	0.05%	35.50 d
	0.10%	31.70 e
	0.20%	28.02 f
$S_{\bar{x}}$	1.04	
Probability level	**	

* Means in a column followed by the same letter are not significantly different at (P<0.01) by DMRT.

3.3.1.3 Effect of botanicals and siperin on cucumber production

The study minutely investigated the plant height and number of leavers/plant of cucumber, which are significantly differed among the botanicals and siperin (Appendix VII). Here jute seed showed the highest plant height (222.30 cm) and more number of leaves/plant (69.33 No.) having no statistical difference with siperin (219.30 cm plant height and 67.67 no. of leaves/plant). Control treatment gave the shortest plant (193.7 cm) as well as less no. of leaves/plant (57.00 No.). The custard apple leaves and urmoi leaves ranked in the 3rd and 4th highest position among the studied botanicals and siperin including the control ones, in respect of plant height and no. of leavers/plant of cucumber (Table 3.5).

Table 3.5 Effect of botanicals and siperin on growth and yield attributes including presence of beetle in cucumber field

Treatments	Plant length (cm)	No. of leaves/ plant	No. of fruits/ plant	No. of beetle/ plant
Control	193.7 c	57.00 c	14.00 c	5.00 a
Jute seed	222.3 a	69.33 a	24.67 a	1.33 b
Custard apple leaves	211.7 ab	65.00 ab	20.33 b	2.00 b
Urmoi leaves	203.7 bc	60.67 bc	18.67 b	2.33 b
Siperin 10 Ec	219.3 a	67.67 a	22.67 ab	1.33 b
$LSD_{.005}$	12.21	4.71	3.89	1.45
Level of significance	**	**	**	**
CV (%)	3.09	3.92	10.29	32.27

* Means in a column followed by the same letter are not significantly different at (P<0.01) by DMRT.

Number of fruits/plant was significantly affected by the botanicals and siperin (Appendix VII). Jute seed produced the highest no. of fruit per plant (24.67 nos.) as compared to siperin. Here control treatment produces the lowest no. of fruits /plant. Both custard apple leaves and urmoi leaves produced the more fruits/plant than that of control but the less fruit/plant than that of siperin as well as jute seed. The produced fruits/plant was ranged from 14.00 to 24.67 number during this study (Table 3.5).

The study also found that significant no. of beetle/plant was affected by botanicals and siperin. Here jute seed and siperin ensured the minimum number of bettle/plant (1.33 No.) having no statistical a difference with custard apple leaves and urmoi leaves (Appendix VII). The control treatment carried the highest number of beetle/plant (Table 3.5).

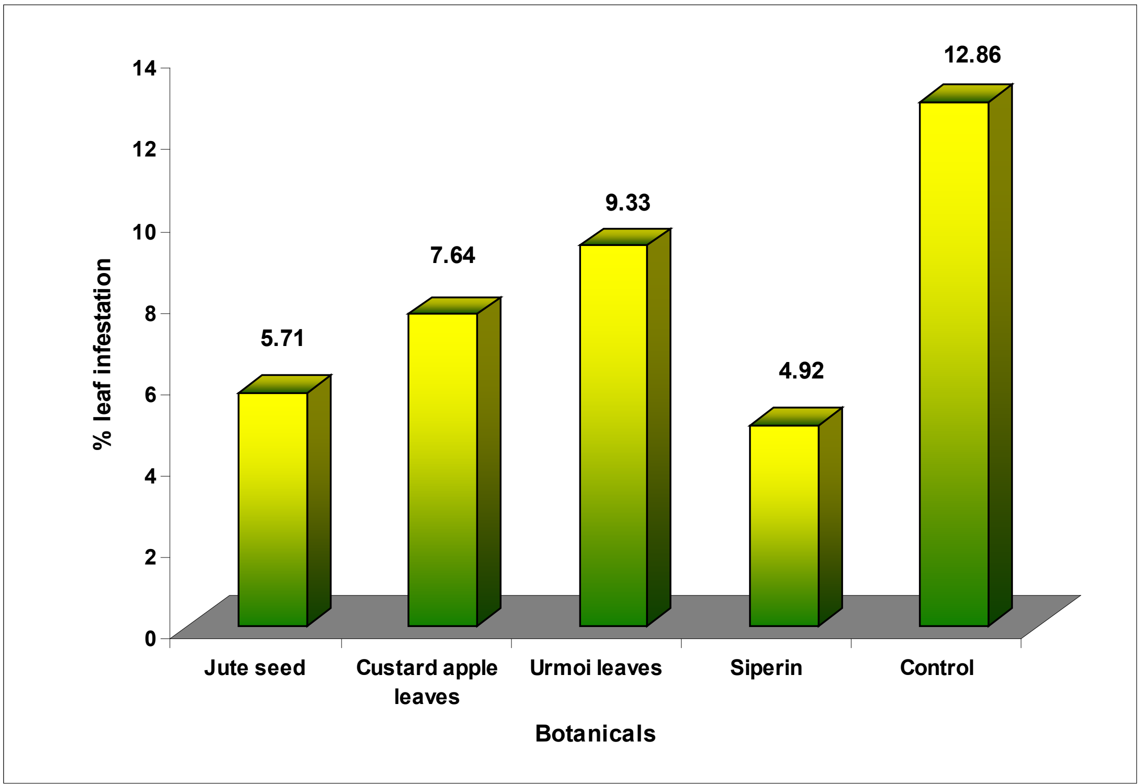

Fig. 3.9 Effect of botanicals as well as siperin on % leaf infestation of cucumber

Studied botanicals along with siperin showed excellent effect against % leaf infestation of cucumber (Appendix VII). Jute seed ensured the minimum % leaf infestation (Fig 3.9), whereas maximum percent of leaf infestation was observed in control treatment. Amongst the studied botanicals, jute seed showed 1.33 and 1.63 times higher performances than that of custard apple leaves and urmoi leaves, respectively. Even jute seed showed 1.20 times higher performances than the chemical insecticide, siperin (Fig. 3.9). Jute seed reduced the leaf infestation upto 2.25 times compared to control one.

The study observed that the fruit weight/plant ranged from 0.24 to 3.96 kg/plant (Fig. 3.5), which detected as significant due to effect of botanicals as well as siperin compared to control (Appendix VII). Here jute seed gave the best as well as the highest fruit yield (3.96 kg / plant) which recorded as the 1.15, 1.22, 1.07 and 16.50 times higher yield/ plant than that of custard apple leaves, urmoi leaves, siperin and control one, respectively (Fig. 3.10).

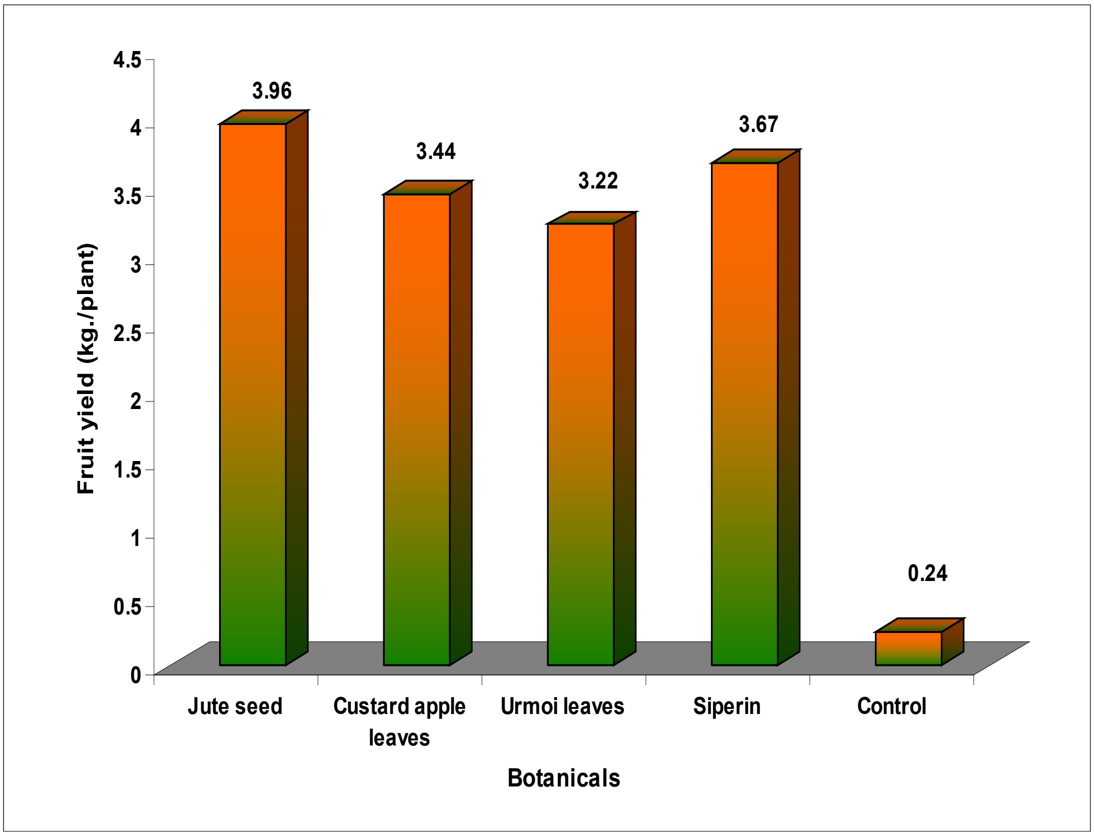

Fig. 3.10 Effect of botanicals as well as siperin on fruit yield of cucumber

3.3.2 Discussion

There are many insect pests of cucurbits in Bangladesh, among them red pumpkin beetle is one the most important constraint to cucurbit production capable of 30-100% yield loss (Alam, 1969; Gupta and Verna, 1992 and Dillon *et al.*, 2005). It is polyphagous and attacks more than 81 plant species including pumpkin, squash, cucumber, bottle guard, sweet guard, bitter gourd, snake gourd, wax gourd, water mellon, etc. and a wide range of food crops (Doharey, 1983). In the study, the effectiveness of botanicals and siperin showed the significant effect on mortality (%), % weight loss of cucumber as well as cucumber production in respect of plant height, no. of leaves/plant, no. of fruits/plant and fruit weight (kg/plant).

The studied botanicals could also be kept the significant and excellent effect in terms of reducing the no. of bettle/plant as well as % leaf infestation of cucumber (Appendix V-VII). Plant extract showed minimum damage which also confirms the results of Datta and Saxena (2001). They studied the 11 derivates from plant and recorded that the plants have the ability to act as anti-feedant which has minimized the damage caused by different insect pests.

Here in the present study, siperin @ 0.2% ensured 100 % mortality at 96 hrs also starting from 48 hrs. On the other hand siperin @ 0.1% gave the mortality (%) upto 93.33%. This concentration (0.1%) of siperin applied in field in respect of economic thresh hold level (ETL) for pest control of cucumber field (Table 3.3). According to Araya and Emana (2009) the botanical powders have good effect in controlling colepterous beetle.

There were three botanicals namely jute seed, custard apple leaves and urmoi leaves were applied in cucumber leaves @ 5.00, 7.50 and 10.00% concentration, where higher concentration ensured the more mortality (%). Hence 10.00% concentration of the studied botanicals exercised in field condition (Table 3.2-3.3). The population and damage of red pumpkin beetle was reduced upto great extent by the application of chemical control (Methomyl) and plant extract. Plant products have the ability to reveal the red pumpkin beetle and can reduce the damage. These findings are somewhat similar to the observations of Pankaj and Anita (2009). They observed the repellant properties of some plant products against red pumpkin beetle.

In respect of interaction effect jute seed @ 10.00% ensured the % mortality as the value 86.66% which is 86.66% effective as compared to siperin. This botanical showed 1.13 and 1.18 times better performances over custard apple leaves and urmoi leaves, respectively in terms of % mortality of red pumpkin beetle. The result in the present study also in line with the result of Muhammad and Bilal (2014), where they tested different synthetic insecticides for the control of red pumpkin beetle and reported that the synthetic insecticides greatly affects the haemocytes of red pumpkin beetle. Said and Muhammad (2000) reported that the different concentration of plant dust can reduce the population of red pumpkin beetle.

