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In vitro efficiency of crude extract of *Ricinus communis*, *Abroma augusta*, and *Bombax ceiba* seed on brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee

Rina Khatun[1,#], Khasrul Alam[1,#], Shahin Rana[1], Abdullah Al Mashud[2], Abdullah Al Masud[1], Sabbir Ahmed[1], Rezuanul Islam[1*] and Mohammad Abu Hena Mostofa Jamal[1]*

[1]Department Biotechnology and Genetic Engineering, Islamic University, Kushtia-7003, Bangladesh.
[2]Department of Electrical and Electronic Engineering, Faculty of Engineering and Technology, Islamic University, Kushtia-7003, Bangladesh.

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Brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee is a major pest. The frequent use of toxic chemical insecticides ultimately poses a problem due to pollution of the environment, health hazards, and adverse effects on beneficial organisms. Hence, the current researches looked into the efficacy of various botanicals against brinjal pests. This experiment was carried out to see how ethyl acetate and methanol extracts of grinded seeds of *Ricinus communis*, *Abroma augusta*, and *Bombax ceiba* affected the growth of brinjal shoots and fruit borers. Among the three plant extracts of ethyl acetate, 100% of *R. communis* and *A. augusta* extracts controlled 100% borers after 72 h of administration, 50 and 25% of *R. communis* extract controlled 100% borers after 72 and 96 h of administration. In the case of methanolic extracts, 100% of *A. augusta* extract controlled 100% borers after 72 h of administration, and 50 and 25% of *R. communis* extract controlled 100% borers after 72 and 84 h of treatment, respectively. When compared with the other two botanical extracts, *R. communis* seed extract performed the best against the pest attack. *A. augusta* and *B. ceiba* seed extract showed moderate efficacy against those pests.

Key words: Crude extract, brinjal pest, insecticides, botanicals, pest control, ethyl acetate, methanol extracts.

INTRODUCTION

Brinjal, also known as eggplant, is a short-lived perennial herb, one of the most commonly produced and low-cost vegetable crops in Bangladesh and other areas of the world. Brinjal (*Solanum melongena* L.) is a member of the Solanaceae family, which has over 2450 plant species divided into 95 genera (David, 2017). It is a versatile crop

*Corresponding author. E-mail: rezwaniu@gmail.com, jamalbtg@gmail.com.

#Authors that contributed equally

that may be grown in a variety of climatic conditions and at any time of the year (Cork et al., 2005). The plant is highly well-suited to both rainy and dry season culture, even though heavy rainfall inhibits both vegetative progress and flower creation. Brinjal has a high nutritional value when compared with other vegetables, containing 89.0 g of water, 1.4 g of protein, 1.0 g of fat, 8.0 g of carbohydrate, 1.5 g of cellulose, 130 mg of calcium, 105 mg of vitamin C, and 1.6 mg of iron (Degri, 2014). Brinjal is a good source of vitamin A (carotene), vitamin B-complex, and vitamin C, all of which are important for optimum health, as well as a decent amount of phosphorus, calcium, and iron ions for the body's bone and blood cell growth (Fayemi, 1999; Natural Resources Institute, 2000).

Brinjal growers in Bangladesh frequently fail to achieve the required output due to excessive damage caused by various insect pests that severely harm brinjal seedlings and plants. At the initial stage, the larvae bore into the shoot choking the movement of plant sap causing shoot drying and at later stages, it enters inside the fruit and demolishes its internal content. This type of interior mode of feeding makes this pest much evasive from the reach of even the most powerful insecticides (Krithika and Ananthanarayana, 2017). A single larva is sufficient to damage 4 to 6 healthy fruits. Alternative pest management strategies are necessary to decrease the misuse of chemical pesticides in vegetables. Here, three plant seed extracts such as ricin (*Ricinus communis*), devil's cotton (*Abroma augusta*), and cotton (*Bombax ceiba*) seed with a high level of toxicity were used for control of brinjal shoot and fruit borer.

