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Evaluating the Repellency of Brassica Junicea Essential Oil Against *Ferrisia Virgata* on Guava

Ghulam Hussain Khoso*
Department of Plant Protection, Sindh Agriculture University Tandojam. Corresponding Author Email:hussainafnankhoso@gmail.com
Laiba Rashid Mughaal
Department of Plant Protection, Sindh Agriculture University Tandojam
Asadullah Gorchani
Department of Plant Protection, Sindh Agriculture University Tandojam
Abdul Musawar Shar
Department of Entomology, Sindh Agriculture University Tandojam
Shahzeb Ali Memon
Department of Plant Protection, Sindh Agriculture University Tandojam

ABSTRACT

This is the first study on mustard oil dilution and bioactivity against mealybug on Guava. (*Psidium guajava* L.) is one of the most common and popular delicious fruit grown for edible fruits. The *P. guajava* is subject to attack by several kinds of insects including guava mealy bugs; once population develops the, it is hard to control. *Brassica junicea* oil was diluted with four different solvents, i.e. ethanol, kerosene, petrol, and spirit. The working solution was form at 1,000ppm and applied with the help of hand sprayers on guava tender leaves and flowers which contains Mealy bug. Number of Mealybug was recorded before and after 24, 48, and 72 hours of Spray. Result showed Different solvents showed different percentages of dilution, ethanol diluted maximum percentages of essential oil, followed by sprit, kerosene and patrol. The essential oil from *B junicea* significantly decreased mealybug population on Guava. Mealybug population decreased with increased of time, continuously spray can decrease mealybug population. Maximum effect of essential oil was observed on third spray followed by second and first spray with mean number of 4.43 ±0.75, 4.93 ±0.20 and 7.47±0.62, respectively. There is significance between control and treatment, when treatment was compared with control. Our study proved that essential oil from mustard can repel mealybug on guava. Further study is required to identify mustard oil chemical components and observed bioactivity on other noxious insect pests.

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Keywords: Guava, Guava mealybug, Essential oils, eco-friendly Management, Biological Control

Introduction

Guava (*Psidium guajava L*) is one of the most common and popular delicious fruit, grown for edible fruits, nutritional values in the world (Jyoti & Vora 2018). It is very rich in vitamin C which is also found in citrus, it is also good source of vitamin A and other elements guava is a small monoecious evergreen tree height between 2 and 10 meters (Patel et al., 2011). The common Guava has a fruit with a yellow skin and white, yellow, or pink flesh many consider it a "magical" fruit because of its array of nutrients and medical uses (Dr.Axe 2017). Guava is subject to attack by several kinds of insect pests. Among the more important are guava fruit fly, mealy bugs, whitefly, red-banded thrips, guava fruit moth etc.

Guava mealy bug (*Ferrisia virgata* Ckll) is one of the most commonly occurring pest found on guava and other host trees (Wabale et al., 2010). Mealy bugs are small soft bodies sucking pest and one of the most economic insect pests all over the world. Which embrace the second largest family of insects and comprises approximately 300 spp which damage many agricultural and horticultural crops (Sirisena et al., 2013). Mealy bug infestation appear on plants as tiny soft bodied insects surrounded by fuzzy, white mass around the stems and leaf nodes (VenZile 2013). Mealy bugs damage plants by inserting their threadlike mouthparts into any part of the plant and sucking out sap (Frank 2011). The co-evolutionary relationship among mealy bug hosts and its parasitoids appear to be strong and successful classical biological control strategy against mealy bugs (Charles 2011). There is a traditional and most common way used to control the pest infestation in which harmful chemicals are often used (Aheer et al., 2009; Gulzar et al., 2015) which cause environmental contamination and health hazards (Edwards, 2013; Nicolopoulou-Stamati et al., 2016). Chemical pesticides contain some non eco-friendly substances which cause harm to other living organisms. Extensive use of pesticides contaminates soil and water, remain in the crops and finally enter food chain, thereby posing threat to the human beings (Sharma et al. 2017). The release of pesticides into the air largely depends upon the physical and chemical properties of

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the active compound, application procedure and changing environment conditions (Waite et al. 2005).