The studied botanicals and siperin showed the significantly % weight loss in cucumber leaves. Here jute seed @ 10.00% concentration showed the 94 % efficiency as compared to siperin. The botanical also kept the 1.28% more efficiency than that of 10% concentration of urmoi leaves also having no statistical difference with custard apple leaves (10% concentration). Always control treatment was favorable for more % weight loss in cucumber upto 57.04 %. The insecticidal activities of the botanical powders are broad variable and dependent on different factors like the presence of bio active chemicals, which need to be identified, isolated and manufactured in the factory for pest management. The plant powders may act as fumigant, repellent, stomach poison and physical barrier. The damage can be minimized by controlling the population of red pumpkin beetle by using extracts of different plants, which confirms the results of Pankaj and Anita (2009) who tested different plant extract as a repellent of red pumpkin beetle. The plant extract can be used instead of synthetic pesticides or can be supplemented to avoid excessive use of chemicals for the safe and friendly environment.

The study found that the higher concentration reduced the % weight loss in cucumber leaves than that of lowers ones (Fig. 3.8).In the study the cucumber crops were cultivated based on applying the botanicals and siperin which kept on the excellent performance in respect of plant height, no. of leaves/plant, no. of fruits/plant and fruit yield/plant. Jute seed ensured the best plant height, more no. of leave/plant and more no. of fruits/plant having no statistical difference with siperin. Here the jute seed kept the better results over control treatment and such even over custard apple leaves and urmoi leaves in terms of above growth and yield oriented parameters.

The jute seed showed higher fruit yield/plant compare to custard apple leaves and siperin not statistically significant. The yield in jute seed was about 1.22 times higher than that of urmoi leaves which also about 17 times higher than that of control one. The studied botanicals also regarded as the effective ones in terms of no. of fruit/plant as well as % leaf infestation. Leaf infestation was lower in siperin but there was no statistically difference with jute seed. On the other hand control treatment always showed more no. of beetle/plant as well as higher % leaf infestation. The most commonly used method for controlling red pumpkin beetle in Bangladesh is the application of insecticides (Karim, 1992), but due to the unconscious use of synthetic insecticide development of insects resistance to insecticides, induction of resurgence to target pests, outbreak of secondary pests and undesirable effect on non target organisms as well as serious environment pollutions is occurred.

Conclusion

Out of three botanicals jute seed showed excellent result in controlling the red pumpkin beetle in cucumber field. Jute seed extract was found to effective as same as chemical insecticide siperin during this experiment. Therefore, the activity of jute seed ensured the sustainable vegetables cultivation in Bangladesh.

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Chapter 4

EFFICACY OF SIPERIN AND BOTANICALS FOR CONTROLLING THE BLACK BEAN APHID

ABSTRACT

The effect of three different botanical extracts- jute seeds, custard apple leaves and urmoi leaves, and one chemical insecticide (siperin) was tested on black bean aphid population in country bean field and laboratory conditions at Entomology Division, BINA, Mymensingh during November, 2012 January, 2014. Black bean aphids were exposed to three botanical extracts and one chemical insecticide and then % mortality was counted after 12, 24, 36 and 48 hrs interval. The study observed the mortality (%) upto 66.67% in siperin, 53.36 % in jute seed, 44.17% in custard apple leaves and 42.50% in urmoi leaves after 48 hrs interval. More mortality of aphid with a long treatment time and higher doses was observed. About 1.50-2.50 times higher mortality was found in 7.5% concentration than that of 5% and 1.23-2.07 times higher in case of 10% than that of 7.5% concentration of botanicals. The study also observed significant effect of siperin and botanicals on plant height, no. of twig/plant, no. of leaves/plant, total no. of pod/plant, pod length and pod weight/plant of country bean. During the study, jute seed gave 2nd highest pod yield **(**1.78 kg/plant**)** which recorded as the 1.15, 1.22, 1.07 and 16.50 times higher yield/plant than that of custard apple leaves, urmoi leaves, siperin and control one, respectively. Chemical insecticide siperin as well as botanical extract of jute seed both showed minimum bean aphid infestation in country bean but the effect was non-significant.

4.1 Introduction

Country bean (*Lablab purpureus* (L.) Sweet) is an ancient legume crop widely grown throughout the world for its vegetable or pulse for human consumption or as animal forage or feed. Flowers and immature pods also used as a vegetable. It is also used as a fodder legume sown for grazing and conservation in broad-acre agricultural systems in tropical environments with a summer rainfall. Also used as green manure, cover crop and in cut-and-carry systems and as a concentrate feed. It can be incorporated into cereal cropping systems as a legume ley to address soil fertility decline and is used as an intercrop species with maize to provide better legume/stover feed quality. As a dual purpose (human food and animal feed) legume , it is sown as a monoculture or in intercrop systems (Pengelly *et al*., 2001). Country bean is also an important vegetable crop in Bangladesh. It is grown on approximately 11000 ha across the country during the winter season, yielding an average of 4.53 t of fresh pods per ha for a total yield of about 50000 t (BBS 2004).

Dolichos bean is found infested by a number of insect pests especially black bean ahid which damages the Growing points, stems, leaves, inflorescences, fruits and whole bean plant. Beans suffer damage to flowers and pods due to not develop properly (BBA, 2013). Hence, in order to protect their crops from damages of aphid infestation, growers in Bangladesh often apply synthetic chemical insecticides. In order to protect their crops from damages of aphid infestation, growers in Bangladesh often apply synthetic chemical insecticides. Although synthetic insecticides usually provide quick and adequate control for the time being, they are usually expensive and leave long-lasting residues over the exposed surface of the crops, in soil and water (Hussain, 1989).

Botanical products can be easily and cheaply collected in rural Bangladesh, have been found promising and useful for pest control (Roy *et al*., 2005). This insecticides are biodegradable and they often breakdown quickly after being exposed to the surrounding environmental conditions like sunlight, moisture and air (Pedigo, 2002); resulting the botanical extracts remained effective only 24 h after being applied. There also have been a large number of plant-products, which possess pesticidal properties and have been used successfully for controlling various pests in field and laboratory conditions (Bajpai and Sehgal, 2000). The insecticidal properties of plant extracts have long been known and well documented against various insect pests including aphids (Pedigo, 2002).

Here in this piece of study, three botanicals extracts such as jute seed, custard apple leaves and urmoi leaves were tested against the black bean aphid for protecting the country bean plant in eco-friendly way in Bangladesh.

Objectives of this study:

I. To investigate the effectiveness of siperin and botanicals on mortality (%) of black bean aphid,

II. To identify the effectiveness of botanical extracts on growth and yield of country bean plant and

III. To study the efficiency of jute seeds as the botanical insecticide for eco-friendly controlling the black bean aphid in country bean field.

4.2. Materials and Methods

The control of black bean aphid study was conducted starting from November, 2012 and continued upto January, 2014, where mortality (%) test was performed in December, 2012 to February, 2013 and field experiment was carried out in the period of 10th September, 2013 to 15th January, 2014.

4.2.1 Collection of insect

The black bean aphids were collected from Bangladesh Agricultural University campus for conducting the mortality (%) test, whereas in country bean field black bean aphid are from open environment.

4.2.2 Insect rearing

The black bean aphid was reared under laboratory condition in the Entomology Division, BINA, Mymensingh (Fig 4.1). The rearing of black bean aphid was done for conducting the mortality test in the laboratory. The laboratory tests evaluated the efficacy of the studied botanicals and the appropriate doses of botanicals against the damages caused by black bean aphid in country bean (Fig. 4.1).

Rearing of black been aphids

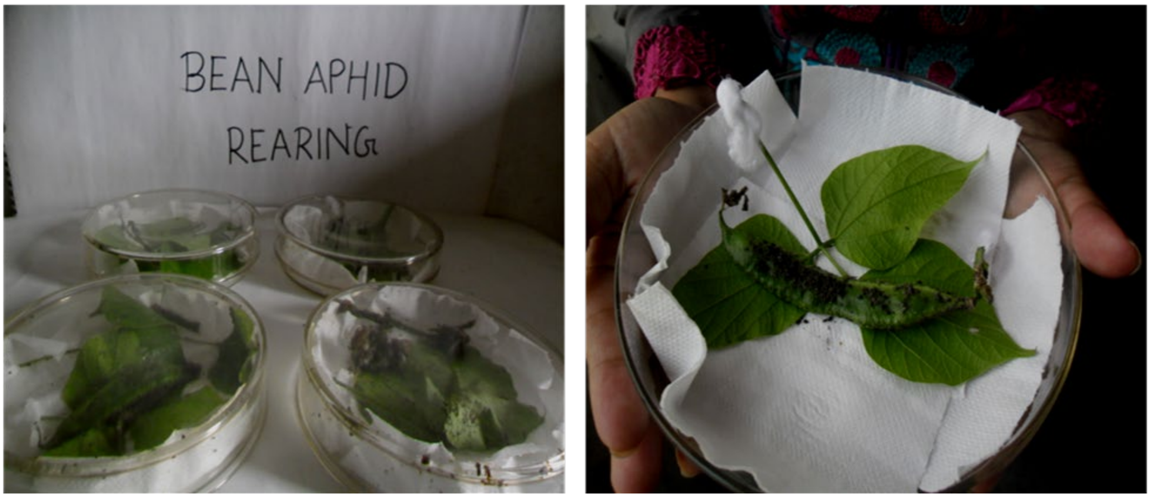

Fig.4.1 Rearing of black bean aphid

4.2.3 Collection of siperin and botanicals

In this study, one chemical insecticide namely siperin (10 EC) were collected from dealers of insecticides in Mymensingh town. On the other hand three selected botanicals (jute seed, custard apple leaves and urmoi leaves) were collected from BAU campus of Mymensingh district. These three botanicals were fixed based on conducting the screened test during the time of November, 2012 to January, 2013. After collection of the botanicals, fresh plant parts were washed in running tap-water and air dried in the shade for 1 (one) week at room temperature 30 $\pm$ 2ºC. On the other hand siperin was preserved in the laboratory of Entomology Division, BINA, Mymensingh.

4.2.4 Formulation of siperin

Siperin (**10 EC**) formulation was prepared adding the tap water, when necessary as per fulfillment the requirement in conduct of laboratory as well as field experiment.

4.2.5 Preparation of botanical extracts

Botanical extracts of jute seeds, custard apple leaves as well as urmoi leaves were prepared in the laboratory of the Entomology Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh-2202 following the procedures as stated in the chapter 3.2.5.

4.2.6 Treatment of the Experiment

4.2.6.1 Treatment for conducting the laboratory test

In the laboratory three no. of doses of siperin and botanicals were used along with a control. The formulation of siperin was made adding the water as per requirement. On the other botanicals extracts was diluted in methanol (due to acts as the good solvent).

Insecticides and Botanicals	Concentration (%)
Control (using methanol)	0
Siperin	0.05
	0.10
	0.20
Custard apple	5.00
	7.50
	10.00
Urmoi	5.00
	7.50
	10.00
Jute seed	5.00
	7.50
	10.00

4.2.6.2 Treatment for the field experiment

In the field condition, only the best doses of siperin and botanicals were used based on the laboratory results. Details are presented below:

Insecticides and Botanicals	Concentration (%)
Control	0
Siperin	0.10
Custard apple	10.00
Urmoi	10.00
Jute seed	10.00

During field experiment, formulation of siperin was made adding the water as per requirement. But in case of botanicals, extracts was diluted at first with 0.5% detergent for proper mix-up and then added the water as per requirement for the field experiment.

4.2.7 Design of the Experiment

The laboratory experiment was laid out in a Completely Randomized Design (CRD) with three replications. On the other hand in case of field experiment Randomized Complete Block Design (RCBD) was followed with also three no. of replications.