The castor bean or castor oil plant, *R. communis L*., and its methanolic extracts of the leaves were tested against eight pathogenic bacteria in rats and demonstrated antibacterial activity (Babu et al., 2017). At low doses, the pericarp of *Ricinus* produced central nervous system responses in mice, while at high levels, animals died rapidly (Sabina et al., 2011). In rats, analgesic efficacy was found in a water extract of the root bark, whereas an ethanolic extract of *R. communis* root bark showed antihistamine and anti-inflammatory activities (Lomash et al., 2010). The scientific name of Ulat Kambal is *A. augusta,* a medicinal plant. Steroids, alkaloids, triterpenes, megastigmanes, flavonoids, and phenylethanoid glycosides are found throughout the plant where leaves contain taraxerol and stem bark contains friedelin and beta-sitosterol (Gupta et al., 2011). Diabetes, inflammation, rheumatoid arthritis, migraines, uterine problems, and bleeding are all treated with the leaves (Das et al., 2012; Islam et al., 2013). *A. augusta* has a long and storied history in the Ayurvedic system, and it is sometimes utilized as a pesticide. The toxin delivers the *A. augusta* seed with some degree of natural defense from insect pests such as aphids, leafhopper or other insects. Cottonseed oil is a widely used vegetable oil obtained from cotton plant seeds. The oil, vitamin E, fatty acids, and antioxidants in a whole cottonseed range from 15 to 20%. It is high in polyunsaturated fat, which can help lower LDL and improve HDL, but it is also high in saturated fat, which increases cholesterol and boosts the risk of cardiovascular disease. Unrefined cottonseed oil is used as a pesticide, and this naturally produced toxin helps give the oil its yellow color and protects the plant from insects. It was principally utilized in the manufacture of oil lamps and candles in the 1800s, but it is currently found in pesticides, laundry detergents, and cosmetics.

MATERIALS AND METHODS

Sample collection and drying

At first, collected seeds were sliced into small pieces for easy drying. Then the sliced seeds were dried in shade away from the sunlight until they dried. Seed samples required 8 to 14 days to completely dry. 95 g *R. communis,* 80 g *A. augusta,* and 100 g *B. ceiba* seeds were collected and dried in shade away from the sunlight for 8 to 14 days for extract preparation.

Pulverization and powder preparation

Completely dried small pieces of seeds were pulverized into finely powdered substances by using mortar and pestle and finally fine powdered substances were prepared. After drying, 60 g of *R. communis,* 50 g of *A. augusta*, and 60 g of *B. ceiba* seed sample were pulverized and powder prepared, respectively.

Extract preparation

In this work, ethyl acetate and methanol were used, respectively for extraction of *R. communis, A. augusta,* and *B. ceiba* seeds as extract solvents. The dried pulverized fine powders of 60 g of *R. communis,* 50 g of *A. augusta*, and 60 g of *B. ceiba* were taken into 3 conical flasks which were previously filled with 200 ml ethyl acetate. After that conical flasks were sealed with foil paper and placed into an automatic electric shaker of 150 rpm for 24 h at room temperature. Seed particles were removed from the ethyl acetate solution after filtration with Whatman No.1 filter paper. The remaining crude extract was taken into another previously washed conical flask for serial extraction of methanol. 200 ml methanol was added to filtrated crude of seed and put into shaker again to prepare methanol extract. After 24 h of shaking in the automatic electric shaker, methanol extract was filtrated using Whatman No.1 filter paper and stored at room temperature after labeling carefully. After filtration, the crude extracts were then condensed to concentrate through a rotatory evaporator. The amount of extract of ethyl acetate is shown in Table 1. Measured extracts were stored at 4°C to use later. 6.52, 6.96, and 9.24 g of *R. communis, A. augusta,* and *B. ceiba* extracts were obtained.

The amount of prepared extract in methanol is shown in Table 2. Measured extracts were stored at 4°C to be used later. 8.13, 6.75, and 9.5 g of *R. communis, A. augusta,* and *B. ceiba* extracts were obtained.

Larvae collection

Brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee) larvae

Table 1. The extracted amount of ethyl acetate after hard condensation.

Sample	Blank weight of vial [a] (g)	Weight of vial with extract [b] (g)	Net amount of extract [b-a] (g)
R. communis	15.91	22.43	6.52
A. augusta	14.32	21.28	6.96
B. ceiba	12.83	22.07	9.24

Table 2. The extracted amount of methanol after hard condensation.

