International Journal of Natural Sciences: Current and Future Research Trends (IJNSCFRT)
ISSN: 2790-7929

https://ijnscfrtjournal.isrra.org/index.php/Natural_Sciences_Journal/index

The Potential of Cassia Didymobotrya (Popcorn Cassia) and Cassia fistula L. Golden Shower) Leaf Extract as Organic Pesticides in Eggplant Production

Zosimo A. Liberato[a*], Milagros O. Liberato[b], Jonathan De la Cruz[c]

[a]*Research and Extension Office, Ilocos Sur Polytechnic State College, Sta. Maria, Ilocos Sur, Philippines*

[b]*Graduate School, Ilocos Sur Polytechnic State College, Sta. Maria, Ilocos Sur, Philippines*

[c]*College of Agriculture Forestry Engineering and Dev.Com, Ilocos Sur Polytechnic State College*

[a]*Email: liberatozosimo@gmail.com*

Abstract

The low yield of Eggplant has been the problem of many farmers in the Ilocos Region and in other parts of the country where Eggplant is grown. The common practice of the growers to increase yield is synthetic pesticides that are found a negative effect on nutritive value and fertility of the soil. The search for plant extracts as biopesticides should be explored for the safety of the consumer and the environment. Thus, the study was conducted to determine the potential of *Cassia didymobotrya* (Popcorn cassia) and *Cassia fistula L*. (Golden Shower) leaf extract as organic pesticides in Eggplant production. The experimental area will observe the RCBD consisting of three treatments and three replications. The data gathered was analyzed, calculated, and evaluated using the analysis of variance (ANOVA) for the randomized Complete Block Design. Significant differences were further analyzed using Tukey Kramer Multiple comparison tests at a 0.05 level of significance. Results show that before application of the mixture at the early vegetative stage, mites appeared to be the most number that attack the leaves of the plants and slight attack of Phomopsis blight but when applied with 25ml *Cassia didymobotrya* and 75 ml *Cassia fistula L*. mixed with 4 liters of water damage leaf was lesser than other treatments, The same was observed at growth stage mites have lessened their number when treated with the mixture, and Phomopsis blight slowly disappears when the affected leaves are removed that favors the development of flowers and more fruits develop.

---

* Corresponding author.

It can be concluded that Eggplant applied with 25ml Cassia didymobotrya and 75ml Cassia fistula L. with 4 liters of water controls the attack of Phomopsis blight and mites that damage the leaves as well as fruit borer that attack the fruits of eggplant leading to more marketable fruits harvested and higher return on investment. It is recommended that the same mixture be used to verify the validity of the results.

Keywords: Cassia didymobotrya; Cassia fistula; leaf extracts; pest; Eggplant.

1. Introduction

Some Diseases of eggplant care are caused by fungus-like Cercospora leaf spot, Early blight (*Alternaria emetophilia*), Phomopsis fruit rot (*Phomopsis vexans*), Powdery mildew Leveillula Taurica and insects like Flea beetles, aphids, Hornworms, Stinkbugs, spider mites. Cassia didymobotrya have toxic properties slightly less than half that of nicotine used as sulfate. The toxicity of extracts of Tephrosia vogelii is of the same order as that of nicotine in the form of sulfate, and these extracts should be able to replace nicotine in all sprays against soft-bodied insects such as aphids and thrips. The application of the botanical pesticide did not negatively affect the beneficial predatory insects and other arthropods population in the coffee ecosystem[1].

Heavy soil treatment with pesticides can cause populations of beneficial soil microorganisms to decline. According to the soil scientist Dr. Elaine Ingham, "If we lose both bacteria and fungi, then the soil degrades. Overuse of chemical fertilizers and pesticides affects the soil organisms that are similar to human overuse of antibiotics. Indiscriminate use of chemicals might work for a few years, but after a while, there aren't enough beneficial soil organisms to hold onto the nutrients"[2].

Pesticides have a rapid and positive influence on the quantity of produced food; simultaneously, they are involved in several side effects, often creating some hazards to human health and well-being. The authors show these facts given the possible entrance of these substances into the food chain and present several actions or measures undertaken by various organizations, especially UN Agencies. The main emphasis is on pesticide residues in consumed food, based on the experience gained in different countries, including Poland. From the toxicological or health point of view, it is essential to know whether these substances interact with other nutrients entering plant or animal tissues or whether they remain on the surface and are easily removed before human consumption. Some effects of processing on decreasing the content of these residues in foodstuffs are also briefly outlined. Another aspect connected with the application of pesticides is their influence (mainly negative) on the nutritive value of harvested plants[3].