4.2.8 Mortality Test for Black Bean Aphid

Fresh and young country bean leaves were collected and treated by siperin as well as botanicals then dry in air. Then, each treated country bean leave separately was placed upside down in a petri dish 7.5 cm (dia). Twenty aphids were released with camel hair brush (Fig. 4.2).

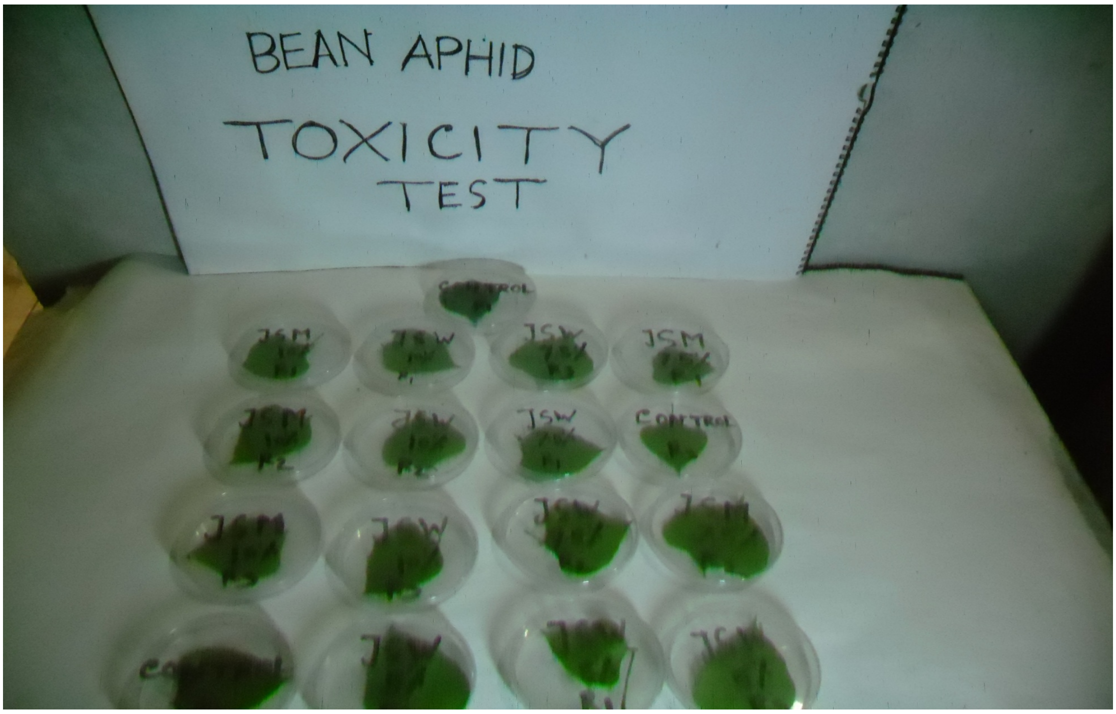

Fig. 4.2 Determination the mortality (%) of black bean aphid

4.2.9 Data Collection in Laboratory

- In the laboratory, aphid mortality at 12, 24, 36 and 48 hrs (%) for different concentrations of botanicals as well as siperin were determined.

4.2.10 Preparation of land for vegetables cultivation

The experimental land was first ploughed with country plough. Ploughed soil was then brought into desirable final tilth condition by five operations of ploughing followed by laddering. The stubbles of the crops and uprooted weeds removed from the field and the land was properly leveled. Finally pit preparation was completed for planting of country bean seeds.

4.2.11 Fertilizer application

The country bean crop was fertilized by cow dung, urea, TSP, MP and Tricompost @1 5 kg, 70 g, 60 g, 50 g and 500.00 g/pit, respectively. The whole amount of cowdung and fertilizers were used as the basal dose during pit preparation.

4.2.12 Cultivation of vegetables in field

In the study country bean crop was cultivated in the standard manner selecting the suitable time (10th September, 2013 to 15th January, 2014). The photographic overview of the cultivated vegetable is shown in Fig. 4.3. The cultivation procedures are also outlined herewith below (Table 4.1).

Table 4.1 Cultivation procedures of country bean in experimental field

Name of crop	:	Country bean
Date of planting	:	10th September, 2013
Practiced intercultural operations	:	• Earthing up, • Stalking, • Weeding (3 times) and • Supply irrigation water (kept in furrow).
Harvesting period	:	Starting in 14th November 2013 which will be continued up to 15th January 2014

Experimental plot of Bean

Fig. 4.3 The field experiment of country bean

4.2.13 Application of botanicals and siperin in field

The plants in experimental plots were sprayed with three studied botanical extracts (extracts @10% with 0.5% detergent) and Siperin (@ 0.1% concentration) twice a week with the help of a sprayer. After application of botanicals and siperin, the pest attack was also monitored daily and no. of country bean leaves and pods attacked by black been aphid was recorded three days in a week.

4.2.14 Data collection from field

- Plant height,
- No. of twigs/plant,
- No. of leaves/plant,

- Infested leaves/plant,
- Total n o. of pods/plant,
- Infested pods/plant,
- Pod length and
- Pod weight/plant

4.2.15 Data Analysis

i) Laboratory: The collected data were statistically analysed by Completely Ranomized Design (CRD). Mean values were ranked by Duncan's Multiple Range Test, DMRT (Duncan, 1951).

ii) Field: The observed values were statistically analyzed by RCBD. Mean values were adjusted by one way ANOVA and the significant level was tested by Duncan's Multiple Range Test (Duncan, 1951).

4.3 Results and Discussion

4.3.1 Results

4.3.1.1 Effect of botanicals and siperin and their interaction effect on mortality (%) of black bean aphid in lab

4.3.1.1.1 Effect of botanicals and siperin on mortality (%) of black bean aphid at different intervals in lab

This study found significant effect of botanicals and siperin on mortality (%) of black bean aphid at different intervals i,e. 12, 24, 36 and 48 hrs (Fig. 4.4 and Appendix VIII). The study measured the mortality (%) upto 66.67% in siperin at 48 hrs. Jute seed caused 53.36 % mortality at 48 hrs counted 80.00% effective as compared to siperin, whereas 66.25 and 63.75% effective in case of custard apple and urmoi leaves, respectively at 48 hrs. The study also revealed that jute seed showed 1.21 and 1.25% time better performances than that of custard apple and urmoi leaves, respectively (Fig. 4.4).

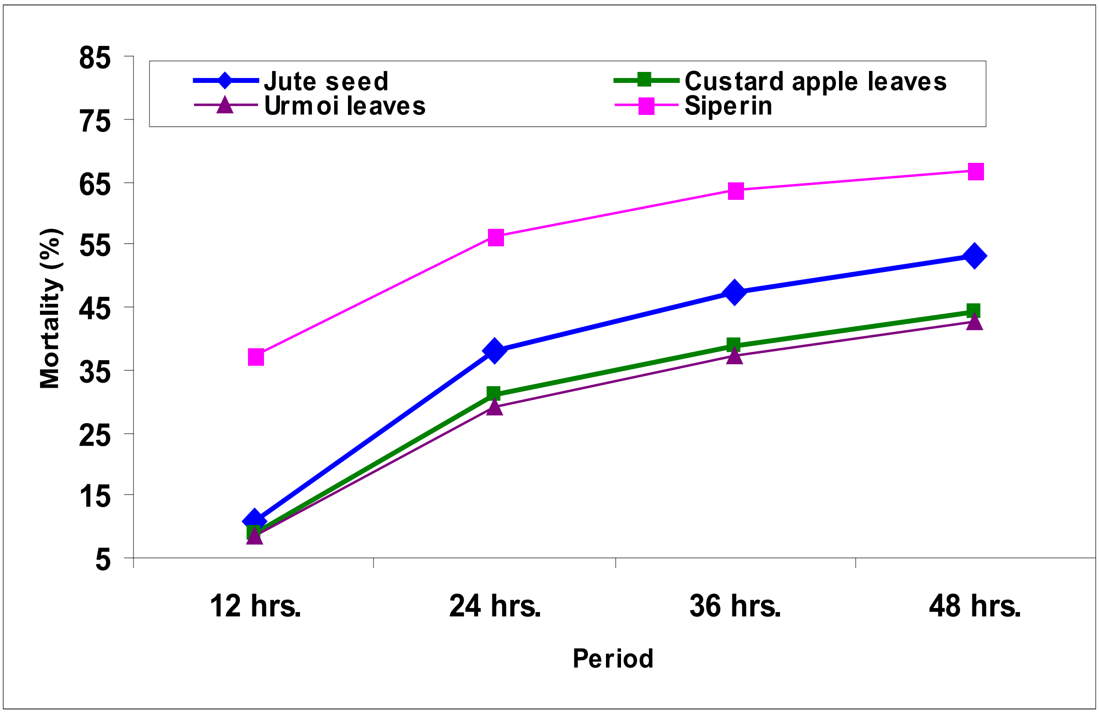

Fig. 4.4 Effect of botanicals and siperin on mortality (%) of black bean aphid at different intervals

4.3.1.1.2 Effect of Doses on Mortality (%) of Black Bean Aphid at different Intervals in lab

The effect of the doses of botanicals showed significant mortality (%) at different intervals (Appendix VIII). Each botanical consisted of 3 doses along with control. Control treatment did not show any mortality (%) of black bean aphid (Table 4.2). The study observed the more mortality (%) in higher doses at all the intervals, 1.50-2.50 times higher mortality in 7.5% concentration than that of 5% and 1.23-2.07 times higher in case of 10% than that of 7.5% concentration of botanicals. The study noticed increased mortality (%) of black bean aphid with passing the treated time in respect to doses of botanicals and siperin (Table 4.2).

Table 4.2 Effect of the doses of botanicals on mortality (%) of black bean aphid at different intervals in lab.

Concentration (%)	Adult mortality at different time intervals (%)			
	12 hrs	24 hrs	36 hrs	48 hrs
0	0.000d	0.000d	0.000d	0.000d
5	7.498c	24.58c	35.83c	46.67c
7.5	18.75b	55.00b	66.67b	71.67b
10	38.75a	74.58a	84.58a	88.33a
$LSD_{0.05}$	1.83	2.08	2.88	2.55
Level of significance	**	**	**	**
CV (%)	13.59	6.49	7.40	5.93

* Means in a column followed by the same letter are not significantly different at ($P<0.01$) by DMRT.

4.3.1.1.3 Effect of botanicals and siperin as well as doses of botanicals on mortality (%) of black bean aphid at different intervals in lab

The study herewith intensively investigated the significant interaction effect of botanicals and siperin on the mortality (%) of black bean aphid at different intervals (Appendix VIII). Siperin (0.05%) showed 18.33% mortality at 12 hrs which reached to 66.67% after 48 hrs (Table 4.3). In higher concentration of siperin (0.10%) exerted the mortality of black bean aphid ranged from 35.00 to 100.00 % during intervals 12 hrs to 48 hrs (Table 4.3). The highest i.e. 100% mortality achieved in 0.20% concentration of siperin within 24 hrs. This result was the similar as like as 36 and 48 hrs of intervals. The jute seed showed 25.00% mortality at 12 hrs which reached to 98.33% after 48 hrs. in 10.00% concentration dose. The study also expressed 80.00 and 75.00% mortality from custard apple leaves and urmoi leaves at 48 hrs in 10% concentration of these two botanicals (Table 4.3). Here jute seed (10%) showed the excellent effect on mortality (%) i.e. 78.00% efficacy compare to siperin after 24 hrs, also remarking 91.67% effective as compared to siperin at 36 hrs and 98.33% effective at 48 hrs. The jute seed gave the better performances over custard apple leaves and urmoi leaves at all the intervals also in all of the doses of botanicals (Table 4.3). The study also revealed that the % mortality increased with increasing of the applied doses of the studied botanicals (Table 4.3).