Sample	Blank weight of vial [a] (g)	Weight of vial with extract [b] (g)	Net amount of extract [b-a] (g)
R. communis	13.36	21.49	8.13
A. augusta	14..54	21.29	6.75
B. ceiba	13	22.5	9.5

were collected from pesticide-free infected brinjal from an experimental field beside the Islamic University area, Kushtia. A sterilized knife was used to chop up infested fruits. With an insect brush, the larvae from the chopped fruits were gathered and released on freshly harvested insecticide-free brinjal fruits from the experimental field. Comparatively particular instar or similar size and shape larvae were selected for this work.

In vitro preparation and growth

Petri dishes were washed and dried for *in vitro* experiments of botanicals. Pesticide and insect-free, healthy brinjal were collected from the experimental field and sliced into small pieces. 10 larvae were taken in each Petri dish and covered with a muslin cloth to allow aeration. Sliced brinjal fruit was served as food for larvae to allow continued growth.

Efficiency evaluation of seed extract

Ethyl acetate extract was firstly applied, 10 Petri-dishes were washed with detergent and dried afterward, 9 of these Petri-dishes were marked as A1, A2, A3, B1, B2, B3, C1, C2, and C3 for treatment, and one plate was used as control. Exactly 10 larvae were taken into each Petri-dish which was previously selected and sliced brinjal were added as a food source. In A1, A2, and A3 Petri-dishes, sliced brinjal fruit were sprayed with 100, 50, and 25% of *R. communis,* respectively. In the same manner, 100, 50, and 25% of *A. augusta* and *B. ceiba* extracts of ethyl acetate were sprayed in B1, B2, B3, C1, C2, and C3 plates, respectively. One plate was used as a control where no extracts were sprayed on the food source. After each spray, Petri-dishes were wrapped with muslin cloth and make tighten with a rubber band. Every plate was carefully labeled and placed at room temperature. After 24 h, the food supply was changed with fresh pesticide-free brinjal slices. During the change of food source, previously added brinjal were carefully checked and any borer inside, was taken out and placed in a newly supplied food source. Then the food was sprayed again with the same extract and concentration previously used. Secondly, extract solution of methanol was applied in the same manner. 10 Petri-dishes were washed and marked as D1, D2, D3, E1, E2, E3, F1, F2, F3, and control. 100, 50, and 25% solution of *R. communis, A. augusta,* and *B. ceiba* extracts of methanol were applied in D1, D2, D3, E1, E2, E3, F1, F2, and F3, respectively. A control plate was also with this preparation. All these plates were kept in shade, inspected every 12 h, and counted the live and dead larvae. Food sources were changed after 24 h with fresh pesticide-free healthy sliced brinjal and sprayed with the exact extract which was previously applied. The control plate was maintained as free from any spraying and observed every 12 h.

RESULTS

Effect of plant extracts on larvae

The 100% ethyl acetate extract of *R. communis, A. augusta*, and *B. ceiba* control fruit borer and brinjal shoot, *L. orbonalis* Guenee within 72 to 96 h. *R. communis* extract controlled earlier than other extract (Figure 1).

The 50% ethyl acetate extract of *R. communis, A. augusta*, and *B. ceiba* control fruit borer and brinjal shoot, *L. orbonalis* Guenee within 72 to 108 h. *R. communis* extract controlled earlier than other extract (Figure 2).

The 25% ethyl acetate extract of *R. communis, A. augusta,* and *B. ceiba* control fruit borer and brinjal shoot, *L. orbonalis* Guenee within 96 to 108 h. *R. communis* extract controlled earlier than other extract (Figure 3).

The 100% methanol extract of *R. communis, A. augusta,* and *B. ceiba* control fruit borer and brinjal shoot, *L. orbonalis* Guenee within 72 to 108 h. *A. augusta* extract controlled earlier than other extract (Figure 4).

The 50% methanol extract of *R. communis, A. augusta,* and *B. ceiba* control fruit borer and brinjal shoot, *L. orbonalis* Guenee within 72 to 108 h. *R. communis* extract controlled earlier than other extract (Figure 5).

The 25% methanol extract of *R. communis, A. augusta,* and *B. ceiba* control fruit borer and brinjal shoot, *L. orbonalis* Guenee within 72 to 120 h. *R. communis* extract controlled earlier than other extract (Figure 6).