Brassica junicea is also commonly known as brown mustard (Lin et al., 2011). The genus Brassica contains over 150 species that are cultivated worldwide as oilseed crops. The oil contains low pungency, low erotic acid (less than 2%) and low aliphatic glucosinolate (less than 30 µmol/g) which is a natural hybrid between *B. Rapa* and *B. nigra* (Houbein et al. 2008, Jham et al. 2009, Salama et al. 2011, Hill et al. 2011) The oil is commonly used for cooking (Duke 2002), various health benefits and diseases prevention effects (Lee et al. 2010) and for medicinal purposes (Anonymous 2008, Wilson 2017). In addition, this oil helps to prevent some insect species, especially used to prevent mosquito and midges. To the best of our knowledge no any scientific work has been published on effects of *B. junicea* oil on insect pests. Therefore this study was conducted to determine the repellency effects of essential oil from *B. junicea* on mealybug. It is hoped that the information from this study will be added in account of control methods of mealybug in fruit trees.

Review Literature

Importance of Guava

A popular fruit crop in tropical and subtropical areas, guava (Psidium guajava L.) is prized for its nutritional, therapeutic, and economic benefits (Naseer et al., 2018). It is cultivated in nations like Bangladesh, Brazil, India, Pakistan, and the Philippines since it is a member of the Myrtaceae family and grows well in a variety of soil and climate conditions (Daswani et al., 2017). Guava, also referred to as the "poor man's apple," is inexpensive, nutrient-dense, and high in vitamin C, dietary fibre, antioxidants, and vital minerals including potassium, magnesium, and folate (Joseph & Priya 2011). It is an essential crop for reducing hunger and promoting food security because of these nutrients. Guava has therapeutic value in addition to its nutritional value.Because of their antibacterial, anti-inflammatory, and antidiabetic qualities, the leaves, bark, and fruit have long been used to treat a variety of illnesses (Kumaret al., 2013). Guava leaves are particularly utilised in herbal treatments to cure infections and digestive problems. However, insect pests—particularly sap-sucking insects like mealybugs, whiteflies, aphids, and scale insects—pose a serious

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threat to guava crops (Reddy 2018). By consuming its sap and releasing chemicals that encourage the growth of mould, these pests harm the plant (Zvereva et al., 2010). Ferrisia virgata, often known as the striped mealybug, is the most detrimental of these since it reduces photosynthesis, causes premature fruit drop, and degrades fruit quality, all of which have an impact on farmer incomes and market potential (Muniappan 2012).

Impacts on Pest Populations

Numerous insect pests pose a major danger to guava crops, including sap-sucking species like mealybugs (Ferrisia virgata), aphids (Aphis gossypii), whiteflies (Bemisia tabaci), and scale insects (Vennila et al., 2012). Through constant sap extraction, these pests damage the plants, resulting in stunted development and decreased fruit output. Additionally, their eating habits promote the spread of viral illnesses and fungus infections (Mduma et al., 2015). Controlling these pests is made more difficult by their quick reproduction and capacity to infest broad regions in a short amount of time, which results in lower fruit quality and higher yield losses (Prusky 2011).

Brassica junicea Essential Oil

The Brassicaceae family includes Brassica junicea, also known as Indian mustard, which is widely grown for its seeds (Pradhan & Pental 2010). These seeds have uses in both medicinal and cookery and are a great source of oil. The high glucosinolate content, especially sinigrin, of B. junicea seeds is one of their main characteristics. A significant component of mustard essential oil, allyl isothiocyanate (AITC), is produced when sinigrin is broken down by the enzyme myrosinase (Mazumder et al., 2016). AITC is a viable natural alternative for controlling insect pests in agriculture because of its potent antibacterial and insect-repelling qualities.

Mealybug Insect Complex in Guava and Its Impact on Yield

A major pest group in guava-growing areas, particularly in tropical and subtropical zones, are mealybugs. Young shoots, fruiting branches, and leaf axils are the targets of species such as Ferrisia virgata, Maconellicoccus hirsutus, and Phenacoccus solenopsis (Gundappa & Mani 2022). They produce curling leaves, malformed shoots, withering, and early fruit drop by penetrating plant tissues and feeding on sap (Jeyakumar 2011). Black sooty mould is further drawn to their sugary secretions,