Table 4.3 Interaction effects of botanicals as well as siperin and their doses on mortality (%) of black bean aphid at different intervals in lab

Plant extracts	Concentration (%)	Adult mortality at different time intervals (%)			
		12 hrs	24 hrs	36 hrs	48 hrs
Control	0	0.000 j	0.000 k	0.000 j	0.000 m
Jute seed	5	5.000f	25.00h	33.33f	45.00f
	7.5	13.33e	48.33e	65.00d	70.00cd
	10	25.00c	78.33c	91.67b	98.33a
Custard apple leaves	5	3.330fg	20.00i	28.33fg	38.33g
	7.5	13.33e	41.67f	51.67e	58.33e
	10	18.33d	61.67d	75.00c	80.00b
Urmoi leaves	5	3.330fg	16.67i	25.00g	36.67g
	7.5	13.33e	41.67f	51.67e	58.33e
	10	16.67de	58.33d	71.67c	75.00bc
Siperin 10EC	0.05	18.33d	36.67g	56.67e	66.67d
	0.10	35.00b	88.33b	98.33a	100.0a
	0.20	95.00a	100.0a	100.0a	100.0a
$LSD_{0.05}$	-	3.67	4.16	5.75	5.09
Level of significance	-	**	**	**	**
CV (%)	-	13.59	6.49	7.40	5.93

* Means in a column followed by the same letter are not significantly different at (P<0.01) by DMRT.

4.3.1.2 Effect of botanicals and siperin on country bean production

This study found significant effect of siperin and botanicals on the growth and yield attributes in respect to plant height, no. of twig/plant, no. of leaves/plant, infested leaves/plant, total no. of pod/plant, infested pod/plant, pod length and pod weight/plant (Appendix IX). During this study, jute seed showed the 2nd highest plant height (308.30 cm), no. of twigs/plant (11.00 no.) and no. of leaves/plant (16.67 no.) having no statistical difference with siperin, custard apple leaves and urmoi leaves, respectively (Table 4.4). In case of the studied three growth attributes siperin showed the highest performances in respect of plant height, no. of twigs/plant and no. of leaves/plant. The custard apple leaves and urmoi leaves were found in the 3rd and 4th highest position out of three botanicals and one chemical insecticides siperin including control (Table 4.4).

Table 4.4 Effect of botanicals and siperin on growth and yield of country bean

Treatments	Plant height (cm)	No. of twig / plant	No. of leaves/ twig	Total no. of pod / plant	Pod length (cm)
Control	286.0b	5.667c	11.00b	183.0b	8.000b
Jute seed	308.3a	11.00ab	16.67a	213.3a	12.83a
Custard apple leaves	307.0a	10.67ab	14.67a	208.7a	12.33a
Urmoi leaves	306.0a	10.33b	14.33a	207.0a	11.67a
Siperin 10 Ec	310.7a	11.67a	16.68a	216.7a	13.00a
$LSD_{.005}$	15.41	1.14	2.20	14.60	1.29
Level of significance	*	**	**	**	**
CV (%)	2.70	6.14	7.97	3.77	5.93

* Means in a column followed by the same letter are not significantly different at (P<0.01) by DMRT.

No. of pods/plant significantly was also affected by the botanicals and siperin (Appendix IX). Jute seed produced the 2nd highest no. of podsper plant (213.33 nos.) having no statistical difference with siperin, custard apple leaves and urmoi leaves, respectively. Here control treatment produced the lowest no. of pods/plant. Both custard apple leaves and urmoi leaves produced the moderate pods/plant among the studied botanicals and siperin including the control one. The produced pods/ plant ranged from 207.00 to 216.70 no. (Table 4.4).

The study also observed significant pod length which affected by the studied botanicals and siperin (Appendix IX). The siperin, jute seed, custard aple leaves and urmoi leaves produced the 1st, 2nd, 3rd and 4th highest pod length of country bean though there was no significant differences amongst the studied treatment except the control one. Here control treatment produced the lowest pod length. The observed pod length ranged from 12.33 – 13.00 cm no. (Table 4.4).

The studied botanicals along with siperin kept the excellent and significant effect on infested leaves/plant of country bean (Appendix IX).The siperin and jute seed ensured the minimum infested leaves/plant representing 1.33 and 1.67 infested leaves/plant, respectively, whereas control treatment gave the maximum infested leaves/plant of country bean (Fig. 4.5). Amongst the studied botanicals, jute seed showed 2.20 and 2.40 times higher performances than those of custard apple leaves and urmoi leaves, respectively. Such event there was no significant variation between the performances of siperin and the jute seed in respect of infested leaves/plant (Appendix IX). After all jute seed reduced the leaf infestation 11.60 times lower than control one (Fig. 4.5).

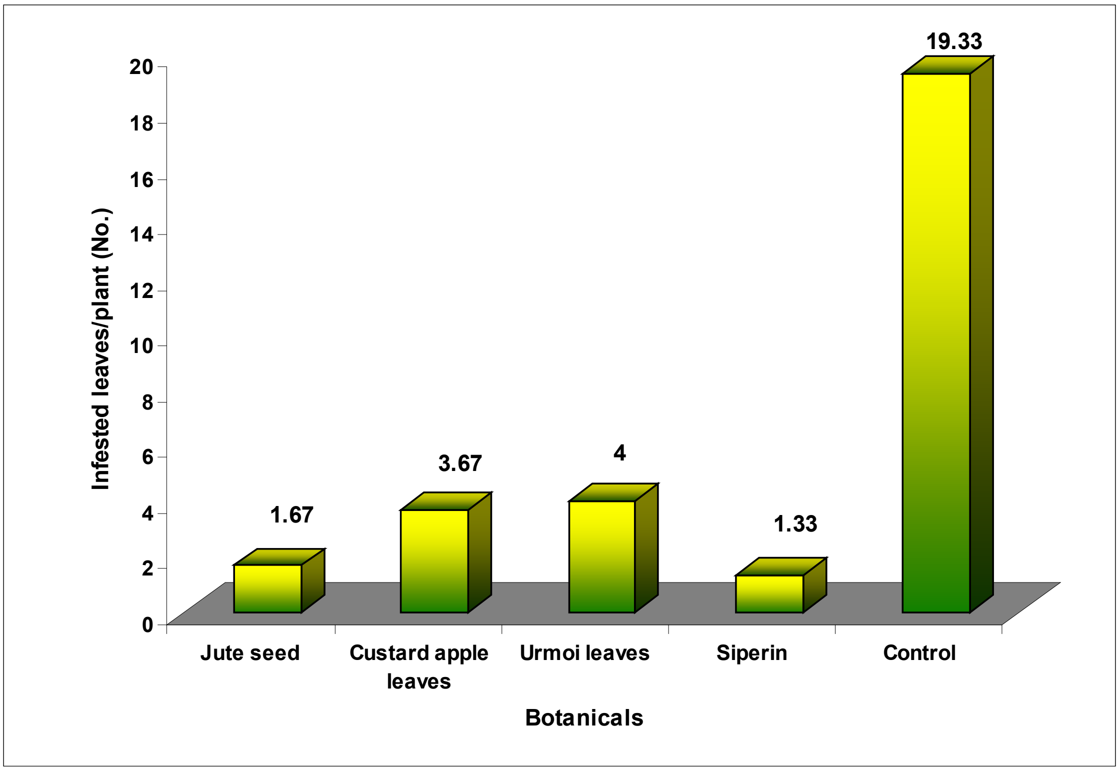

Fig. 4.5 Effect of botanicals as well as siperin on infested leaves/plant of country bean

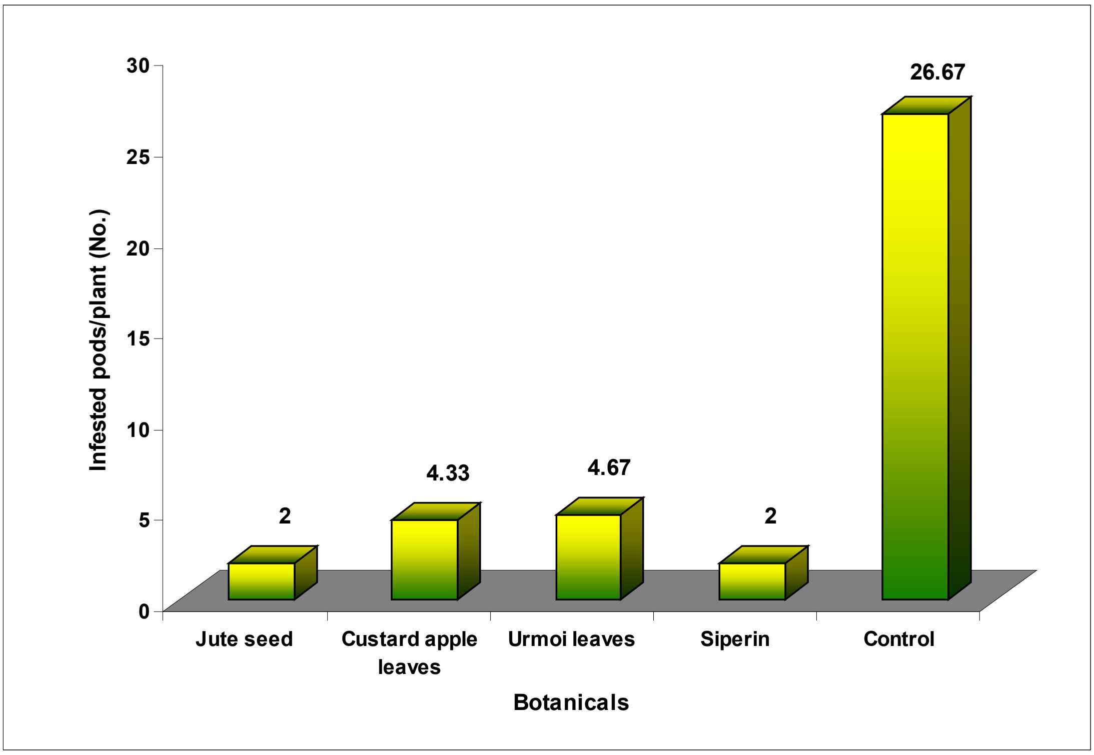

Fig. 4.6 Effect of botanicals as well as siperin on infested pods/plant of country bean

The study also investigated the significant effect of botanicals and siperin in respect to reducing the infested pods/plant (Appendix IX and Fig. 4.6), where minimum infested pod/plant jointly recorded from siperin as well as jute seed. Numerically custard apple leaves and urmoi leaves ranked in the 2nd and 3rd highest position in respect to reducing the infested pods/plant though having no statistical differences between them (Appendix IX). The control treatment carried the highest infested pods/plant of country bean (Fig. 4.6).

The study observed the highest and the lowest pod weight/ plant remarking as 1.79 and 1.08 kg/plant in siperin and the control treatment, respectively (Fig. 4.7), which detected also as significant (Appendix IX). Here jute seed gave the 2nd highest pod yield as the value 1.78 kg / plant which recorded as the 1.15, 1.22, 1.07 and 16.50 times higher yield/ plant than that of custard apple leaves, urmoi leaves, siperin and the control one, respectively (Fig. 4.7).