DISCUSSION

Brinjal production is one of the major sources of income

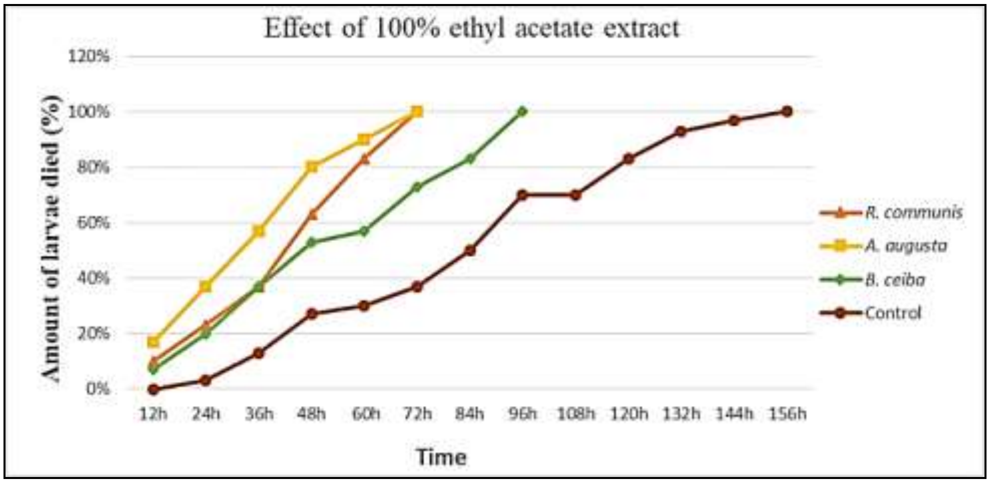

Figure 1. Comparative efficiency of 100% ethyl acetate extract of *R. Communis, A. Augusta* and *B. Ceiba* with control on fruit borer and brinjal shoot.

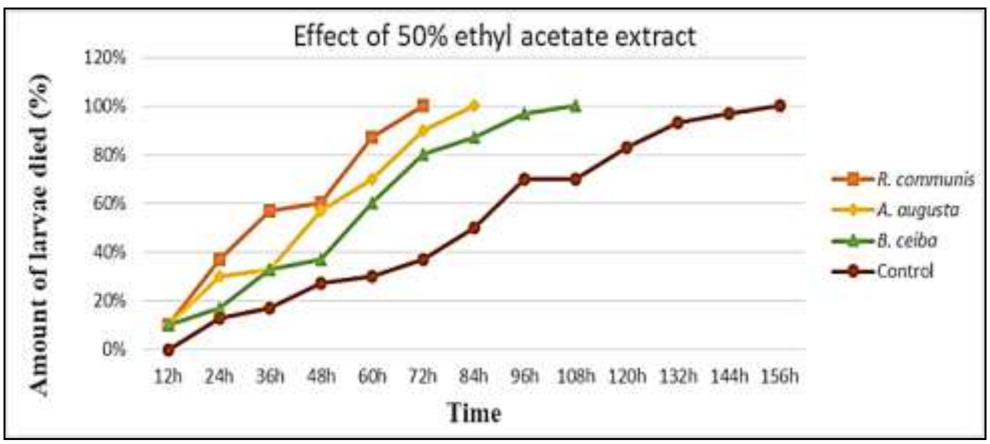

Figure 2. Comparative efficiency of 50% ethyl acetate extract of *R. Communis, A. Augusta* and *B. Ceiba* with control on brinjal shoot and fruit borer, L. Orbonalis Guenee