Biopesticides are derivatives of plants, microorganisms, and insects. Substances from plants and animals have been used to manage diseases in crops, animals, and humans. Reliance on nature to heal nature is a practice for many people worldwide. Synthetic chemicals overtook the use of natural products due to their efficacy, reliability, and quick knockdown effect [4].

A total of 35 components, accounting for 97.44 % of the essential oil of C. cassis, were identified. The principal compounds in the essential oil were trans-cinnamaldehyde (49.33 %), acetophenone (6.94 %), trans-cinnamic

acid (5.45 %) and cis-cinnamaldehyde (4.44 %) followed by omethoxycinnamaldehyde (3.48 %), coumarin (3.42 %) and (E)-cinnamyl alcohol (3.21 %). The essential oil displayed contact toxicity against adult L. bostrychophila with a median lethal concentration (LC50) of 55.68 µg/cm2 and fumigant toxicity (LC50, 1.33 mg/l air). Trans-cinnamaldehyde exhibited strong contact and fumigant toxicity with LC50 of 43.40 µg/cm2 and 1.29 mg/l air, respectively. The essential oil of C. cassis and its constituent compound, trans-cinnamaldehyde, possess the potential for development into natural fumigants/insecticides to control booklice [5].

Plants have evolved and developed many compounds, which can help combat pathogenic microorganisms during infection and attack. These compounds include steroids, alkaloids, phenylpropanoids, phenolics, terpenoids, and nitrogenated compounds [6].

Cassia fistula L. was found to be active on most clinically isolated microorganisms and fungi compared with standard drugs [7]. The leaf extract of *Cassia fistula L.* with different solvents viz, methanol, benzene, and acetone was studied for the larvicidal, ovicidal, and repellent activity against Aedes aegypti. The extract exhibited dose-dependent activity and produced significant mortality. The 24 h LC50 concentration of the extract against Aedes aegypti was observed at 10.69, 18.27, and 23.95 mg/l, respectively. The mean percent hatchability of the ovicidal activity was observed at 120.00 h after treatment. The percent hatchability was inversely proportional to the concentration of extract and directly proportional to the eggs. The crude section of *Cassia fistula L*. shows significant repellency against Aedes aegypti. These results reveal that the natural extract of *Cassia fistula L.* served as a potential larvicidal, ovicidal, and repellent agent against the chikungunya vector mosquito [8].

Natural plant products with bioactivity toward insects include several classes of molecules, for example, terpenes, flavonoids, alkaloids, polyphenols, cyanogenic glucosides, quinones, amides, aldehydes, thiophenes, amino acids, saccharides, and polyketides (which is not an exhaustive list of insecticidal substances). Those compounds generally have important ecological activities in nature, such as antifeedant, attractant, nematicide, fungicide, repellent, insecticide, insect growth regulator, and allelopathic agents, actings as a promising source for novel pest control agents or biopesticides [9].

On the study of [10]Cassia Percentage yield *Senna didymobotrya* (Friesen) leaf extracts Methanolic extract Aqueous extract Weight of concentrate= 10.81g Weight of concentrate=2.51g Weight of dry powder= 100g Weight of dry powder=100g Percentage yield = 10.81% Percentage yield=2.51% Cassia didymobotrya stem bark extracts Methanolic extract Aqueous extract Weight of concentrate= 9.81 Weight of concentrate=1.11g Weight of dry powder= 100g Weight of dry powder=100g Percentage yield= 9.81% Percentage yield=1.11%. Phytochemical Results for Cassia didmobotrya Extracts Stem bark Leaf Compound Aqueous Methanol Aqueous Methanol Alkaloids + + _ _ Saponins + + + + Flavanoids + + + + Tannins + + + + Terpenes + + + + Phenols + + + + Anthracenes + + + + Anthraquinones _ _ _ _ +: presence of secondary metabolite -: absence of the secondary metabolite.

Rhein's antifeedant and larvicidal activities (1,8-dihyhydroxyanthraquinone-3-carboxylic acid) isolated from the ethyl acetate extract of Cassia fistula flower were studied against the lepidopteran pest, Spodoptera litura, and

Helicoverpa armigera. The compound rhein showed moderate antifeedant activity (56.79%) against S.litura at 1000ppm, whereas it showed significant activity against H.armigera (76.13%) at 1000ppm. Rhein exhibited larvicidal activity of 67.5% against H.armigera with an LC 50 value of 1192.55ppm. After treatment with compound rhein, the larvae showed malformation and mortality in the larval, pupal, and adult stages [11].