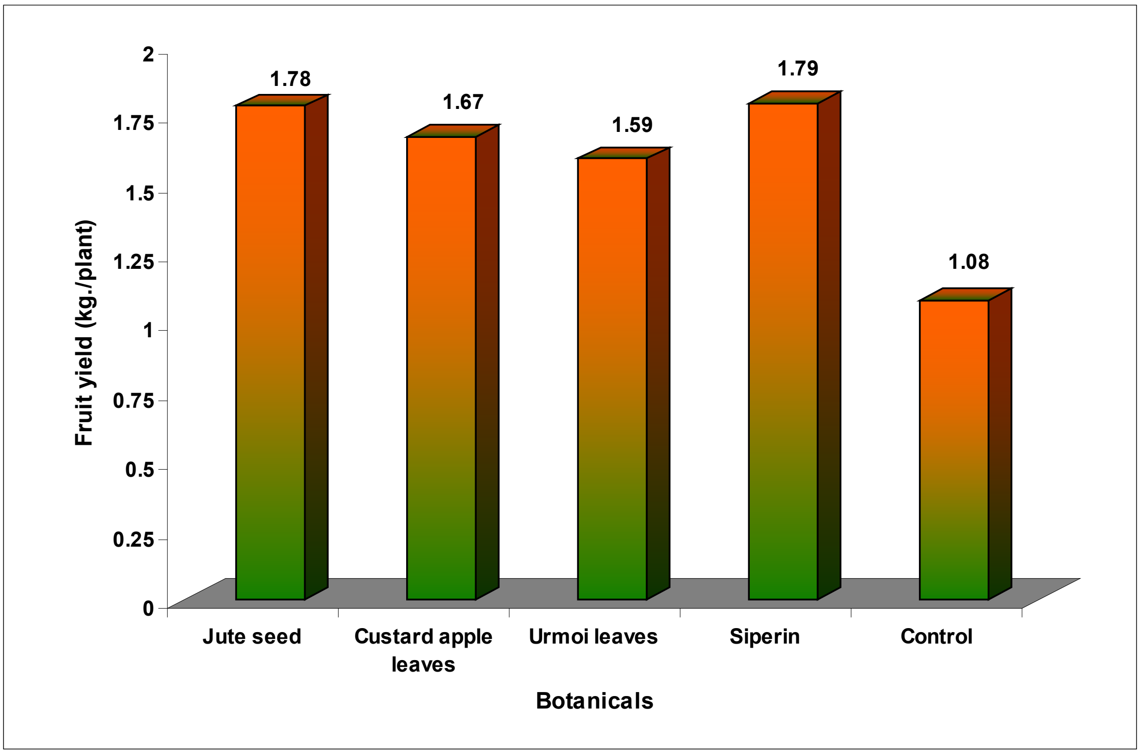

Fig. 4.7 Effect of botanicals as well as siperin on pod yield of country bean

4.3.2 Discussion

The vegetable cultivation in Bangladesh provides an ample opportunity for men and women folk of the disadvantaged groups. But the yield per unit area is quite low since the insect pests cause 30 – 40% losses in general and even 100% losses if no control measure is applied (Rahman, 2005). Recently, the use of insecticides has considerably increased in vegetables like eggplant, country bean, cucurbits, yard long bean etc particularly in their intensive growing areas. In the present study siperin ensured upto 66.67% mortality of black bean aphid at 48 hrs treatment (Fig. 4.4). But, it is the matter of concern that chemical residues, especially derivatives of chlorinated pesticides, exhibit bioaccumulation could build up to harmful levels in the body as well as in the environment (Walter, 2009). The different botanical extracts had notable effects on reduction of aphid numbers in yard-long bean (Bahar *et al*., 2007). Botanical products can also be easily and cheaply collected in rural Bangladesh, have been found promising and useful for pest control (Roy *et al*., 2005).

Serious problems of genetic resistance by insect species, residual toxicity, photo toxicity, vertebrate toxicity, widespread environmental hazards and increasing costs of application of the presently used synthetic pesticides have diverted the need for effective, biodegradable pesticides (Zettler and Cuperus 1990; Talukder and Howse 2000). This awareness has created worldwide interest in the development of alternative strategies such as use of plant-derived materials, which are more readily biodegradable. This demand of interest encouraged to conduct the present jute seed oriented botanical controls of black bean aphid to minimize the losses of country bean as occurred by black bean aphid.

The present study found out that botanical extracts such as extract of jute seed ensured 53.36 % mortality of black bean aphid at 48 hrs and accounted to 80.00% effective in case of mortality (%) of black bean aphid compare to siperin, whereas 66.25 and 63.75% effective performances were detected in case of other two studied botanicals viz. custard apple and urmoi leaves, respectively (Fig 4.4). The botanicals derived other benefits of applying remarked as less toxic to mammals, may be more selective in action, and may retard the development of resistance (Elhag 2000). The insecticidal property of botanical extract (tobacco extract) has long been known and well documented against various insect pests including aphids (Pedigo, 2002). Saikia *et al*. (2000) reported that leaf (10-50%) and seed kernel (5%) extracts of neem caused significant mortality of the bean aphid.

The study detected increased mortality (%) of black bean aphid passing the treated hrs in respect to all the studied doses of botanicals and siperin. The more mortality (%) was observed in higher doses at all the intervals remarking 1.50-2.50 times higher mortality in 7.5% concentration than that of 5% and 1.23-2.07 times higher in case of 10% than that of 7.5% concentration of botanicals. In the study, 100% mortality was achieved in 0.20% concentration of siperin started from 24 hrs of treatment (Table 4.3). Here jute seed showed the excellent effect on mortality of black bean aphid (78.00%) which gave the better performances over custard apple leaves and urmoi leaves (Table 4.3).

Plant extracts were found also effective and chemical insecticide was found highly effective in controlling bean aphid (Jahan *et al*., 2013). The percent population of aphid was found to decreasing with the increasing of time from the treatment application (Table 4.3). Botanicals are plant derived traditional and non-synthetic protectants are used for the protection of agricultural produce. These plants are available in many developing countries and contain several active ingredients and act in different ways under different circumstances (Isman, 2006). It has been also known that tobacco leaves (*Nicotiana tabacum*) have been used as insecticide and pesticide for long time (Abdul-ghany *et al*., 2011) , although the rank-order of the treatments appeared to be inconsistent across different post-treatment times. This result was in agreement with the observation by Bahar *et al* (2007).

The study herewith intensively investigated the significant interaction effect of botanicals and siperin on plant height, no. of twig/plant, no. of leaves/plant, infested leaves/plant, total no. of pod/plant, infested pod/plant, pod length and pod weight/plant (Appendix IX). After siperin, jute seed showed the highest plant height (308.30 cm), no. of twigs/plant (11.00 no.) and no. of leaves/plant (16.67 no.) but no statistical difference with siperin, custard apple leaves and urmoi leaves (Table 4.4).

The study also observed the significant pod length and total no. of pods/plant as affected by the botanicals and siperin (Appendix IX). The siperin, jute seed, custard aple leaves and urmoi leaves produced the 1st, 2nd, 3rd and 4th highest pod length as well as total no. of pods/plant of country bean though there was no significant differences amongst the studied treatment except the control ones (Table 4.4). Control treatment gave the worst performances in respect of pod length and total no. of pods/plant of country bean. The botanical extracts benefited bean yield and plant biomass, which was presumably due to reduction of aphid numbers and protection of crops from pest (Pedigo, 2002).

There was a significant effect of treatments on yard-long bean yields with respect to mean number of pods per plant, pod weight and weight of plant biomass (Bahar *et al*., 2007). Treatments of botanical extracts resulted in intermediate levels of pod weight, which were the best than the control one (Table 4.4). In the case of both fresh and dry weight of plant biomass, the trends of the present results were more or less similar to the findings of Jahan *et al*. (2011). The study also investigated the significant effect of botanicals and siperin in respect to reducing the infested leaves/plant as well as infested pods/plant of country bean (Appendix IX and Fig. 4.6-4.7). The siperin and jute seed ensured the minimum infestations in country bean plant. Numerically custard apple leaves and urmoi leaves ranked in the 2nd and 3rd highest position in respect to reducing the infestations. The control treatment carried the highest infestations in country bean (Fig. 4.6-4.7). This result was in agreement with the observation of Prabal *et al*. (2000), Ulrichs *et al.* (2001) and Egwurube, *et al.,* (2000). According to Prabal *et al*., (2000) and Ulrichs *et al.,*(2001), plant extracts and according to Egwurube, *et al*., (2000) chemical insecticides are effective control measures to control bean aphids. The reductions of aphid numbers increased with increase of the time after treatments were applied, which is a usual phenomenon for most insecticides. Although botanical insecticides are biodegradable and they often breakdown quickly after being exposed to the surrounding environmental conditions like sunlight, moisture and air (Pedigo, 2002). The represent study found that the botanical extracts remained effective at least 48 h after being applied (Fig. 4.6-4.7). Jahan *et al*., (2013) revealed that both insecticides (Neem leaf extracts and Haymethoate) were found significantly effective in reduction of aphid (*A.craccivora*) population on twig, inflorescence and pod comparing to the untreated control plot.

The study observed the highest and the lowest pod weight/ plant as 1.79 and 1.08 kg/plant in siperin and control treatment. Here jute seed gave the 2nd highest pod yield as 1.78 kg/plant which recorded as the 1.15, 1.22, 1.07 and 16.50 times higher yield/plant than those of custard apple leaves, urmoi leaves, siperin and control, respectively (Fig. 4.7). Different botanical extracts had notable effects in increasing the yield of yard-long bean (Bahar *et al*., 2007). Botanical extract also had significant effect on pod weight. Weight of total pods of botanical extract-treated plants was the highest compare to untreated one (Fig. 4.7).

Conclusion

The study found jute seed may very effective for controlling the black been aphid. The 10% dose of jute seed caused 98.33% mortality of bean aphid within 48 hrs.

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Chapter 5

EFFICACY OF SIPERIN AND BOTANICALS FOR THE CONTROL OF OKRA JASSID

ABSTRACT

The present study was conducted to investigate the efficacy of three botanicals (jute seed, custard apple leaves and urmoi leaves) for controlling of okra jassid in okra field during March, 2013 - June, 2014. Botanical extracts were evaluated in respect of % mortality of okra jassid. The results showed that botanical extracts were effective in reducing jassid infestation. During mortality test, 62.08% mortality of okra jassids was found in siperin, on the other hand, jute seed, custard apple and urmoi leaves caused the mortality (%) to 48.75, 36.67 and 35.00 during 48 hrs, respectively. The study found more mortality (%) with a long treatment time and also in higher doses. Overall the doses showed the mortality (%) ranged 8.333-82.08%. The study also observed the significant variations in plant height, no. of leaves/plant, infested leaves/plant, total no. of fruit/plant, fruit length and fruit weight/plant of okra for the application of siperin and botanicals. The study found 0.854 fruit weight/plant and 9.41% infested leaves/plant but no statistical differences with chemical insecticide siperin.

5.1 Introduction

The word *okra* (*Abelmoschus esculentus* L. Moench) is West African in origin, probably from Igbo *ọ́kụ̀rụ̀* (McWhorte, 2000). The geographical origin of okra is disputed, with supporters of West African, Ethiopian, and South Asian origins. The plant is cultivated in tropical, subtropical and warm temperate regions around the world (NRC, 2006). It is an important summer vegetable in Bangladesh. It is a nutritious vegetable which plays an important role to meet the demand of vegetables of the country when vegetables are scanty in the market. These green fruits are rich sources of vitamins, calcium, potassium and other minerals. Okra is specially valued in different parts of the country for its tender and delicious fruits (Annon, 2000).

Okra is cultivated throughout Bangladesh but its average national yield is poor, only 3.07 t ha^{-1}. The yield is very low compared to the yield 9.7-10 t ha^{-1} of other developed countries of the world due to attacked by different insect pests (Ewete, 1983) from sowing up to harvesting. Okra plant is highly susceptible to jassid, whitefly, aphid, thrip, spotted bollworm, American bollworm etc. Among sucking insect pests, jassid (*Amrasca devastans*) is more serious (Atwal, 1994) and transmit certain viral diseases. It lays maximum number of eggs and thus becomes suitable place for survival and feeding. Moreover, they cause a great damage by sucking the plant sap (Bernardo and Taylo, 1990; Sharma and Singh, 2002).

Insect pests cause 35-40% crop yield losses and ultimately increase the level of damage up to 60-70% in optimal conditions (Salim, 1999). Use of insecticides is the most common method of pest control under the local conditions. Nevertheless, the insecticides application provides an immediate solution to control the pests (Mehmood et al., 2001) and seems to be most important pest management tool in boosting agricultural production. But, it is a matter of concern that it creates environmental, soil and water pollution, and kills the beneficial insects (predators, pollinators etc.).

However, use of botanical insecticides is one of the safest methods of pest control; it does not cause environmental, soil and water pollution and also no damage to beneficial insects. Therefore there is a need to develop alternates for handling such economically important pests approach. With the view of environmental friendly pest management approach, several plant products are used to control insect pests effectively (Solangi et al., 2013). Keeping the above facts in view, an experiment was carried out to determine the evaluation of three botanicals for the control of jassid in okra crop field.