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which lowers photosynthetic activity and light penetration. According to Acema et al. (2016), heavily infested orchards may experience yield reductions of up to 50%, which would negatively impact both local sales and export prospects. Ants frequently provide protection for these pests in return for honeydew, which makes it challenging for natural predators to manage the population.The efficacy of chemical sprays is further limited by their waxy covering and propensity to conceal themselves in confined plant regions (McGiffen et al., 2014). Furthermore, an excessive dependence on synthetic pesticides has damaged beneficial insect populations and resulted in pest resistance. Environmentally friendly pest management techniques are becoming more popular as a result of these problems. Essential oils extracted from plants, particularly Brassica juncea, have the potential to be used as natural repellents (Ahuja et al., 2011). These herbal remedies can be successfully incorporated into current pest management methods, are safe for non-target creatures, and are biodegradable. Developing sustainable measures to minimise crop damage and economic loss requires an understanding of the biology and behaviour of the mealybug complex (Daane et al., 2012).

Ecological Impact of Mealybug Infestation in Guava

Because mealybug infestations damage plants and reduce their output, they can upset the ecological balance in guava orchards (Reddy & Sreedevi 2016). These pests cause yellowing of the leaves, reduced growth, and early fruit and foliage loss by sucking sap from different sections of the plant (Van Rooyen 2017). According to Santos et al. (2013), their sugary excretions serve as a growing medium for sooty mould, which obstructs photosynthesis by covering the leaves and fruits in a black film. Furthermore, mealybugs and ants frequently develop mutualistic partnerships that shield them from predators, which makes biological management more challenging. Many producers use synthetic pesticides to control infestations, which can damage non-target species, including beneficial insects, and pollute the environment (Romeh 2018). The climate exacerbates the issue because mealybug population growth is often favoured by warm, dry weather. In the end, guava-growing ecosystems' ecological stability and long-term productivity are at risk due to this infestation (Fand et al., 2014).

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Material And Methods

Research study was conducted in the experimental farm of Center for Agriculture and Bioscience International Organization at Larkana vicinity in the month of October when guava trees bear's squares and Mealy bug observed on trees.

Oil Extraction And Working Solution Preparation

Brown mustard oil was purchase from Shafee Dawa Khana (registered), Islamabad. Oil was obtained by pressing method. Matured seeds were harvested from matured crop; seeds proceed for drying in shadow with 50±5^{0}C and 30±5 RH. Seeds were cleaned and sorted before oil extraction. Healthy and uniform seeds were used for oil extraction. The obtained oil was stored at cold and shadow place and used with 6months of extractions.

Crude oil was diluted with four different solvents, i.e. ethanol, kerosene, petrol, and spirit. 1ml of oil essential oil was added in glass vial and 1ml of solvent was added then in same vial. Vial was shaken for 30 minutes and kept for 24 hours for proper dilution. Double distilled water added to get 100 ml (1,000ppm). The same method was applied for dilution with each solvent. The obtained solution was used as working solution and applied on target on same day. For control solution, same amount of ethanol was added in water.

Bioassay

Laboratory Experiment

Crude oil was diluted with four different solvents, i.e. ethanol, kerosene, patrol, and spirit. 1ml of oil essential oil was added in glass vial and 1ml of solvent was added then in same vial. Vial was shaken for 30 minutes and kept for 24 hours for proper dilution. Double distilled water added to get 100 ml (1,000ppm). The same method was applied for dilution with each solvent. The

Field Experiment

Working solution applied with the help of hand sprayers within 1hour immediately after preparation on tender leaves of Guava containing Mealy bug. Number of individual insects (Mealy Bug) was recorded before and after 24, 48, and 72 hours of Spray.

Data Analysis

The subject data was analyzed and graphs prepared on micro-soft Excel 2010 for

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window 2010

Result

Result showed that essential oil from *B junicea* significantly decreased mealybug population on Guava. Mealybug population decreased with increased of time. In the start, maximum number of mealybug observes at 24 hours of exposure with mean number of 8.70±1.80, followed by 48 hours and 72 hours of exposure with mean number of 7.00±1.82 and 6.70±1.58, respectively (Fig.1). The following spray significantly decreased mealybug population. The minimum number of mealy bug were observed on 72 hours with mean number of 4.90±1.10 followed by 48 hours and 24 hours of exposure with mean number of 5.30±1.17 and 5.30±1.17, respectively (Fig.1). The 3rd and last spray followed on second spray, added in account of mealybug population control on Guava. The minimum number of mealybug was observed on 72 hours of exposure with mean number of 3.40±0.98 followed by 48 hours and 24 hours of exposure with mean number of 4.00±1.09 and 4.60±1.03, respectively (Fig.1).