Liu and his colleagues [12] state that the contact and fumigant activity of the essential oil0f C.cassia twigs and trans-cinnamaldehyde are pretty promising. Currently used fumigants are synthetic insecticides. The most effective fumigants are also highly toxic to humans and other non-target organisms; the essential oil and trans-cinnamaldehyde show potential to be developed as natural fumigants/insecticides for the control of booklouse. Insecticidal and acaricidal responses of Cinnamomum cassia oils made by organic solvent(OS), steam distillation (SD), and supercritical fluid(SF) and their components were examined in two bioassays (contact and fumigant bioassay) against Plodia interpuncctella, Sitophilus oryzae, S.zeamais.Tyrophagus putrescentiae, and Sitotroga cerealella adults. Using the touch of fumigant bioassay against T,putrescentiae adults, OS oil exhibited the strongest toxicities(50% lethaldose[LD_{50}],2.60µg/cm^2 and 1.34µg/cm^3, followed by SF and SD oils [13].

Reference [14], in their laboratory experiments, conducted the efficacy of powder and extract of C.alata on Collosobruchus maculatus Fab. Damage in stored cowpea(Vigna unguiculata L.) seeds. The powder and the extract were evaluated on C. maculatos for mortality. Oviposition and adult emergence effects. The long-term storage of the treated seeds was also investigated. Higher mortality of 100% was recorded in roots treated with C. alata extract at the level of 4.0%v/w, while the most increased mortality of 80.30% was also recorded in seed treated with 4.0%v/ of C.alata powder. The powder and the extract significantly reduced the emergence of the treated seeds.

Reference [15] The in vitro antimicrobial activity of *Senna didymobotrya(Friesen)* and Phlogacanthus thyrsiflorus leaf extracts were studied against selected bacteria and fungi following the Agar disc diffusion method. Leaves were extracted using distilled water, methanol, and ethyl acetate. For each extract, three different concentrations were applied to the disc (100µg, 250µg, and 500µg/disc). While the aqueous extracts of the selected plant leaves showed mild to moderately effective, the methanol and ethyl acetate extracts were more efficient than the aqueous extract. The inhibition zone diameter was seen to increase with the concentration.

Oil extracts from the leaves of E.milli and C.occidentallis may be safe for use by humans as insecticidal agents, with its toxicity manifesting only at very high concentrations (3000 and 5000 mg kg-1b.wt) [16].

Nyamwamu, L.B. and his colleagues [17]One of the plants commonly used in Kenya to treat diarrhea, malaria, ringworm, jaundice, and intestinal worms is *Senna didymobotya*. The main objective of this analysis was to examine the phytochemical composition of Senna didymobotya's plant roots. Chemical tests were conducted using standard protocols for Screening and detecting bioactive chemical constituents in medicinal plants in crude root extracts. The study showed that the plant's roots contained steroids, terpenoids, anthraquinones, tannins, saponins, glycosides, flavonoids, alkaloids, and phenols.

Baskar and his colleagues [18] reveal in their study that many commercially available agro and household chemicals are used as pesticides, repellents, and growth inhibitors against insect pests. The repeated uses of these chemicals against insect pests have caused the development of resistance in them; they also cause ill effects on non-target organisms—the presence of terpenoids, flavonoids, and quinone. The maximum antifeedant activity of 72.30% was recorded in chloroform extract followed by hexane (69.02%), and ethyl acetate (57.40%) extracts against H. armigera. Chloroform extracts of S. xanthocarpum showed more than 60% larvicidal and pupicidal activity against H. armigera. The effective chloroform extract was fractionated with increasing polarity of the solvent system (hexane, chloroform, and ethyl acetate extracts). Based on the TLC profile, nine significant fractions were isolated. The fourth fraction showed higher antifeedant, larvicidal, and pupicidal activity against H. armigera. The effective fraction reduced the hemolymph and gut protein concentration in a concentration-dependent manner (r 2 0.99). The effective fraction 4 showed 100% larvicidal activity at 500 ppm with an LC50 value of 227.95 ppm. The fourth fraction did not show any toxic symptoms or mortality of earthworm. Based on these results, this effective fraction could be used to develop a pesticide formulation to control insects.

The low yield of Eggplant has been the problem of many farmers in the Ilocos Region and in other parts of the country where Eggplant is grown. The common practice of the growers to increase yield is synthetic pesticides that are found a negative effect on nutritive value and fertility of the soil.

The use of natural pest control is less expensive than chemical pesticides, and it's harmless for plants and the environment as a whole. Organic pesticides can be readily available if only farmers become familiar with different plants used as pesticides. Most of all, the knowledge on preparing such pesticides as Golden Shower (*Cassia fistula l*)and Popcorn Cassia (*Cassia didymobotrya*).