Specific objectives of this study:

I. To study the effectiveness of siperin and botanicals on mortality (%) of okra jassid,

II. To identify the effectiveness of botanical extracts on growth and yield of okra and

III. To investigate the efficiency of jute seeds as the botanical insecticide for eco-friendly controlling of okra jassid in okra field.

5.2. Materials and Methods

This study was conducted during March, 2013 - June, 2014, where mortality (%) test on okra jassid was performed in May, 2013 to June, 2013 and field experiment was carried out in the period of 1st March, 2014 to 7th June, 2014.

5.2.1 Collection of insect

The Okra jassids were collected from Bangladesh Agricultural University campus for conducting the mortality (%) test.

5.2.2 Insect rearing

The okra jassid was reared under laboratory condition in the Entomology Division, BINA, Mymensingh (Fig 5.1). The rearing of okra jassid was done for conducting the mortality test in the laboratory. The laboratory tests evaluated the efficacy of the studied botanicals and also appropriate doses of botanicals against okra jassid (Fig. 5.1).

Fig.5.1 Rearing of Okra jassid

5.2.3 Collection of Siperin and Botanicals

In the study one chemical insecticide namely siperin (10 EC) was collected from dealer of insecticides in Mymensingh town. On the other hand three selected botanicals (jute seed, custard apple leaves and urmoi leaves) were collected from BAU campus of Mymensingh district. These three botanicals were fixed based on conducting the screened test during March, 2013 to May, 2013. After collection of the botanicals, fresh plant parts were washed in running tap-water and air dried in the shade for 1 (one) week at room temperature 30 ± 2ºC. On the other hand siperin was preserved in the laboratory of Entomology Division, BINA, Mymensingh.

5.2.4 Formulation of Siperin

Siperin (10 EC) formulation was prepared adding the tap water, when necessary as per fulfillment the requirement in conduct of laboratory as well as field experiment.

5.2.5 Preparation of Botanical Extracts

Botanical extracts of jute seeds, custard apple leaves and urmoi leaves were prepared in the laboratory of the Entomology Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh following the procedures stated in the chapter 3.2.5.

5.2.6 Treatment of the Experiment

5.2.6.1 Treatment for conducting the laboratory test

In the laboratory three no. of doses of siperin and botanicals were used along with a control ones as stated herewith. The formulation of siperin was made adding the water as per requirement. On the other botanicals extracts was diluted in methanol (due to acts of it as the good solvent).

5.2.6.2 Treatment for the field experiment

In the field condition only the best doses of laboratory results of siperin and botanicals were used. Details are presented below:

Treatment for conducting the laboratory test

Insecticides and Botanicals	Concentration (%)
Control (using methanol)	0
Siperin	0.05
	0.10
	0.20
Custard apple	5.00
	7.50
	10.00
Urmoi	5.00
	7.50
	10.00
Jute seed	5.00
	7.50
	10.00

Treatment for the field experiment

Insecticides and Botanicals	Concentration (%)
Control	0
Siperin	0.10
Custard apple	10.00
Urmoi	10.00
Jute seed	10.00

During the field experiment formulation of siperin was made adding the water as per requirement. But in case of botanicals, extract was diluted at first with 0.5% detergent for proper mix-up and then added the water as per requirement for the field experiment.

5.2.7 Design of the experiment

The laboratory experiment was laid out in a Completely Randomized Design (CRD) with three replications. On the other hand in case of field experiment Randomized Complete Block Design (RCBD) was followed with also three no. of replications.

5.2.8 Mortality test for Okra jassid

Fresh and young Okra leaves were collected and treated by siperin as well as botanicals then kept for airdried. Then each treated Okra leaves separately were placed upside down in a petri dish 7.5 cm (dia). Twenty okra jassids were released with camel hair brush (Fig. 5.2).

Fig. 5.2 Determination the mortality (%) of Okra jassid

5.2.9 Data collection in laboratory

- In the laboratory adult mortality at 12, 24, 36 and 48 hrs (%) in different concentrations of botanicals as well as siperin were determined.

5.2.10 Preparation of land for vegetables cultivation

The experimental land was first ploughed with a country plough. Ploughed soil was then brought into desirable final tilth condition by five operations of ploughing followed by laddering. The stubbles of the crops and uprooted weeds were removed from the field and the land was properly leveled. Finally okra seeds were seeded in the experimental field.

5.2.11 Fertilizer application

The okra crop was fertilized by cow dung, urea, TSP, MP , Tricompost, gypsum, zinc and, boron @ 60 kg, 1kg, 600 g, 500 g ,1kg, 250gm, 25gm,and 25gm/decimel, respectively.

5.2.12 Cultivation of vegetables in field

During this study, okra crop was cultivated in the standard manner during 1st March 2014 to 7th June 2014. The photographic overview of the cultivated vegetable is shown in Fig. 5.3. The cultivation procedures are also outlined herewith below (Table 5.1).

Fig. 5.3 The field experiment with Okra

Table 5.1 Cultivation procedures of Okra in the experimental field

Name of crop	:	Okra (*Abelmuscus esculentus*)
Date of planting	:	1st March 2014
Practiced intercultural operations	:	• Thinning, • Weeding (3 times) and • Supply irrigation water (tap water).
Harvesting period	:	Starting in 2nd April 2014 continued up to 7th June 2014

5.2.13 Application of botanicals and siperin in field

The plants of the experimental plots were sprayed with three studied botanical extracts (extracts @10% with 0.5% detergent) and Siperin (@ 0.1% concentration) twice a week with the help of a sprayer. After application of botanicals and siperin, the pest attack was also monitored daily and no. of okra leaves and fruits attacked by okra jassid was recorded every three days a week.

5.2.14 Data collection from field

- Plant height,
- No. of leaves/plant,
- Infested leaves/plant (%),
- Total no. of fruits/plant,
- Fruit length and
- Fruit weight/plant

5.2.15 Data Analysis

i) Laboratory: The collected data were statistically analysed by Completely Ranomized Design (CRD). Mean values were ranked by Duncan's Multiple Range Test, DMRT (Duncan, 1951).

ii) Field: The observed values were statistically analyzed by RCBD. Mean values were adjusted by one way ANOVA and the significant level was tested by Duncan's Multiple Range Test (Duncan, 1951).

5.3 Results and Discussion

5.3.1 Results

5.3.1.1 Effect of botanicals and siperin and their interaction effect on mortality (%) of okra jassid

5.3.1.1.1 Effect of botanicals and siperin on mortality (%) of okra jassid at different intervals

This study observed significant effect of botanicals and siperin on mortality (%) of okra jassid at different intervals i,e. 12, 24, 36 and 48 hrs (Fig. 5.4 and Appendix X). Mortality (%) of okra jassid found upto 62.08% in siperin at 48 hrs. On the other hand, jute seed, custard apple and urmoi leaves caused the mortality (%) up to 48.75, 36.67 and 35.00 during 48 hrs. The study also showed the 79.00, 60.00 and 56.00% effectiveness of jute seed, custard apple and urmoi leaves, respectively in respect of mortality (%) of okra jassid in comparison to siperin. However, the study showed the increased mortality (%) of okra jassid with treated time in respect of all the studied botanicals and siperin (Fig. 5.4).

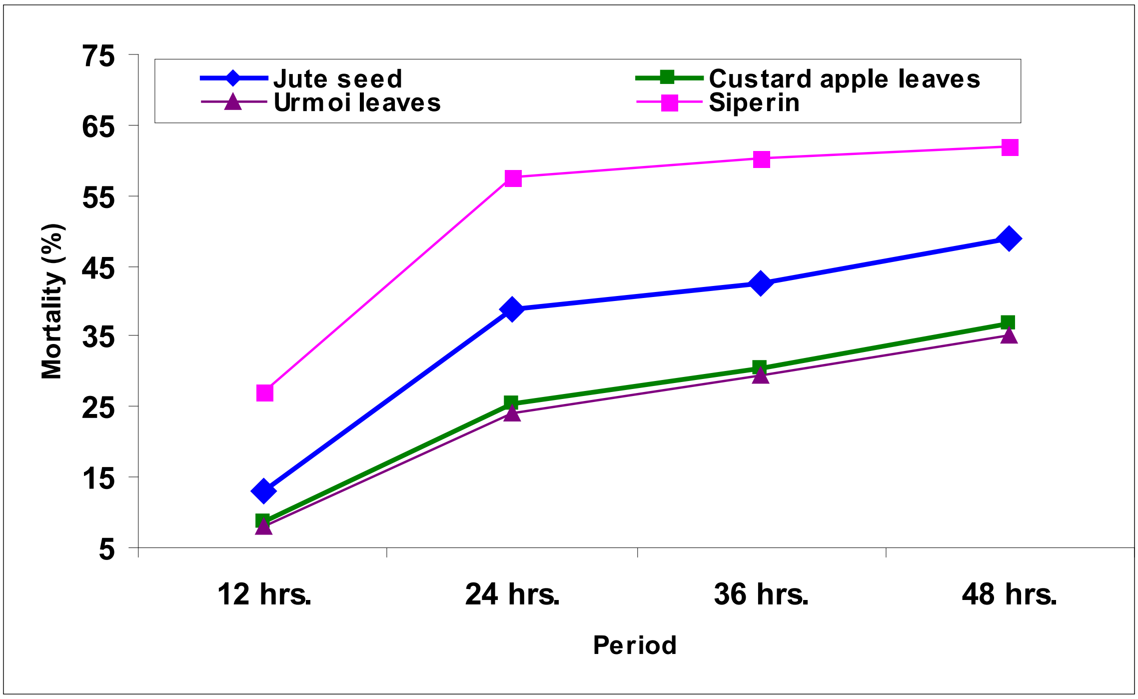

Fig. 5.4 Effect of botanicals and siperin on mortality (%) of okra jassid at different intervals

5.3.1.1.2 Effect of doses on mortality (%) of Okra jassid at different intervals

Significant mortality (%) of okra jassid was found in different doses of botanicals at different intervals (Appendix X). Botanicals consisted 3 numbers of doses along with control one, where control treatment did not show any mortality (%) of okra jassid (Table 5.2). The study observed mortality (%) in higher doses at all the intervals, 2.00 times higher mortality in 7.5% concentration than that of 5% and 4 times higher mortality (%) in case of 10.00% concentration than that of 5% at 12 hrs. This trend was applicable at 24, 36 and 48 hrs, but the increasing trend was not reached as like as 12 hrs (Table 5.2). Overall the studied doses ensured the mortality (%) ranged 8.333-82.08%.

Table 5.2 Effect of the doses of botanicals on mortality (%) of Okra jassid at different intervals

Concentration (%)	Adult mortality at different time intervals (%)			
	12 hrs	24 hrs	36 hrs	48 hrs
0	0.000d	0.000d	0.000d	0.000d
5	8.333c	27.50c	32.08c	38.33c
7.5	16.67b	50.42b	56.25b	62.08b
10	31.67a	67.92a	74.58a	82.08a
$LSD_{0.05}$	1.28	2.16	2.25	1.99
Level of significance	**	**	**	**
CV (%)	10.88	7.14	6.63	5.25

* Means in a column followed by the same letter are not significantly different at ($P<0.01$) by DMRT.