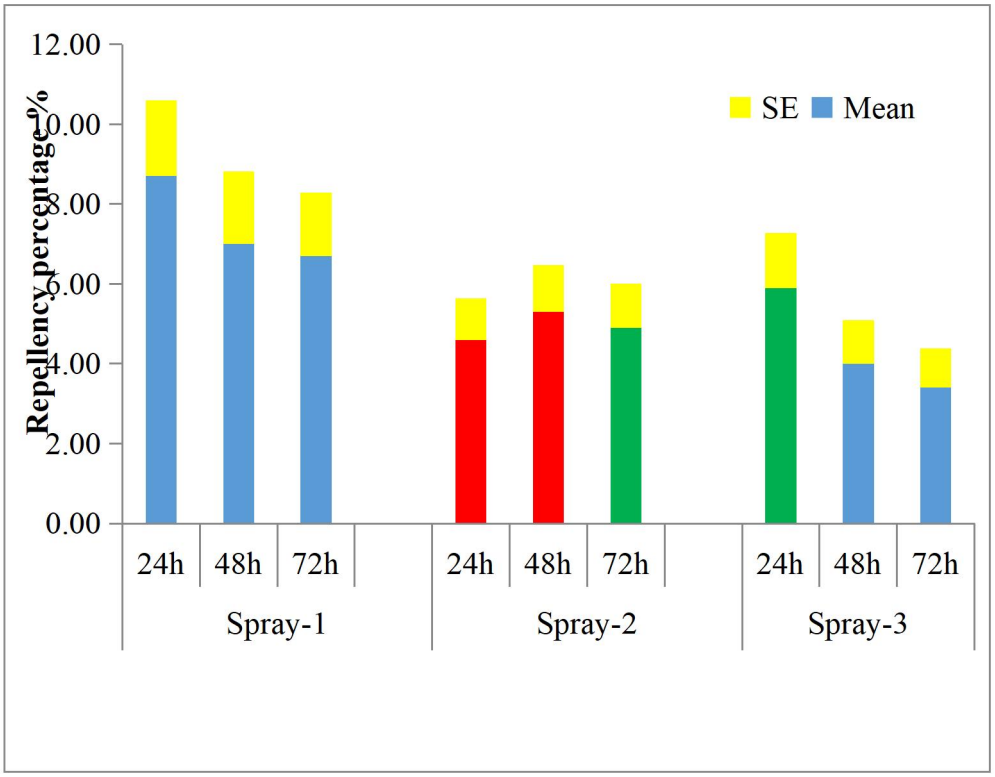

Figure 1. Percentages Of Sprays On Daily Basis Of All Three Sprays

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We observed significant difference between sprayers. Continuously spray can decrease mealybug population. Maximum effect of essential oil was observed on third spray followed by second and first spray with mean number of 4.43 ±0.75, 4.93 ±0.20 and 7.47±0.62, respectively (Fig. 2).