The study aims to determine the potency of *Cassia didymobotrya* and *Cassia fistula* l. concentrates

Specifically, The Potential of the two extracts in Eggplant's growth and yield performance. Identify the pest and diseases of eggplants early until the fruiting period. The best concentrate that is effective for the control of pests in Eggplant. We hypothesized that *Cassia fistula L*. and *Cassia didymobotrya* leaf extract could control the pest and diseases of Eggplant and promote better yield of the farmers.

2. Materials and Methods

2.1. Materials

The materials used in the study were the seeds of Eggplant (long purple variety), record note, sprayer, meter

stick, leaves of *Cassia didymobotrya* and *Cassia fistula l.*, plastic mulch, organic fertilizer, experimental area.

Methods

The experimental area was laid out observing the RCBD consisting of three treatments and 3 replications as follows :

T0 Control (Commercial Pesticide)

T1(100ml)Cassia didymobotrya mixed with 4 liters of water)

T2 (25ml) Cassia didymobotrya Plus 75ml Cassia fistula l. mixed with 4 liters of water)

T3 (50 ml) Cassia didymobotrya and 50mlCassia fistula l. mix with 4 liters of water).

2.2. Research Design and Treatments

The data gathered was analyzed, calculated, and evaluated using the analysis of variance (ANOVA) for the randomized Complete Block Design. Significant differences were further analyzed using Tukey Kramer Multiple comparison tests at a 0.05 level of significance.

3. Results and Discussion

The table shows the performance of Eggplant applied with different levels of *Cassia didymobotrya* (Popcorn cassia) and *Cassia Fistula l* (Golden shower) leaf extract as organic pesticides.

Growth Performance

Table 1: Growth performance of Eggplant treated with organic pesticides

Treatments	Growth Performance				
	Initial(cm)	Final(cm)	Flowers	Develop Fruits	Damage Leaf
T0	12.70	89.98	12^{b}	9^{a}	1^{d}
T1	12.68	89.29	12^{b}	8^{ab}	5^{a}
T2	12.70	89.65	12^{b}	9^{a}	2^{c}
T3	12.73	90.11	15^{a}	7^{b}	3^{b}
F-test	ns	ns	**	**	**
CV(%)	2.61	3.38	25.35	27.79	51.51

Means with the same letter are not significant 0.01 alpha.

Initial Height and Final Height. As seen in table 1, T3 (50 ml Cassia didymobotrya and 50ml Cassia fistula I) stipulated the highest in terms of height, and T1 (100 ml *Cassia didymobotrya or Senna didymobotrya (Friesen*) being the lowest. At the early vegetative stage, mites appeared to be the most number that attacks the leaves of the plants and slight attack of Phomopsis blight. However, when applied with the treatments, the diseases slowly

decrease in number, and the plants treated with 50 ml *Cassia didymobotrya or Senna didymobotrya (Friesen)* and 50 ml *Cassia fistula l.* are taller in terms of height. Analysis of variance shows no significant difference among treatment means, which means that any of the treatments used in the study can be applied to Eggplant and the growth of the plant was not affected by the applied treatment because cassia plants were intended for the treatment of pest and diseases in the study and the applied treatment does not favor the growth of the plants used in the study. According to [19]. Biofertilizers composed of free-living bacteria promote plant growth, improve productivity by strengthening its roots, and reduce the amount of synthetic fertilizer applied to the crops. And [20] states that the insecticidal and fumigant activities of *Cinnamomum cassia* (Blume) bark-derived materials against the oak, not weevil(mechoris ursulus Roelofs), were examined using filter paper diffusion and fumigation methods and compared to those of the commercially available Cinnamomum bark-derived compound(eugenol, salicylaldehyde,trans-cinnamic acid, and cinnamyl alcohol). The biologically active constituent of Cinnamomum bark was characterized as trans-cinnamaldehyde by spectroscopic analysis. In a test with the filter paper, respectively. At 2.5 mg/pape,strong insecticidal activity was produced from eugenol(90.0% mortality) and salicylaldehyde(88.9%).

The number of flowers. Table1 shows the number of flowers applied with the different treatments. T3 outranks other treatments that give a highly significant difference which means that the Eggplant was applied with 50ml of the *Cassia didymobotrya* and *Cassia Fistula L*. leaf extract added with 4 liters of water produce more flowers than the other treatments. The increase of flowers was due to the application of the extracts because at this stage, mites have lessened their number when treated with the mixture, and Phomopsis blight slowly disappears when the affected leaves are removed before applying the extracts. The results corroborate the statement of [21] that plant products from Cassia species may be utilized as promising biopesticides with commercial value as an alternative to synthetic pesticides. Reference [22] their study of larvicidal activity of the *Cassia tora* seed extract states that Fractionation of the crude extract decreased mosquito larvicidal activity. However, larvicidal activity increased with increasing doses of the treatments and exposure time. The known anthraquinones aurantio-ubtusin and obtusin were identified as vital larvicidal compounds.