5.3.1.1.3 Effect of botanicals and siperin as well as doses of botanicals on mortality (%) of Okra jassid at different intervals

The study intensively investigated the significant interaction effect of botanicals and siperin on the mortality (%) of okra jassid at different intervals (Appendi X). Siperin showed 13.33% mortality at 12 hrs which reached to 51.67% at 48 hrs for treatment of 0.05% concentration (Table 5.3). The 0.10% concentration of siperin exerted the mortality of okra jassid ranged from 33.33 to 96.67 % at the studied different intervals within 12 to 48 hrs (Table 4.3). The highest i.e. cent percent mortality achieved in 0.20% concentration of siperin in 24 hrs. The jute seed ensured 28.33% mortality at 12 hrs which reached to 91.67% at 48 hrs interval for 10.00% concentration of jute seed. The study also observed the 68.33 % mortality both from custard apple leaves and urmoi leaves at 48 hrs for 10% concentration of botanicals (Table 5.3). Here jute seed showed excellent effect on mortality (%) i.e. 76.67% of okra jassid just after siperin from 24 hrs, also remarking 81.67% effective as compared to siperin at 36 hrs and 91.67% effective at 48 hrs from 10% concentration of jute seed. The jute seed gave the better performances over custard apple leaves and urmoi leaves at all the intervals also in all of the doses of botanicals (Table 5.3). Howover, the study showed the higher mortality in increased doses of botanicals and siperin with treated time (Table 5.3).

Table 5.3 Interaction effects of botanicals as well as siperin and their doses on mortality (%) of Okra jassid at different intervals

Plant extracts	Concentration (%)	Adult mortality at different time intervals (%)			
		12 hrs	24 hrs	36 hrs	48 hrs
Control	0	0.000 j	0.000 k	0.000 j	0.000 m
Jute seed	5	10.00g	31.67f	35.00h	41.67g
	7.5	13.33f	46.67d	53.33e	61.67d
	10	28.33c	76.67c	81.67c	91.67b
Custard apple leaves	5	5.00h	18.33g	23.33i	31.67h
	7.5	10.00g	35.00f	40.00g	46.67f
	10	20.00d	48.33d	58.33d	68.33c
Urmoi leaves	5	5.00h	18.33g	23.33i	28.33h
	7.5	10.00g	31.67f	36.67gh	43.33fg
	10	16.67e	46.67d	58.33d	68.33c
Siperin 10EC	0.05	13.33f	41.67e	46.67f	51.67e
	0.10	33.33b	88.33b	95.00b	96.67a
	0.20	61.67a	100.0a	100.0a	100.0a
$LSD_{0.05}$	-	2.57	4.33	4.49	3.98
Level of significance	-	**	**	**	**
CV (%)	-	10.88	7.14	6.63	5.25

* Means in a column followed by the same letter are not significantly different at (P<0.01) by DMRT.

5.3.1.2 Effect of botanicals and siperin on Okra production

The study observed the significant variations in plant height, no. of leaves/plant, infested leaves/plant, total no. of fruit/plant, fruit length and fruit weight/plant (Appendix XI) for the application of siperin and botanicals (jute seed, custard apple leaves and urmoi leaves). Jute seed showed heighest no. of leaves/plant (24.67 nos.) and 2nd heighest performances in plant height (118.70 cm) but no statistical difference with siperin (Table 5.4). In case of the studied two growth parameters such as plant height and no. of leaves/plants, siperin showed the tallest plant representing 119.00 cm plant height but 2nd heighest performances in no. of leaves/plant (24.33 nos.), respectively. The custard apple leaves and urmoi leaves ranked in the 3rd and 4th highest position among the studied botanicals and siperin including the control one (Table 5.4).

Table 5.4 Effect of botanicals and siperin on growth and yield of Okra

Treatments	Plant height (cm)	No. of leaves/ twig	Total no. of fruits/ plant	Fruit length (cm)
Control	95.67b	22.00b	57.00b	10.67c
Jute seed	118.70a	24.67a	67.00a	15.00a
Custard apple leaves	106.30ab	22.67b	63.00a	13.33ab
Urmoi leaves	104.70ab	22.67b	62.67a	12.00bc
Siperin 10 Ec	119.00a	24.33a	65.67a	15.00a
$LSD_{.005}$	14.47	1.55	4.53	1.70
Level of significance	*	**	**	**
CV (%)	7.06	3.54	3.82	6.85

* Means in a column followed by the same letter are not significantly different at ($P<0.01$) by DMRT.

No. of fruits/plant of okra significantly affected by botanicals and siperin (Appendix XI). Jute seed treatment produced the highest no. of fruits/per plant (67.00 nos.) having no statistical difference with siperin, custard apple leaves and urmoi leaves, respectively. Here control treatment produces the lowest no. of fruits/plant (57.00 nos.). Both custard apple leaves and urmoi leaves produced the 2nd and 3rd heighest fruits/plant among the studied botanicals and siperin including the control ones having no statistical differences among the botanicals and siperin except the control treatment (Table 5.4).

Fruit length was significantly affected by the studied botanicals and siperin (Appendix XI), where siperin and jute seed combindly produced the heighest fruit length (15.00 cm). However, custard apple leaves and urmoi leaves produced the 2nd and 3rd highest fruit length of okra (Table 5.4). Here control treatment produces the lowest fruit length. The observed fruit length ranged from 10.67-15.00 cm due to effect of botanicals and siperin (Table 5.4).

Three studied botanicals and siperin showed excellent and significant effect on infested leaves/plant of okra (Appendix XI).The siperin and jute seed ensured the minimum infested leaves/plant representing 8.24 and 9.41% infested leaves/plant, respectively (Fig 5.5), having no statistical differences between them. The control treatment gave the maximum infested leaves/plant of okra (37.86%). The custard apple leaves and urmoi leaves produced the moderate infested leaves/plant but there is no statistical differences between them (Fig. 5.5).

The study investigated the highest fruit weight/plant as 0.854 kg/plant from the jute seed having no statistical differences with siperin (Fig. 5.6**,** Appendix XI). In the study, jute seed also gave 2nd highest fruit yield as the value 1.78 kg/plant which was 1.10, 1.160 and 1.660 times higher yield/ plant than those of custard apple leaves, urmoi leaves and the control one, respectively (Fig. 5.6).

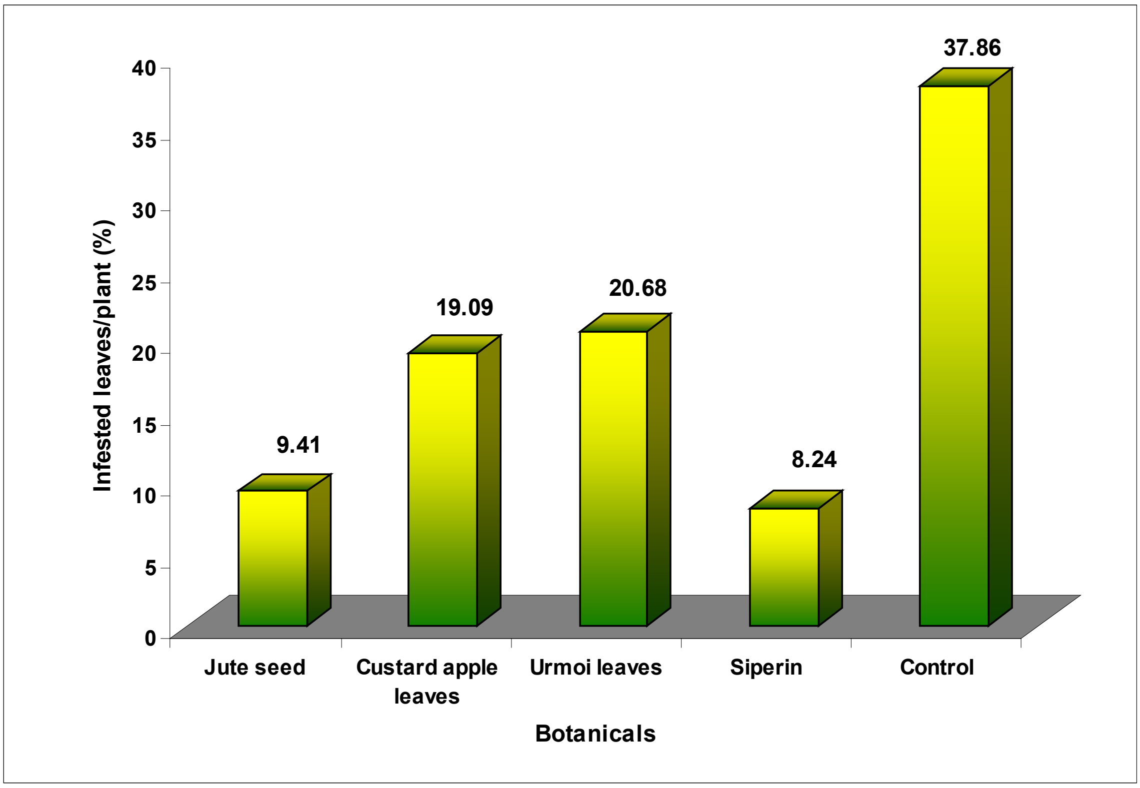

Fig. 5.5 Effect of botanicals as well as siperin on infested leaves (%) of okra

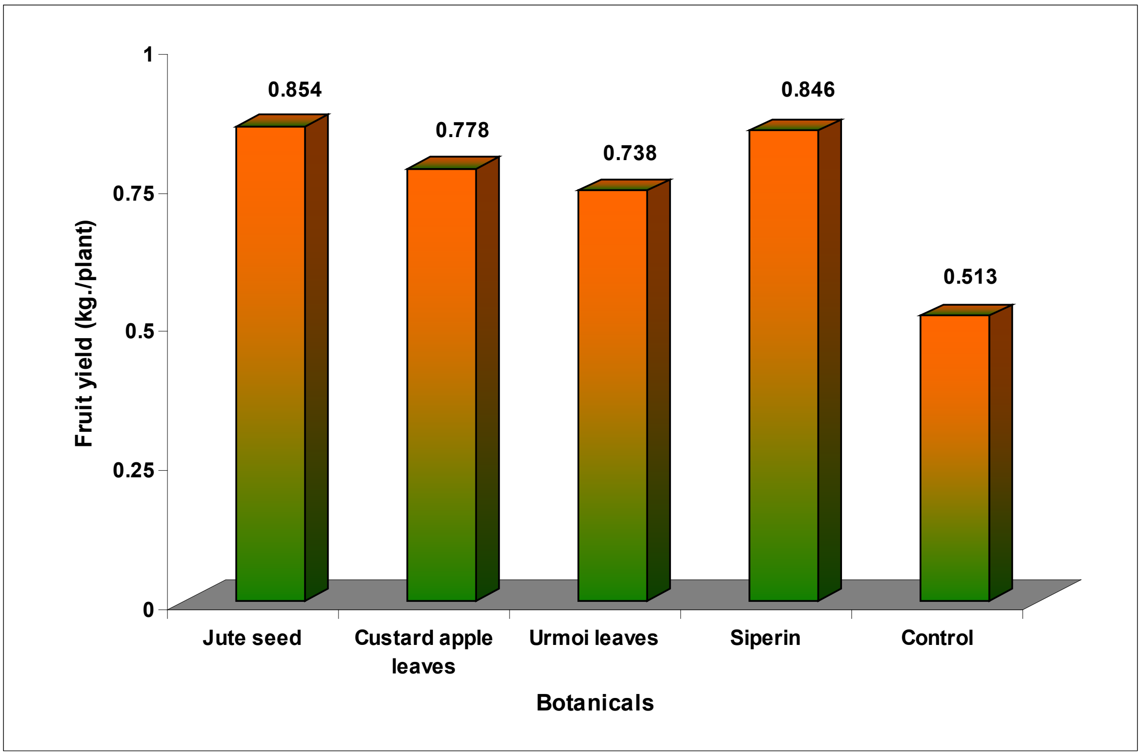

Fig. 5.6 Effect of botanicals as well as siperin on fruit yield of okra

5.3.2 Discussion

Amrasca devastans is the most important sucking insects that attack okra crop (Singh *et al,*. 1993; Dhandapani *et al.*, 2003). In present study, botanical jute seed and chemical insecticide siperin were used to minimize the losses of okra occurred by okra jassid. The results of present study revealed that botanicals pesticides and siperin significantly reduced the population of jassid after 12, 24, 36 and 48 hrs and mortality ranged 35.00-62.08 % (Fig. 5.4). These results are supported by the findings of Mishra and Mishra (2002) who evaluated various botanical products against the insect pests. Singh and Kumar (2003) evaluated various neem based products against jassid of okra and found endosulfan and achok most effective in controlling the okra Jassid. Many researchers (Naqvi, 1996; Aslam and Naqvi, 2000) have reported the effectiveness of botanicals insecticides in controlling different pests in okra field (Ambedkar *et al.*, 1999; Akbar *et al.,* 2005, 2007).