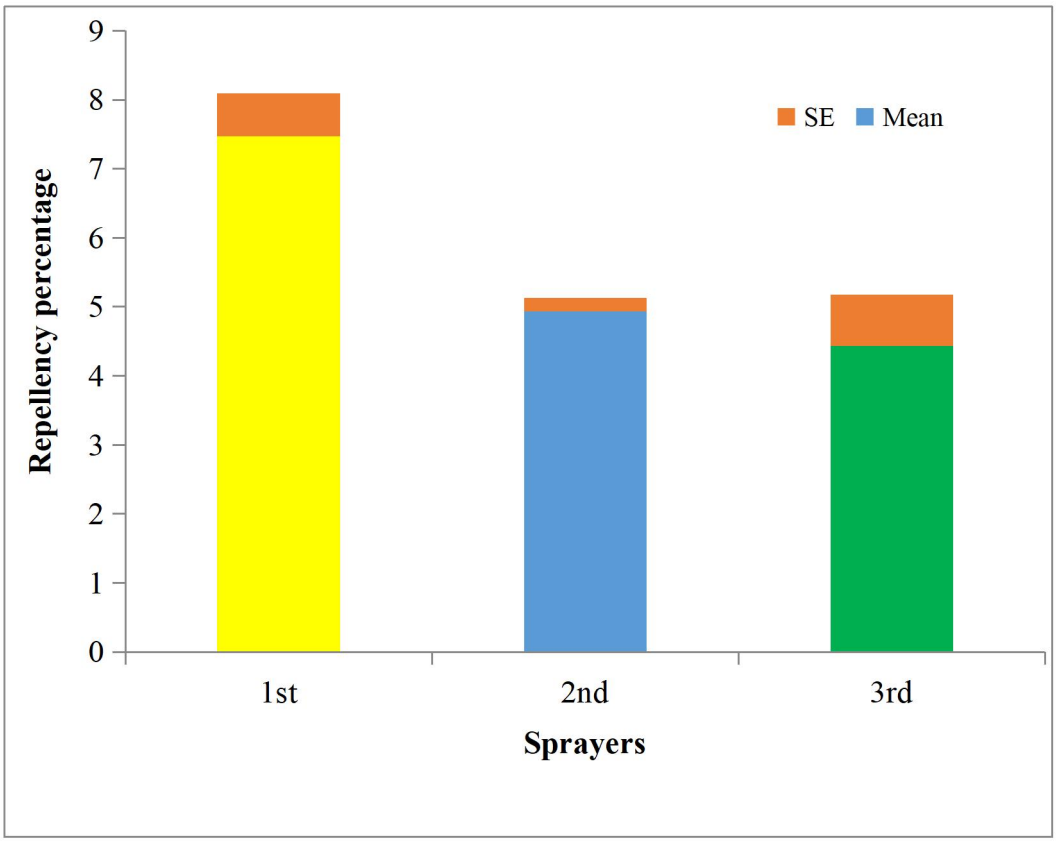

Figure 2. Mean Percentages Of First, Second And Third Sprays

Results showed significance between control and treatment, when treatment was compared with control. Treatment showed significant difference between application times where as no any significance between controlled application times (Fig.3).

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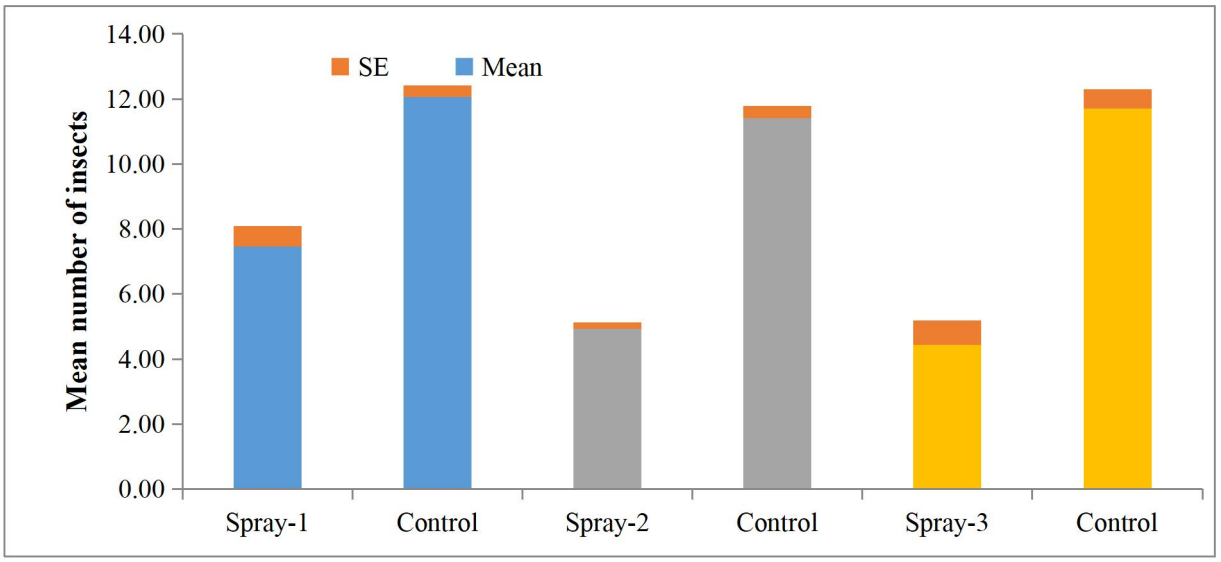

Figure 3. Comparison Of Repellency Percentages Between Treatment And Control

Different solvents showed different percentages of dilution, when essential oil was diluted with four different solvents. Ethanol diluted maximum percentages of essential oil (93%), followed by sprit, kerosene and patrol with mean percentage of dilutions 72%, 46% and 37%, respectively (Fig.4).