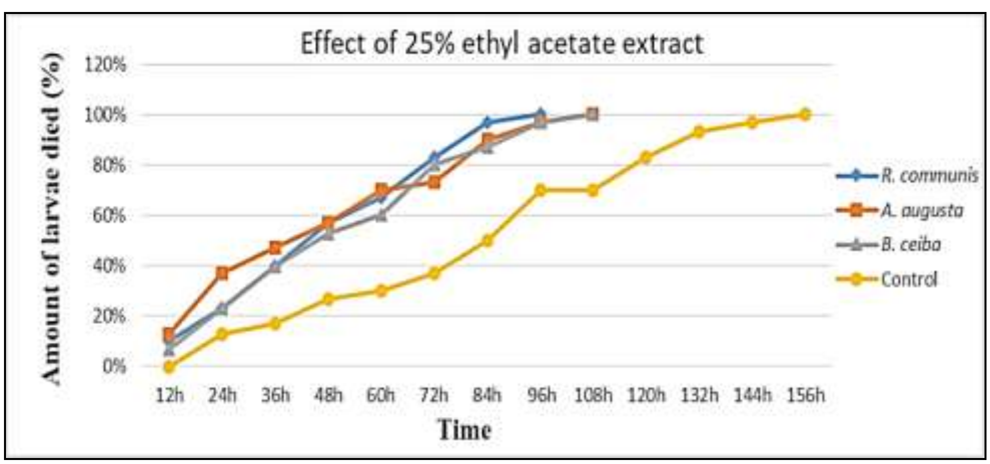

Figure 3. Comparative efficiency of 25% ethyl acetate extract of *R. Communis, A. Augusta and B. Ceiba* with control on fruit borer and brinjal shoot, *L. Orbonalis* Guenee

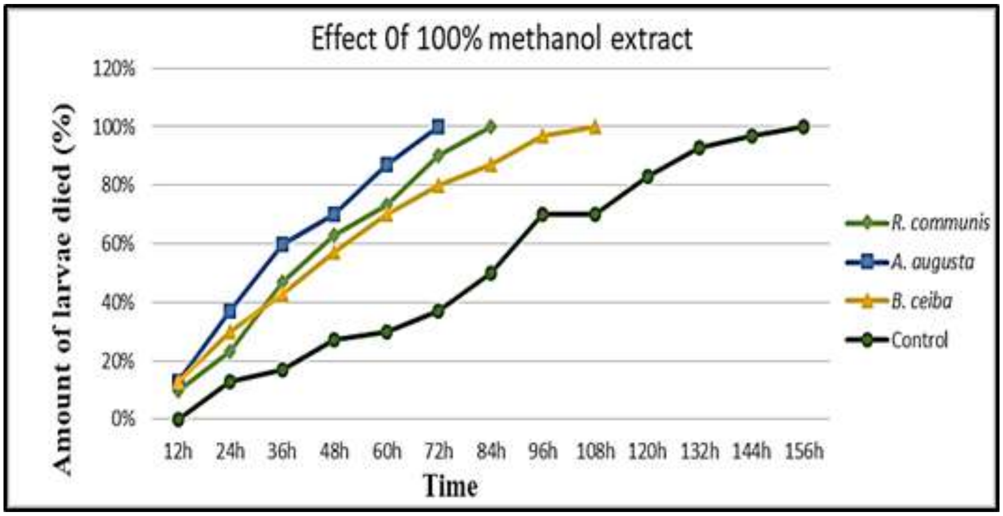

Figure 4. Comparative efficiency of 100% methanol extract of *R. Communis*, *A. Augusta* and *B. Ceiba* with control on fruit borer and brinjal shoot, *L. Orbonalis* Guenee

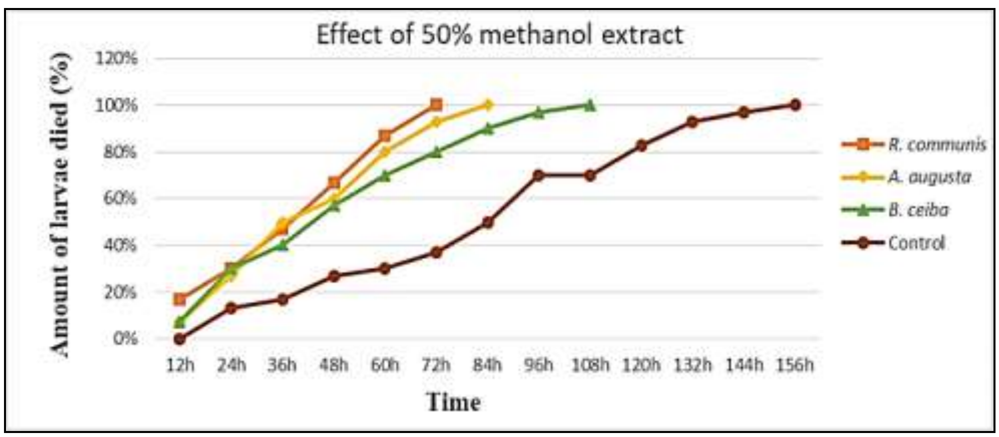

Figure 5. Comparative efficiency of 50% methanol extract of *R. Communis, A. Augusta and B. Ceiba* with control on brinjal shoot and fruit borer, *L. Orbonalis* Guenee