The number of Develop Fruits. The number of fruits that developed T_2 and T_0 records was the highest compared to other treatments that were applied with 100 ml *Cassia didymobotrya* and 50 ml leaf extract of *Cassia didymobotrya* and 50 ml *Cassia fistula Linn* leaf extracts. A highly significant difference was observed between T_2 and T_3 using the Tukey Kramer Multiple Comparison test. The results imply that applying 25 ml leaf extract of *Cassia didymobotrya* and 75 ml *Cassia fistula Linn* controls the insects that damage the flower and leaf resulting in the development of more fruits. Results show that biopesticides also have the required dosage to be more effective. The pesticide properties present in the mixture had just enough to control the insects present in eggplant at the fruiting stage. Alemayehu and his colleagues [23] states that *Senna didymobotrya (Friesen)* is a plant traditionally used for the treatment of sexually transmitted diseases, purgative, appetizer, skin diseases, insecticidal and antibiotic. Reference [24] reveal that Clerodendron inerme and *Cassia fistula L*. leaves were extracted with methanol and ethanol. The efficacy of the extracts as insecticidal agents were assessed on third instar larvae of Spodoptera litura. The results suggest that ethanol extracts of Cassia fistula (LD50 = 1.70389) and methanol extracts of Clerodendron inerme (LD50 = 3.84670) show higher toxicity on third instar larvae of Spodoptera litura.

The number of Damage Leaf. Table 1 also presents the number of the damaged leaf of eggplant results shows that T2 appeared to be the less number of broken leaves caused by mites, and limited Phomopsis blight was observed, which implies that the 25 ml *Cassia dydimobotrya or Senna didymobotrya (Friesen)* and 75 ml *Casia fistula l.* was influential in the control of mites and other insects that damage the leaf of the Eggplant. Biopesticides when applied at the right amount and right time was also effective for the control of the pest. A highly significant difference was observed between T_2 and T_1 when analyzed by the Tukey Kramer Multiple Comparison test at a 0.05 level of significance. Reference [25] state that *Euschistus servus*(Born stink bug) is the common serious insect pest of soybean. It has been found that about 75% of the plants get damaged when these insects attack. In the present investigation, *Cassia fistula* was tested for lethal toxicity against the nymphal instar stage *of Euschistus servus.* The values of LC 100, LC 50, LC) and sub-lethal concentration was detected, and results indicated that Cassia fistula had higher toxicity on the 1^{st}-5^{th} nymphal instar stage of *Euschistus servus*.

Reference [26] Sequential extraction was carried out using solvents viz. petroleum ether, chloroform, ethanol, methanol, and water from the plant leaf were investigated for the preliminary phytochemical and antibacterial properties. Results of the study showed that all the extracts had good inhibitory activity against Gram-positive test organisms. Although all five extracts showed good antibacterial activity against bacterial test species, maximum activity was observed in ethanol extract. The minimum inhibitory concentration ranged between 94 to 1 500 μg/ml. Evaluation of phytochemicals such as alkaloids, flavonoids, carbohydrates, glycosides, protein and amino acids, saponins, and triterpenoids revealed the presence of most constituents in polar extracts (ethanol, methanol, and aqueous) compared with nonpolar extracts (petroleum ether and chloroform). Furthermore, the ethanol extract was subjected to TLC bioautography and a time-kill study against *Staphylococcus epidermidis*. All the findings exhibit that the leaf extracts have broad-spectrum activity and suggest their possible use in treating infectious diseases.

Yield Performance

Marketable Fruits. As seen in table 2 on marketable fruits, T2 garnered the highest yield compared to other treatments, which means the 25 ml of *Cassia didymobotrya* or *Senna didymobotrya (Friesen)* and 75ml *Cassia fistula l.* displays a control effect against a pest that leads to more marketable fruit produce. The larvae of the fruit borer were controlled when applied with 25ml of Cassia dydimobotrya, and 75ml of Cassia fistula l. and the occurrence of another pest at the fruiting stage was controlled by frequent application of the mixture. A significant difference was observed among treatment means when further analyzed using TUKEY Kramer Multiple Comparison Test. The results cooperate with the study of [27] that the larvicidal properties of different plants have been reported to lethal concentrations for 50% mortality. The potential of this plant for use in the control of C. quinquifasciatus larvae. The present LC_{50}, values at 24,48,72 and 96h of C/siamea exposure against C qunquefasciatus larvae were 394.29,350.24,319.17 and 272.42ppm,respectively. The larval mortality was

greater at the 24th h and continued to increase to the 96th h. The resulting larvicidal activity of the extract was also comparable with earlier reports.