The study increased mortality (%) of okra jassid with treated time in respect to all doses of botanicals and siperin. The more mortality (%) was observed in higher doses at all the intervals, 2.00 times higher mortality in 7.5% concentration than that of 5% and 4.00 times higher in cease of 10% than that of 5.00% concentration of botanicals at 12 hrs (Table 5.3). The study found 100% mortality in 0.20% concentration of siperin started from 24 hrs of treatment (Table 5.3). The interaction effect of botanicas and siperin along with their studied doses also revealed that jute seed kept the excellent effect on mortality of okra jassid (91.67%) which gave the better performances over custard apple leaves and urmoi leaves at all the intervals (Table 5.3). Botanical pesticides are environment friendly and seems to have some superiority over synthetic insecticides; in this respect more than 2400 plants have been identified with pest control properties (Grainge and Ahmed, 1988).
The study intensively investigated the significant interaction effect of botanicals and siperin on plant height, no. of leaves/plant, infested leaves/plant, total no. of fruit/plant, fruit length and fruit weight/plant (Appendix X). Here jute seed showed the highest no. of leaves/plant (24.67 nos.) and 2nd heighest plant height (118.70 cm) just after siperin but no statistical difference with siperin (Table 5.4). Bhyan *et al.,* (2007) stated that phytopesticidal treatments ensured better height than that of control ones. This was supposed also by Varanwal and Verma (1995).

Here the study also revealed that jute seed showed the highest no. of fruits/plant (67.00 nos.) having no statistical difference with siperin and other studied botanicals such as custard apple leaves and urmoi leaves, respectively (Table 5.4). The study also observed significant fruit length of okra ranged

10.67-15.00 cm but there was no significant differences amongst jute seed and siperin (Table 5.4). Always, control treatment gave the worst performances in respect to all studied growth and yield related attributes of okra.

Botanical extract also had significant effect on fruit weight. Weight of fruits/plants (0.854 kg/plant) achieved from jute seed was higher than that of chemical insecticide (siperin) estimated 0.846 kg/ (Fig. 5.6). Plant extracts were very effective in improving yields of okra, suggesting that they effectively reduced the biotic stress imposed on the okra plants (Asare-Bediako *et al.*, 2014). It has been reported that botanical leaf extract has high values of nitrogen and phosphorus (Moyin-Jesu, 2010) responsible for increasing the crop yield. An increase in yield of okra plants treated with neem extract has also been reported by Oladimeji and Kannike (2009).

Botanical insecticides are broad-spectrum in pest control and many are safe to apply, unique in action and can easily be processed and used. Locally available plant materials have been widely used to protect field and stored products against insect infestation (Golob and Webley, 1980). The indigenous plant materials are available everywhere in Bangladesh country and can easily be produced by the farmers and small traders, which has extensively been used and has proved its pest controlling efficacy against several insect pests both in field and storage (Alam *et al.*, 2010). Here the study also investigated the significant effect of botanicals and siperin for reduction of infested leaves/plant of okra (Appendix XI and Fig. 5.5). The siperin and jute seed ensured the minimum infestations of okra plant. Numerically, custard apple leaves and urmoi leaves ranked in the 2nd and 3rd

highest position in respect to reducing the infestations. The control treatment carried the highest infestations in okra (Fig. 5.5). Akbar *et al.,* (2012) stated in their study that azadirachtin based biosal may successfully be incorporated as an alternative and effective pest management tool without containing particular dependence on conventional insecticides, as azadirachtin is easily degradable and the treated crop/produce remains safe for human consumption.

Conclusion

This study identified jute seed was superior in respect to fruit yield (0.854 kg/plant) compare to chemical insecticide (0.846 kg/plant). Jute seed was also found 91.67% effective in respect to mortality (%) of okra jassid than chemical insecticide (siperin). Therefore, it can be undoubtly recommended to incorporate jute seed for controlling the damages of okra jassid in okra field instead of harmful chemical insecticide siperin.

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Appendix 1. Monthly record of temperature, rainfall, relative humidity and sunshine (hr) from the period from January 2012 to June 2014.

	Month	Air temperature (◦C)			Total rainfall (mm)	Average relative humidity (%)	Sunshine hours
		Maximum	Minimum	Average			
Year 2012	January	23.16	12.43	17.80	18.00	80.03	144.6
	February	27.40	13.94	20.67	Trace	71.97	210.2
	March	31.37	19.17	25.27	1.20	73.84	222.1
	April	31.09	22.07	26.58	203.20	80.83	198.8
	May	33.28	24.24	28.76	85.1	78.61	208.7
	June	31.40	25.64	28.52	281.8	85.17	85.5
	July	31.57	26.49	29.03	404.3	86.68	116.9
	August	32.23	26.72	29.48	239.3	85.81	162.1
	September	32.01	26.45	29.23	237.7	86.53	104.9
	October	31.68	23.00	27.34	31.6	85.27	202.4
	November	28.36	16.94	22.65	18.9	81.73	168.8
	December	22.89	13.15	18.02	00.00	88.90	64.6

Source: Weather Yard, Depertment of Irrigation and Water management, Bangladesh Agricultural University, Mymensingh

	Month	Air temperature (◦C)			Total rainfall (mm)	Average relative humidity (%)	Sunshine hours
		Maximum	Minimum	Average			
Year 2013	January	23.8	10.6	17.3	0.0	78.7	124.8
	February	28.3	15.8	22.2	1.2	71.2	180.4
	March	31.9	19.6	25.6	21.0	73.9	213.5
	April	32.5	22.5	27.5	68.2	77.2	157.1
	May	30.4	23.9	27.2	282.9	84.5	121.2
	June	33.1	26.5	29.8	236.2	83.1	145.9
	July	32.3	26.8	29.5	338.8	84.1	120.7
	August	31.7	26.2	29.0	317.4	85.7	113.3
	September	32.4	26.2	29.3	131.6	85.5	132.0
	October	30.5	23.7	27.1	262.6	86.9	140.9
	November	29.6	16.10	23.1	0.0	81.6	218.1
	December	25.1	13.6	19.4	0.6	64.5	97.5

Source: Weather Yard, Depertment of Irrigation and Water management, Bangladesh Agricultural University, Mymensingh

	Month	Air temperature (◦C)			Total rainfall (mm)	Average relative humidity (%)	Sunshine hours
		Maximum	Minimum	Average			
Year 2014	January	24.3	12.6	18.5	00.0	63.2	106.0
	February	25.6	14.1	19.9	43.6	76.9	148..2
	March	30.6	18.3	24.5	47.7	72.5	229.7
	April	33.5	22.11	27.8	78.30	74.3	224.0
	May	33.16	24.34	28.77	170.8	79.83	152.6
	June	32.23	26.59	29.42	346.20	85.56	83.0

Source: Weather Yard, Depertment of Irrigation and Water management, Bangladesh Agricultural University, Mymensingh

Appendices

Appendix II. Analysis of variance (mean square) for screening the best botanicals controlling the red pumpkin beetle of cucumber

Source of variation	df	Adult mortality at different time intervals (%)			
		24 hrs	48 hrs	72 hrs	96 hrs
Plant extracts	9	1400.30**	1503.65**	1591.111**	1544.07**
Error	20	20.00	33.33	30.000	33.90
Total	29				

** = Significant at 1% level of probability

Appendix III. Analysis of variance (mean square) for screening the best botanicals controlling the black bean aphid of country bean

Source of variation	df	Adult mortality at different time intervals (%)			
		12 hrs	24 hrs	36 hrs	48 hrs
Plant extracts	9	128.148**	1124.537**	1470.000**	1520.741**
Error	20	1.067	24.167	33.333	15.000
Total	29				

** = Significant at 1% level of probability

Appendix IV. Analysis of variance (mean square) for screening the best botanicals controlling the okra jassid of okra

Source of variation	df	Adult mortality at different time intervals (%)			
		12 hrs	24 hrs	36 hrs	48 hrs
Plant extracts	9	155.185**	927.870**	930.463**	1052.222**
Error	20	5.000	13.333	15.000	23.333
Total	29				

** = Significant at 1% level of probability

Appendix V: Analysis of variance (mean square) for adult mortality (%) of red pumpkin beetle at different time intervals

Source of variation	df	Adult mortality at different time intervals (%)			
		24 hrs	48 hrs	72 hrs	96 hrs
Plant extract (A)	3	2237.32**	2349.85**	2161.17**	1727.3**
Concentration (B)	3	11082.40**	13004.07**	14414.88**	15373.1**
A x B	9	340.95**	329.57**	318.51**	270.4**
Error	32	5.33	3.81	4.68	3.5
Total	47				

** = Significant at 1% level of probability

Appendix VI. Analysis of variance for % weight loss of cucumber leaves

Source of variation	df	Weight loss (%)
Plant extract (A)	3	182.580**
Dose (B)	3	1385.962**
A x B	9	26.792**
Error	32	3.292

** = Significant at 1% level of probability

Appendix VII Analysis of variance (mean square) for growth and yield attributes of cucumber including leaf infestation

Source of variation	df	No. of leaves	Plant length (cm)	No. of fruits	Fruit weight (kg)	No. of beetle	% leaf infestation
Replication	2	14.867	28.46	8.27	218.85	0.600	0.118
Treatment	4	77.233**	411.60	50.07**	1009.63**	6.900**	30.18**
Error	8	6.283	42.05	4.27	97.26	0.600	0.542

** = Significant at 1% level of probability.

Appendix VIII. Analysis of variance (mean square) for controlling the black bean aphid of country bean using botanicals at different time intervals

Source of variation	df	Adult mortality at different time intervals (%)			
		12 hrs	24 hrs	36 hrs	48 hrs
Extracts (A)	3	2329.269**	1845.139**	1788.021**	1472.222**
Concentration (B)	3	3412.617**	13000.694**	16531.076**	17755.556**
A x B	9	812.947**	328.935**	275.984**	248.148**
Error	32	4.875	6.250	11.979	9.375

** = Significant at 1% level of probability

Appendix IX. Analysis of variance (mean square) of the data for growth yield and infestation of country bean

Source of variation	Plant height (cm)	No. of twing per plant	No. of leaves per twing	Infested leaves per plant	Total no. of pod per plant	Infested pod per plant	Pod length (cm)	Pod weight per plant (kg)
Replication	26.60	0.867	1.867	1.400	171.467	1.067	0.117	11.97326
Treatments	299.56*	17.267**	16.167**	170.833**	528.233**	333.733**	12.733**	256.70393**
Error	67.01	0.367	1.367	0.483	60.133	0.233	0.471	2.96018

** = Significant at 1% level of probability
* = Significant at 5% level of probability

Appendix X. Analysis of variance (mean square) for controlling the okra jassid of okra using botanicals at different time intervals

Source of variation	df	Adult mortality at different time intervals (%)			
		12 hrs	24 hrs	36 hrs	48 hrs
Extracts (A)	3	947.222**	2884.028**	2485.243**	1895.139**
Concentration (B)	3	2188.889**	10375.694**	12482.465**	14939.583**
A x B	9	250.926**	494.676**	423.669**	338.194**
Error	32	2.375	6.771	7.292	5.729

** = Significant at 1% level of probability

Appendix XI. Analysis of variance (mean square) of the data for growth yield and infestation of okra

Source of variation	df	Plant length(cm)	No. of leaves	% infested leaves	Fruit per plant	Fruit length (cm)	Fruit weight per plant (kg)
Replication	2	34.067	2.579	0.443	14.467	1.400	3.50486
Treatments	4	297.767*	4.067**	424.749**	44.400**	10.767**	57.77676**
Error	8	59.067	0.679	0.910	5.800	0.817	1.95061

** = Significant at 1% level of probability
* = Significant at 5% level of probability