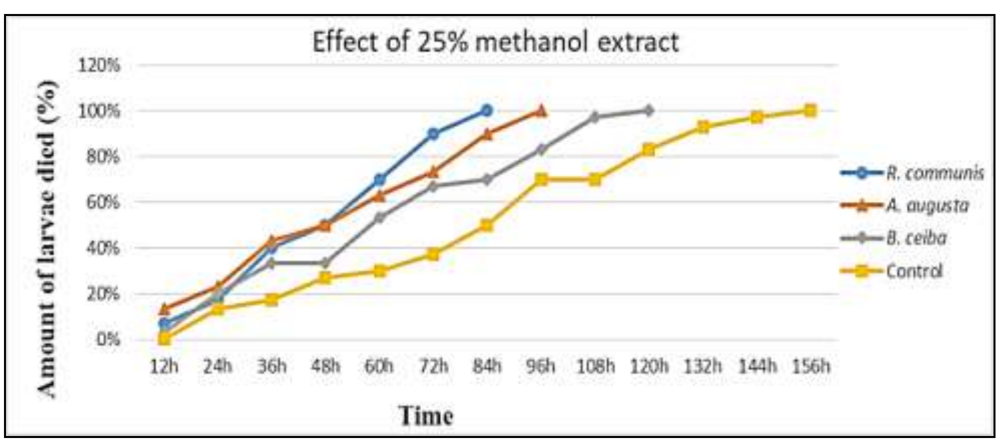

Figure 6. Comparative efficiency of 25% methanol extract of *R. Communis, A. Augusta and B. Ceiba* with control on brinjal shoot and fruit borer, *L. Orbonalis* Guenee.

for rural farmers (Danquah-Jones, 2000). The insect pests are reported to reduced yield and losses of between 75 and 90% of the crop (Onekutu et al., 2013). Plant extracts have been shown to reduce pathogen populations, and they have the potential to be used as an environmentally friendly alternative and as part of integrated pest control strategies (Bowers and Locke, 2004. Insect pests that feed on leaves, flowers, and developing grains, for example, are managed by spraying various extracts of biologically beneficial plant products such as leaves, stems, roots, and whole plants directly on the leaves, flowers, and developing grains. These sprays can control aphids, jassids, and even caterpillars (Prakash et al., 1987, 1990).

In this study, the seed extracts of *R. communis, A. augusta,* and *B. ceiba* (ethyl acetate and methanol extracts) were used to *in vitro* control *L. orbonalis* Guenee which is the most important insect pest of brinjal. The instar larvae bore into the eggplant, making them unmarketable and unfit for human consumption. Among the three extracts of ethyl acetate, 100% of *R. communis* and *A. augusta* extracts controlled 100% borers after 72 h of administration, 50 and 25% of *R. communis* extract controlled 100% borers after 72 and 96 h of administration. Compare to these three extracts with control, 50% of *R. communis* displayed a great potential pesticidal activity to controlled *L. orbonalis* Guenee. Previously, *R. communis* extract was used to repel *Aedes aegypti* oviposition behavior. The castor oil plant, which includes the alkaloid ricinine among other things, was used to stop *A. aegypti* from laying eggs (Leite et al., 2005). The LD50 of castor bean oil against maize weevils was calculated to be 2.04 ml, and 2 ml was shown to be sufficient to kill 50% of the weevils (Wale and Assegie, 2015). In general, *R. communis* has a larvicidal effect on *Plutella xylostella*, with 100% mortality recorded in both ingestion and contact toxicity tests on 3rd instar larvae fed with 10% oil emulsion (Kodjo et al., 2011). Castor oil is one of the very few naturally producing triglycerides, with ricinoleic acid accounting for rough nine-tenths of the fatty acid content (Bagali et al., 2010).