Table 2: Yield Performance of Eggplant gathered in the first and second priming applied with different treatments

Treatments	Yield Performance		
	Marketable Fruits(g)	Non-Marketable Fruits(g)	Yield(g)
T0	850.10d	24.57c	874.67
T1	750.10a	78.63a	828.73
T2	853.30c	35.17b	888.47
T3	825.40b	77.73a	903.13
F-test	*	**	ns
CV(%)	18.02	12.75	16.88

Means with the same letter are not significant at 0.01 alpha.

Non-Marketable Fruits. Stipulated in the table that T_2 appeared to be the lowest nonmarketable fruits applied with the three treatments, which implies that 25ml *Cassia didymobotrya* and 75 ml *Cassia fistula L.* has a control effect against fruit borer that contributed to a lower weight of non-marketable fruits harvested. The lethal concentration of the mixture has just enough to lessen the insect that damage the fruits. The same was observed in the study [28] that no significant impact of biopesticide treatment was observed during the 2019 season on fruit yield or quality, thus indicating that there was no apparent advantage to any of the treatments on improving fruit marketability.

Yield. The yield performance of eggplant in table 2 shows that T_3 displays the highest produce compared to other treatments, but the results from other treatments were also comparable, which means that all treatments used in the study can be applied for the effective control of pests and diseases to achieve higher yield and better quality of the fruits produce. All the mixtures used in the study reach enough lethal concentrations that suppressed the occurrence of pests in eggplant, especially during the fruiting stage which led to higher yield. Analysis of variance found no significant difference in the f-test at 0.01 alpha. Reference [29] in their research found out that (E)-cinnamaldehyde was the predominant component of the extract (50.79%) and essential oil (89.95%). The50% lethal concentration (LC50) for larvae and nymphs treated with the extract was 11.56 and 49.18 mg/mL, respectively. The essential oil, (E)-cinnamaldehyde and fenvalerate exhibited acaricidal activity, with LC50 values of 3.81, 3.15, and 0.14 mg/mL, respectively, against the larvae, and 21.31, 16.93, and 1.89 mg/mL, respectively, against the nymphs. (E)-cinnamaldehyde significantly increased esterase and

monooxygenase activity in both larvae and nymphs. Unlike fenvalerate, C. cassia essential oil and (E)-cinnamaldehyde did not cause mortality of T. molitor or H. axyridis adults.

Senthil-Nathan, Sengottayan[30]Biopesticides, including entomopathogenic viruses, bacteria, fungi, nematodes, and secondary plant metabolites, are gaining increasing importance as they are alternatives to chemical pesticides and are a significant component of many pest control programs. The virulence of various biopesticides such as nuclear polyhedrosis virus (NPV), bacteria, and plant products was tested under laboratory conditions very successfully, and the selected ones were also evaluated under field conditions with significant success.

4. Conclusion

Based on the results of the study, the following conclusions were drawn. Eggplant applied with 25ml Cassia didymobotrya and 75ml Cassia fistula L. with 4 liters of water controls the attack of Phomopsis blight and mites that damage the leaves and fruits of eggplant leading to more marketable fruits harvested and higher return on investment.

5. Recommendation

The use of 25ml *Cassia didymobotrya* and 75ml *Cassia fistula l.* Leaf extracts mixed with 4 liters of water shall be explored to verify their effectiveness against another pest of vegetables, and the same study shall be conducted to evaluate the reliability of the results.

References

[1] Wiryadiputra, S. Effectiveness of Biopesticide Derived from cassia spectacles and Nicotiana tabacum Leaves Against the Main Insect Pests of Coffee and Its Effect On Other Arthropods. Pelita Perkebunan, Vol.22.no.1 p-25,2006. . https://doi.org/10.22302/iccri.jur.pelitaperkebunan.v22i1.27

[2] Aktar,M,W.,Sengupta,D. Chowdhury. Impact of Pesticides Use In Agriculture: Their Benefits And Hazards.Interdiscrip Toxicol. p 7/21, 2009. .doi:10.2478/v10102-009-0001-7

[3] Berger, S., Pardo, B., Skorkowska-Zieleniewska J. Nutritional Implications Of Pesticides In Foods. Bibliotheca Nutritio et Dieta, p-1, 1980, DOI: 10.1159/000387460