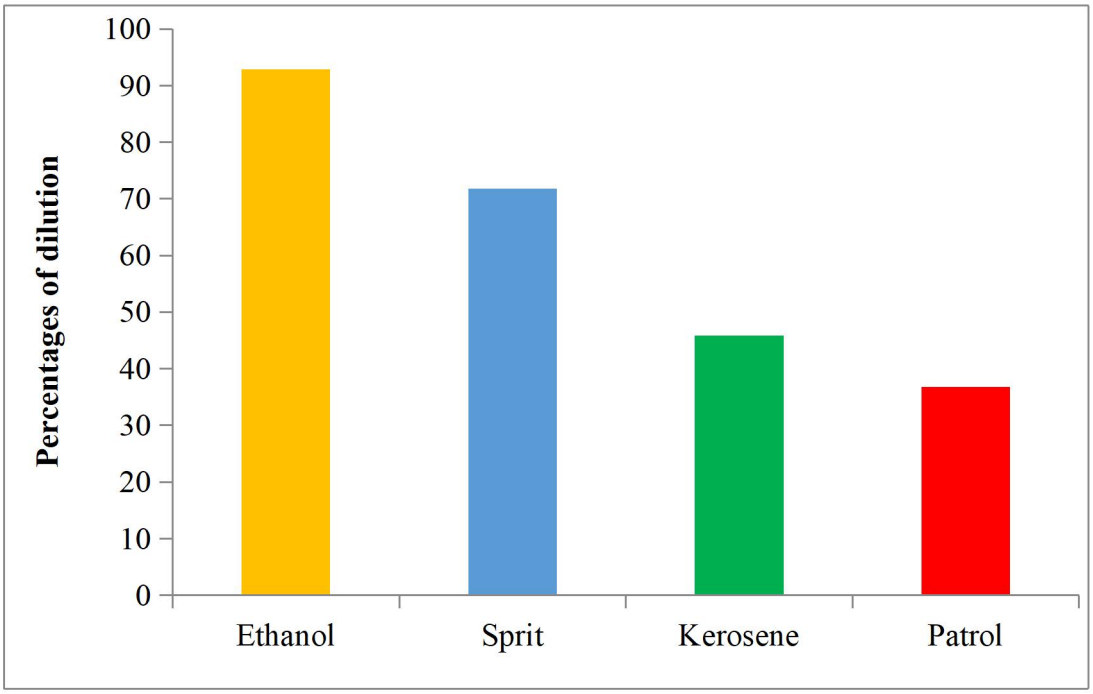

Figure 4. Percentages Of Dilution Of b. Junicea Essential Oil With Different Solvents

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Discussion

Essential oil used in our study showed repellency against mealybug population. As time increased the repellency to mealybug was increase and showed highest repellency at 72hours of bioassay. Whereas, following sprays added maximum repellency to mealybug. Mustard oil repellency and anti-feedings activities observed on various insect pests by different researchers. Gupta et al. (2021) observed antifeeding activities of aqueous extract of mustard seeds against aphids (*Macrosiphum roseiformis*), thrips (*Scirtothrips dorsalis*) and spider mites, (*Tetranychus urticae*). Essential oil from *Brassica junicea* showed bioactivity against Sitophilus oryzae and Callosobruchus sp. (Kim et al. 2003). Essential oil from Brassica Alba showed the insecticidal activity against *C. pomonella*, *D. pini* and *S. exigua* at a rate of 0.422, 11.74 and 11.66 mg per ml, respectively (Konecka et al. 2018). Our results contrast with previous findings showed that mustard oil has bioactivity against some insect pests including mealybug.

Ethanol has ability to dilute maximum percentages of mustard essential oil. However, laboratory experiments on dilutions of ethanol have been confirmed by different researchers; in our study we observed ethanol is the best solvent for mustard oil and there is no any adverse effect of ethanol on targeted insect.

Conclusion

This is the first study on mustard oil dilution and bioactivity against mealybug on Guava. Our study proved that essential oil from mustard can repel mealybug on guava. Further study is required to identify mustard oil chemical components and observed bioactivity on other noxious insect pests.

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