In this study, in the case of methanolic extracts, 100% of *A. augusta* extract controlled 100% borers after 72 h of administration compared to other seed extracts and 50 and 25% of *R. communis* extract controlled 100% borers after 72 and 84 h of treatment, respectively. From this result, *R. communis* showed a more effective value than *A. augusta* extracts because after 72 h of administration, 100% borer were controlled by 50% *R. communis* where 100% *A. augusta* extract was used. Previously, chloroform extracts of *A. augusta* seed, root wood, leaves, and stem bark showed repellent efficacy against adult *Tribolium castaneum* beetles at dose levels of 314.540, 157.270, 78.635, 39.318, 19.659, and 9.831 g/cm^2 on filter paper (Mondal et al., 2013). *A. augusta* is also used for stomachaches, diabetes, dermatitis, and as an abortifacient and anti-fertility agent in powdered form. Leaves are beneficial in the treatment of uterine diseases, diabetes, rheumatic joint discomfort, and sinusitis headaches (Prajapati et al., 2003; Rahmatullah et al., 2010). Singh et al. (2001) conducted antifeedant activity tests on a variety of plants to better understand the repellent potential of various medicinal plant extracts (Singh et al., 2001; Ali et al., 2021). Biopesticides activities of *A. augusta* extracts are due to the presence of taraxerol, gum, beta-sitosterol, resin, fixed oil, bromine, alkaloids, choline and betaine, stigmasterol, and magnesium salts of hydroxyl acids. In the medical field, they are used to make condiments and products that are intended to treat a variety of diseases and health problems. Rice leaf folder and rice green leafhopper infestations were reduced, and rice trungo virus was controlled, using seed oil (1%) produced from several botanicals sprayed on rice plants (Narasimhan and Mariappan, 1988).

The findings suggest that the seed extracts of *R. communis, A. augusta,* and *B. ceiba* possess many active ingredients that showed effective activity against brinjal shoot and fruit borer, *L. orbonalis* Guenee.

Conclusion

A potential botanical against *L. orbonalis* can protect the human, other animals and environment from the toxic effect of chemical pesticides. Out of three botanicals, *R. communis,* seed extract showed the best performance, whereas *A. augusta* and *B. ceiba* seed extract was found to be ineffective to protect the brinjal. Further analysis of the chemical structure of the active ingredients of three botanicals would help to control various insect pests from vegetables. The result concluded that *R. communis* showed comparatively higher effectivity among the three extracts to the control of the fruit and shoot borer in brinjal, *L. orbonalis* Guenee.

CONFLICT OF INTERESTS

The authors declared no competing interests.

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REFERENCES

Ali S, Li Y, Haq IU, Abbas W, Shabbir MZ, Khan MM, Mamay M, Niaz Y, Farooq T, Skalicky M, Zuan AT (2021). The impact of different plant extracts on population suppression of *Helicoverpa armigera* (Hub.) and tomato (*Lycopersicon esculentum* Mill) yield under field