[4] Lengai, Muthomi J. Biopesticides and Their Role in Sustainable Agricultural Production Department of Plant Science and Crop Protection, University of Nairobi, Nairobi, Kenya.Journal of Bioscience and Medicines.Vol.6 No.6 p-7, 2018.DOI: 10.4236/jbm.2018.66002

[5] Liu, X, C. Insecticidal Activity of Essential Oils of Cinnamomum cassia and its Main Constituent, trans- Cinnamaldehyde, against the Booklice, Liposcells bostrychophilla. Tropical Journal of Pharmaceuticals Research .p 4-6, 2014.doi.org/10.4314/tjpr.v13i10.18

[6] Kumar, J., Ramlal, A., Mallick, D., Mishra, V. An Overview of Some Biopesticides and Their Importance in Plant Protection for Commercial Acceptance p 4/19,2021. doi.org/10.3390/plants10061185

[7] Bhalodia. N, R. and Shukla, V.J.Antibacterial and Antifungal Activities from Leaf Extracts of Cassia

fistula l: J Adv Pharm Technol Res. P 10/12, 2011. DOI: 10.4103/2231-4040.82956

[8] Govindajaran, M. Bioefficacy Of Cassia Fistula Linn. (Leguminosae) Leaf Extract Against Chikungunya Vector, Aedes aegypti (Diptera: Culicidae). Europian Review for Medical and Pharmacological Sciences.Vol.13 N-2 p,1,2009. pubmed.ncbi.nlm.nih.gov/19499844

[9] Souto, A.L., Sylvestre, M., Tölke, E.D., Tavares, J.F.; Barbosa-Filho, J.M.; Cebrián-Torrejón, G. Plant-Derived Pesticides as an Alternative to Pest Management and Sustainable Agricultural Production: Prospects, Applications, and Challenges.Molecules. Multidisciplinary Digital Publishing Institute. 1/2, 2021. doi.org/10.3390/molecules26164835

[10] Musau, J, Wanjiru, I, Phytochemical Screening and in vitro Antibacterial Activity of Cassia didymobotrya Fres. International Journal of Research and Review Vol.7; Issue: 10; p 36-37 2020.Original Research Article E-ISSN: 2349-9788; P-ISSN: 2454-2237

[11] Duraipandiyan, V., Ignacimuthu, S., Paulraj, M.G.Anifeedant and larvicidal activities of Rhein isolated from the flowers of Cassia fistula L. Saudi Journal of Biological Sciences 18(2):129-33. P 1/7,2011.doi.org/10.1016/j.sjbs.2010.12.009

[12] Xin Chao Liu1, Jun Cheng2, Na Na Zhao1, and Zhi Long Liu1. Insecticidal Activity of Essential Oils of Cinnamomum cassia and its Main Constituent, trans-Cinnamaldehyde, against the Booklice, Liposcelis bostrychophila.Tropical Journal of Pharmaceutical Research Vol .13 No.10 p-1/4,2014.doi.org/10.4103/2231-4040.82956

[13] Kang, M, S., Lee, H, S. Acaricidal and insecticidal responses of Cinnamomum cassia oils and main constituents. Appl Biol Chem 61,653-6599.p 2/14 2019//doi.org/10.1007/s13765-018-0402-4

[14] Obembe, O, M., Kayote, J. Evaluation of the Insecticidal Properties Of Cassia alata L. Against Cowpea Weevil, Callobrochus maculatus Fab. (Coleoptera: Bruchidae). Budapest International Research in Exact Sciences medical, Biological, Agriculture, Engineering, Science and other related areas. P 1/9,2019.ISSN2655-7827. DOI: doi.org/10.33258/birex.v1i4.481

[15] Singh,S,A,and Singh, N,R. Antimicrobial Activity of Cassia didymobotrya and Phlogacanthus thyrsiflorus.Journal of Chemical and Pharmaceutical Research. P 1/7, 2010, 2(4):304-308. ISSN No. 0975-7384

[16] Okonkwo,C,O.,Ohaere,O,C., Atangwho,J,I. Safety of insecticidal Oils from Cassia occidentalis and Euphorbia milii on Biochemical Markers of Tissue Integrity. Trends in Applied Science Research: Vol 14(4). P 4/8, 2019. DOI:10.3923/tars.2019.303.309

[17] Nyamwamu, B,L., Ngeiywa,M., Mulaa,M., Lelo,A.L., Ingonga,J., Kimutai,A. An Overview of Phytochemical Constituents of Senna didymobotrya Fresen Irwin Roots Used as a Traditional Medicinal Plant in Kenya. Papa Research Best in Science News. P1,2020. https://bp.bookpi.org/index.php/bpi/catalog/book/278.