conditions. PLOS ONE 16(12):e0260470.
Babu PR, Bhuvaneswar C, Sandeep G, Ramaiah CV, Rajendra W (2017). Hepatoprotective role of Ricinus communis leaf extract against d-galactosamine induced acute hepatitis in albino rats. Biomedicine and Pharmacotherapy 88:658-666.
Bowers JH, Locke JC (2004). Effect of formulated plant extracts and oils on population density of Phytophthora nicotianae in soil and control of phytophthora blight in the greenhouse. Plant Disease 88(1):11-16.
Cork A, Alam SN, Rouf FM, Talekar NS (2005). Development of mass trapping technique for control of brinjal shoot and fruit borer, *Leucinodes orbonalis* (Lepidoptera: Pyralidae). Bulletin of Entomological Research 95(6):589-596.
Danquah-Jones A (2000). Variation and correlation among agronomic traits in Garden Egg (*Solanum gilo* Radii). Department of Crop Science. Accra, University of Ghana, Legon 30.
Das S, Datta R, Nandy S (2012). Antipyretic and analgesic effect of methanolic extract of different parts of *Abroma augusta* linn 5(4):129-133.
David JM (2017). Mabberley's plant-book: a portable dictionary of plants, their classification and uses. Cambridge University Press. https://doi.org/https://doi.org/10.1017/9781316335581
Degri MM (2014). The effect of spacing of Egg Plant (*Solanum melongena* L.) (*Solanaceae*) on Shoot and Fruitborer (*Leucinodes orbonalis* Guen.) Infestation in the Dry Savanna zone of Nigeria. Agriculture and Biology Journal of North America 5(1):10-14.
Fayemi PO (1999). Nigerian vegetables. Heinemann Educational Books (Nigeria) Plc pp. 15-20.
Gupta B, Nayak S, Solanki S (2011). *Abroma augusta* Linn f: a review. Der Pharmacia Sinica 2(4):253-261.
Islam MT, Rahman MA, Islam MAU (2013). In vitro Effect of Aqueous Extract of Fresh Leaves of *Abroma augusta* L on the Diffusion of Glucose. Bangladesh Pharmaceutical Journal 16(1):21-26.
Kodjo TA, Gbénonchi M, Sadate A, Komi A, Yaovi G, Dieudonné M, Komla S (2011). Bio-insecticidal effects of plant extracts and oil emulsions of Ricinus communis L. (Malpighiales: Euphorbiaceae) on the diamondback, *Plutella xylostella* L. (Lepidoptera: Plutellidae) under laboratory and semi-field conditions. Journal of Applied Biosciences 43:2899-2914.
Krithika BN, Ananthanarayana S (2017). Effect of Certain Plant Extracts on the Life Cycle of *Leucinodes Orbonalis* (guenee): A Comparitive Study. International Journal of Innovative and Applied Research 5(12):15-19.
Leite AC, Cabral EC, Santos DA, Fernandes JB, Vieira PC, Silva MF (2005). Isolamento do alcalóide ricinina das folhas de Ricinus communis (Euphorbiaceae) através de cromatografias em contracorrente. Química Nova 28(6):983-985
Lomash V, Parihar SK, Jain NK, Katiyar AK (2010). Effect of *Solanum nigrum* and *Ricinus communis* extracts on histamine and carrageenan-induced inflammation in the chicken skin. Cellular and Molecular Biology 56(3):1239-1251.
Mondal OA, Haque E, Haque J, Khan AR (2013). Insecticidal Activities of *Abroma Augusta* (L.) Chloroform and Methanol Extracts Against Tribolium Castaneum (Herbst) Adults. Journal of Life and Earth Science 8:11-15.
Narasimhan V, Mariappan V (1988). Effect of plant derivatives on green leafhopper (GLH) and rice tungro virus (RTV) transmission. International Rice Research Newsletter 13(1):28-29.
Onekutu A, Omoloye AA., Odebiyi JA (2013). Biology of the Eggfruit and Shoot Borer (EFSB), *leucinodes orbonalis* guenee (crambidae) on the garden egg, solanum gilo raddi. Journal of Entomology 10(3):156-162.
Prajapati N Das, Purohit SS, Sharma AK, Kumar T (2003). A handbook of medicinal plants: a complete source book pp. 554-554.
Prakash A, Rao J, Pasalu I, Mathur K (1987). Rice storage and insect pest management. Corpus ID: 126665002
Prakash A, Tiwari SN, Rao J (1990). Exploitation of natural plant products for management of pests and diseases in rice ecosystems. InProc. Symp. Growth , Development and Resource Conservation pp. 23-36.
Rahmatullah M, Sadeak S, Bachar SC, Tozammal HM, Jahan N, Chowdhury MH, Jahan R, Nasrin D, Rahman M, Rahman S (2010). Brine Shrimp Toxicity Study of Different Bangladeshi Medicinal Plants. Advances in Natural and Applied Sciences 4(2):163-173.
Sabina P, Poorna P, Rasool MK (2011). Protective Effect of *Ricinus Communis* Leaves Extract on Carbon Tetrachloride Induced Hepatotoxicity in Albino Rats. Iranian Journal of Pharmaceutical Sciences 7(4):269-278.
Singh IB, Singh K, Singh HN (2001). Relative efficacy of certain plant extracts as antifeedants against gram podborer Heliothis (Helicoverpa) armigera (Hüb.). Bioved 12(1-2):41-44.
Wale M, Assegie H (2015). Efficacy of castor bean oil (*Ricinus communis* L.) against maize weevils (*Sitophilus zeamais* Mots.) in northwestern Ethiopia. Journal of Stored Products Research 63:38-41.