[18] Baskar, K., Ananthi, J. & Ignacimuthu, S. Toxic Effects Of Solanum Xanthocarpum Sch &Wendle Against Helicoverpa Armigera (Hub.), Culex Quinquefasciatus (Say.) And Eisenia Fetida (Savigny, 1826). Environ Sci Pollut Res 25, 2774–2782. p ½,2018. /doi.org/10.1007/s11356-017-0655-1

[19] Mendoza,J.Z.,Caisa,C.S.,Cruz,D.C.,Guzman, Use of Biofertilizers in Agricultural Production. Intech Open Book Series p2/19,2021. DOI 10.5772/intechopen.98264

[20] Park,I,K.,Lee,H,S.,Lee,S,G.,Ahn,Y,G. Insecticidal And Fumigant Activities Of Cinamomum Cassia

Bark-Derived Materials Against(Mechoris ursulus(Coleoptera:attelabidae). Journal of Agricultural Food Chemistry 48:2528-2531. P1/5,2000 .doi:10.1021/jf9904160

[21] Raman Ibrahim, N,B,B., Puchooa, D., Govindan-Soulange, J. et al. Cassia species: A Potential Source Of Biopesticides. Journal of Plant Science and Protection. 128, 339–351 p 1/27,2021. doi.org/10.1007/s41348-020-00408-9

[22] Mbatchu, V, C.Tchuassi, D, P. Dickson, R,A., Annan, K., Mensah, A,Y., Amponsah, I.K., Jacob, J.W.,Cheseto, X.,Habtemarin,S.,Torto,B. Mosquito Larvicidal Activity of Cassia tora seed extract and its key anthraquinones aurantio-obtusin and obtusin. Parasites and Vectors. National Library of Medicine. National Center for Biotechnology Information. Article number;562 p ½, 2017.doi.org/10.1186/s13071-017-2512-y

[23] Alemayehu, I., Tadesse, S., Mammo, F., Kibret, B., & Endale, M. Phytochemical Analysis of the Roots of Senna didymobotrya. Journal of Medicinal Plants Research, 9(34), 900-907.p1/7,2015. DOI:10.5897/JMPR2015.5832

[24] Chauhan, P. Shivakumar, M. R. Muthusamy and Kumar, D. Larvicidal Activity of Solvent Leaf Extracts of Cassia fistula (Linn) and Clerodendron inerme (Gaertn) on the Spodoptera litura (Insecta): Journal of Ecobiotechnology vol 3,no.7. p1/5,2011. ISSN: 2077-0464

[25] Shilpi, K. Tomar, D. Gour, H Lethal Toxicity Of Cassia Fistula Seed Extract On Nymphs Of Euschistus servus. International Journal of Recent Scientific Research. Vol. 5, Issue, 5, pp.1005-1008,2014. ISSN: 0976-3031

[26] Panda, S, K., Padhi, LP. Mohanty, G. Antibacterial Activities And Phytochemical Analysis Of Cassia fistula (Linn.) Leaf. Journal of Advanced Pharmaceutical Technology and Research 2(1): 62–67 2011.doi10.4103/2231-4040.79814.

[27] Jiraungkoorskul,K. and Jiraungkoorskol,W.Larvicidal and Histopathological Effects of Cassia siamea leaf extract against Culex quinquefasciatus.National Library of Medicine. National Center for Biotechnology Information. (2):15-25,2015. PMCID:PMC4729405, PMID:26868707

[28] Pruitt, K, B. An Evaluation of Biopesticide Combinations on Yield Performance and Disease/Arthropod Control of Strawberries Grown in High Tunnel Plasticulture Production Systems in Arkansas. Part of the Agricultural Science Commons, Agronomy and Crop Sciences Commons, Fruit SciencemCommons, Horticulture Commons, and the Plant Pathology Commons.Theses and Dissertations. P1/104,2020. scholarworks.uark.edu/etd/3628

[29] Nwanade,C,F., Wang,M.,Wang,T., Zhang,X.,Wang,C.,Yu,Z.,Liu,J.The acaricidal activity of Cinnamomum cassia(Chinese cinnamon) against the tick Haemaphysalis longicornis is linked to its (E)- cinnamaldehyde content. Parasites Vectors. National Library of Medicine. National Center for Biotechnology Information. p 1/4,2021.doi.org/10.1186/s13071-021-04830-2

[30] Senthil-Nathan, Sengottayan. A Review of Biopesticides and Their Mode of Action Against Insect Pests. Published by Springer p 49,2015.DOI:10.1007/978-81-322-2056-5_3 Edition: