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Anti-feedant activities of plant extracts against insect pests and on their natural enemies on brinjal (*Solanum melongena* L.).

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ABSTRACT

Brinjal *(Solanum melongena* L.) is one of the commonly consumed vegetable in many countries including Pakistan. And attack by sucking and chewing insect pests likewise, Jassid, aphid, whitefly, shoot and fruit borers, cause significant losses in yield production. Therefore a research trail was conducted to evaluate effect of plant extracts against sucking and chewing insect pests and their associated natural enemies in brinjal crop under field conditions. For this four different plant extracts (Neem seed, Garlic, Eucalyptus and Tobacco) were used to evaluate their efficacy. Two sprays were applied at fifteen intervals and data was recorded before and after 24 hours and 72 hours after spray. In present results, we observed that all plant extracts significantly reduced insect pest population as compared with control groups, while among plant extracts the neem seed and garlic extract were observed more lethal to jassids, aphids and on white flies respectively, as compared to eucalyptus and tobacco extract. Similarly, a minimum damage % of fruit borer was also observed in neem seed and garlic extract as compared to tobacco and eucalyptus. However, no adverse effects were observed on natural enemies.

Keywords: Phytophagous insects, Beneficial insects, Biopesticides, Brinjal Crop.

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INTRODUCTION

Brinjal (*Solanum melongena* L.) is a popular vegetable in many nations across the world, particularly in Asia (Harish *et al.*, 2011). It is widely grown throughout the year in other country like wise, China, Japan, India, and Pakistan. (Hanson *et al.*, 2006). Iron, phosphorus, calcium, and vitamins A, B, and C are all abundant in brinjal fruit. Its fresh edible fruits are commonly consumed as a vegetable, but it is also used in the production of homemade pickles and other products too (Cao *et al.*, 2015; Clifton *et al.*, 2020). Crop is vulnerable to a variety of sucking and chewing insect pests, during its development period (Bhagat, 2016; El and Devine, 2003; Regupathy and Dhamu, 1990). Among other insect pest the *Bemesia tabaci, Thrips tabaci, Amrasca biguttula biguttula,* fruit borer *Leucinodes orbonalis, Aphis gossypii,* and non-insect pests such as red spider mite (*Tetranychus macfurlanei*) are the main insect pests that attack on brinjal crop (Srinivasan, 2009; Dutta *et al.*, 2017).

Farmers from developing countries in Africa and Asia still relying on the chemicals pesticide to regulate the population (Dutta *et al.*, 2017; Akter *et al.*, 2018). Yet injudicious and indiscriminative application of chemicals leads to cause many problems in human health including toxins that affect beneficial insects and other organisms

(Ghananand *et al.,* 2011). Such chemicals have long time persistence and accumulation in the environment so, there is a demand of the time to screen out the existing synthetic insecticides to find out alternative management techniques using plant extracts (Odewole *et al.,* 2014; Anwar *et al.,* 2019). Different plant extracts are present in the markets that have unique bio-pesticide compounds likewise, in neem *Azadirachta indica* (Harikrishnan *et al.*, 2003; Abdul *et al.*, 2014; Feng *et al.*, 2015; Mei *et al.*, 2020). Neem consists of Limonoids, terpenoids, flavonoids and alkaloids which control the insects in different ways like antifeedant, repellent, insect growth regulator and oviposition deterrent (Koul and Dhaliwal, 2003; Koul and Walia, 2009; Abdul *et al.*, 2014). Tobacco plant *Nicotania tabacum*, has a nicotine which is very toxic not only for lepidopteran, diptran and many soft bodied insect pests (Udin *et al.*, 2019; Laghari, 2020). Caster bean *Ricinus communis*, contain vital bioactive compounds like ricin, ricinine, N-demethylricinine, and flavonoids that interrupted the normal development of insect pests (Mbelo and Luhata, 2015; Choi *et al.*, 2016). These chemical compounds have efficient insecticidal, antifeedant and repellent properties (Koul, 1999; Laghari, 2020) and also suppress the population of *Spodoptera frugiperda* (Koul and Dhaliwal, 2001; Mei *et al.*, 2020).

So keeping in view pest and pesticide problems, the present study is designed to reduce the pest population of brinjal through selected eco-friendly plant extracts. Hope the result would be helpful for those researchers who are working on bio pesticide in integrated pest management programme.

MATERIAL AND METHODS

Experimental site and layout

Current research was conducted in a farmer field at Uthal District Lasbela Balochistan (25.8700° N, 66.7129° E). The Brinjal crop was sown in the month of September on the area of half acre at farmer field Uthal, Balochistan. A brinjal variety (beejo) was purchased from the local market of Uthal and sown through ridge method with 75cm row-row and 15cm plant-plant distance. The experiment was planned according to Randomized Complete Block Design (RCBD). All the necessary agronomic practices were performed during sowing time. Pre-emergence weedicides like dual-gold 960 EC and S-metolachlor were applied before sowing to inhibit the growth of weeds while later on weeds were eliminated manually to minimize the space, water, nutrients and light competition with main crop.

Selection of Plants as bio-pesticide

The plants like neem (*Azadierachtin indica*), eucalyptus, tobacco (*Nicotiana tabacuim*), and garlic (*Allium sativum*) extracts were used in the experiment. Fresh leaves of neem and eucalyptus were collected from the university field area while leaves of tobacco and garlic bulbs were purchased from market. The leaves of selected plants were washed carefully to remove undesirable material. The leaves of neem, eucalyptus and tobacco were dried separately under the shade and crushed with the help of pistal and mortar. During crushing distilled water was added continuously until all the leaves of neem, eucalyptus and tobacco were thoroughly crushed. After crushing, the material was filtered with the help of muslin cloth.

Plant Extract Procedure

The total 500 grams air- dried tobacco leaves were grinded and soaked in one liter of water for 24 hrs after this aqueous extract was diluted in 37.19 ml / 2 liters of water. Equally, 10 kg leaves of neem and eucalyptus were collected, chopped, dried and boiled in five liters of water until two liters of boiled water remained, which was drained through muslin cloth and prepared for application in the treatments. Whereas, 2 kg of garlic was purchased from local market, and grinded with help of grinding machine for garlic extract. To make a 20% concentration of garlic extract 1000mL pure garlic extract was mixed in 5000 mL liter water for the preparation of 20 % concentration of garlic extract. Plant extraction methods was used in line of (Pandey and Tripathi, 2014). Experimental treatments were applied twice at 15 days interval. The data was recorded before application of treatment and after 24 hrs, 72 hrs of application

from randomly selected 10 plants in the morning time to record the efficiency of the plant extracts.

Statistical Analysis

The data was subject to to calculate plant extract efficacy and insect population before and after treatment. Whereas, data further subjected to statistical software Minitab Version 18 to obtain Analysis of Variance (ANOVA) followed by Least Significance Difference (LSD) to find out the significant level among treatments at P value 0.05.

RESULT

In present observations we noticed that after first spray the mean number of jassid population (0.99±0.26) was observed on neem seed water extract followed by Garlic (1.03±0.78), Tobacco (1.69±0.48) and Eucalyptus (2.59±0.87), while maximum pest population (3.30±0.89) was observed on control treatment. We observed no significant difference between neem seed and garlic water extract. However, all treatments showed significant jassid control. However, all treatments were statistically significant at p<0.05 from control treatments. Similarly, after second spray minimum jassid pest population was observed on neem seed water extract (1.76±0.65) followed by tobacco (1.80±0.83), garlic (1.90±0.17) and eucalyptus (2.76±1.02), whereas maximum pest population of jassid was found in control groups (3.03±0.24). However, we found that all treatments were statistically significant at p<0.05 from control. While no significant difference was observed among neem seed, garlic and tobacco water extracts (Figure 1).

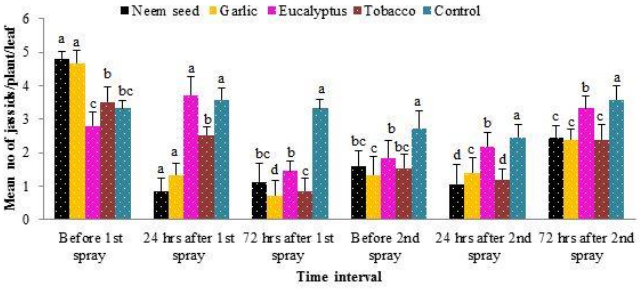

Figure 1. Effect of different plant extracts against jassid on brinjal crop. In the figur mean values that do not share a letter are significantly different at P<0.05 level by using the Fisher LSD method.

Whereas, the observations on whiteflies showed that the minimum population was noticed on neem seed water extract (19.13±0.26) followed by garlic (22.33±0.78), tobacco (22.43±0.48c) and eucalyptus (26.05±0.87), while a maximum pest population of whitefly was observed on control treatment (54.33±0.89). A Statistical significant difference at p<0.05 was noticed between control and other treatments. While no significant difference was observed between neem seed and garlic water extract. Similarly in second spray a minimum whitefly pest population reduction was observed on garlic water extract (21.97±0.17) followed by neem seed (22.36±0.65), tobacco (23.83±0.83) and eucalyptus (24.06±1.02). Whereas a maximum whitefly population was found in control treatment (29.4±0.24). Data showed that all treatments were statistically significant different at p<0.05 to control. However no significant difference was observed among treatments (Figure 2).

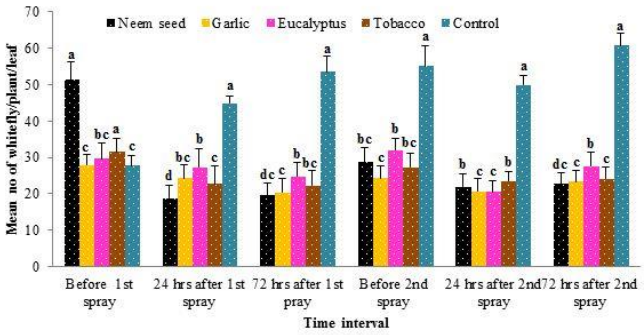

Figure 2. Effect of different plant extracts against whiteflies on brinjal crop. In the figure mean values that do not share a letter are significantly different at P<0.05 level by using the Fisher LSD method

The data regarding aphid revealed that the minimum aphid population was observed on neem seed water extract (0.06±0.26) followed by tobacco (0.23±0.48), garlic (0.26±0.78) and eucalyptus (0.44±0.87). While maximum aphid population was observed on control treatment (3.16±0.89). Data showed that all treatments were statistically different at p<0.05 when compared with control. Moreover, we found no significant difference between neem seed and tobacco water extract. Similarly after second spray minimum aphid population was observed on garlic water

extract (0.22±0.17) followed by tobacco (0.23±0.83), neem seed (0.24±0.65) and eucalyptus (0.95±1.02), whereas a maximum aphid population was found in control treatment (2.56±0.24). Data showed a significant statistical difference at p<0.05 between control treatment but no significant difference was observed among all treatments (Figure 3).

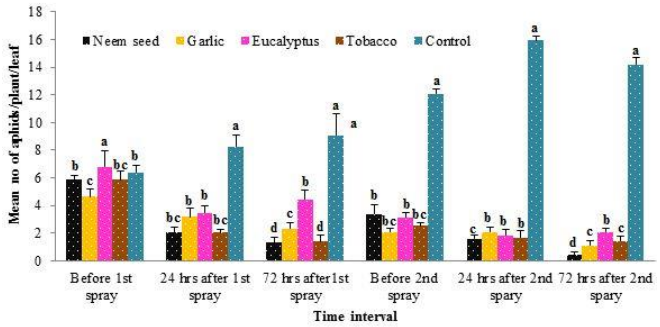

Figure 3. Effect of different plant extract against aphid on brinjal crop. In the figure mean values that do not share a letter are significantly different at P<0.05 level by using the Fisher LSD method**.**

During the study the data of predators were also recorded the minimum predator *Coccinella septempunctata* beetle population was observed on eucalyptus water extract (0.13±0.87) followed by tobacco (0.16±0.48), garlic (0.16±0.78) and neem seed (0.23±0.26), while a maximum *C. septempunctata* were observed on control groups (0.44±0.89). Statistically no significant difference were observed at p>0.05 level between control and treatments. Similarly in second spray minimum *C. septempunctata* populations were observed on garlic water extract followed by tobacco, neem seed and eucalyptus, whereas a maximum *C. septempunctata* were found on control groups. Statistically no significant difference were observed between p>0.05 control and treatments (Figure 4).

Data shown in figure 5 that the other predator *Brumoides suturalis* was also found in the field and minimum *B. suturalis* population was observed on garlic water extract (0.23±0.78) followed by eucalyptus (0.23±0.87), garlic (0.26±0.26) and tobacco (0.26±0.48), while a maximum *B. suturalis* were observed on control groups (0.34±0.89). Statistically no significant p>0.05 difference were observed between control group and among all given treatments.

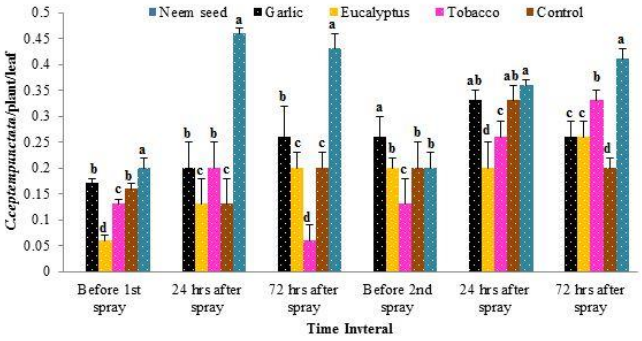

Figure 4. Effect of different plant extracts against *C. septempunctata* beetle on brinjal crop. In the figure mean values that do not share a letter are significantly different at P<0.05 level by using the Fisher LSD method.

Similarly after second spray a minimum *B. suturalis* were noticed on garlic water extract (0.26±0.17) followed by eucalyptus (0.26±1.02) neem seed (0.29±0.65) and tobacco (0.26±0.83), whereas a maximum *B. suturalis* found on control treatment (0.44±0.24). Statistically no significant difference p>0.05 were observed between control and treatments (Figure 5).

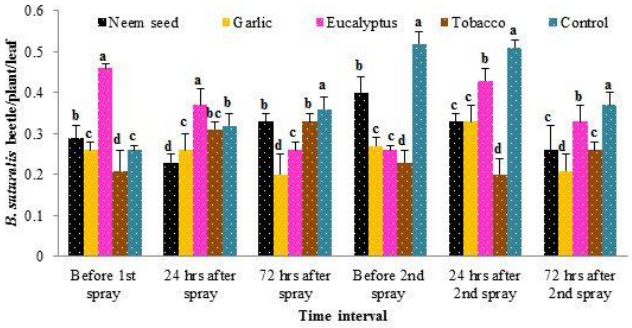

Figure 5. Effect of different plant extracts against *B. suturalis* on brinjal crop. In the figure mean values that do not share a letter are significantly different at P<0.05 level by using the Fisher LSD method.

Data regarding brijal fruit borer showed that the minimum mean fruit damaging (0.34%) damaged fruits/plant were observed on neem seed water extract followed by garlic (0.37%) tobacco (0.49%) and eucalyptus (0.51%) while highest fruit damaged % were observed on control treatment (1.26). All the treatments were found statically different at p< 0.05 with in treatment and with control treatment (Figure 6).

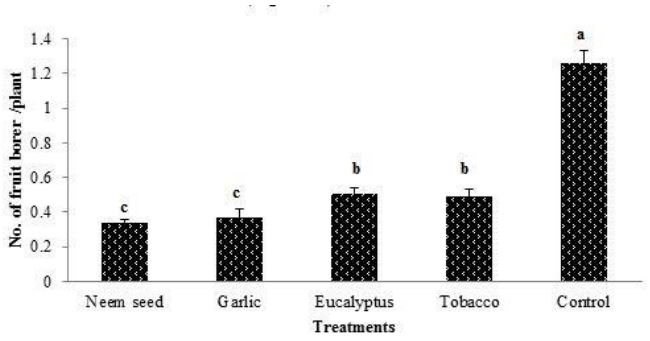

Figure 6. Effect of different plant extracts on brinjal fruit borer. In the figure mean values that do not share a letter are significantly different at P<0.05 level by using the Fisher LSD method.

DISCUSSION

Plant having antifeedant properties are very effective to suppress the insect pest population either having sucking and chewing type of mouth parts. In our study we applied different plant extracts and observed that eucalyptus leaf extract followed by need seed extract were more lethal to targeted insects and significantly reduced the pest population of jassid, white fly and aphid as compared with other, plant extracts likewise tobacco and garlic. We also observed no adverse effect on predatory insects (Figure 1-5). The outcomes of the present research were agree with the findings of several previous scientific studies likewise Khan *et al.* (2013) found remarkable reduction in sucking insect population of like jassid, whitefly and aphid when they applied plant extract against sucking insects. The results of Fiaz *et al.* (2012) also conformed antifeedant response of plant extracts when compared the repellency of different formulations of plant extracts like *Momordica charantia* L., *Azadirachta indica*, *Melia azadarach*, and Lemon oil and revealed that lemon oil followed by neem oil was found most repellent and reduced maximum number of thrips and jassid on cotton crop. Similarly Ambekar *et al.* (2015) found neem leaf extract the most effective against okra fruit borer and caused maximum repellency and reduced fecundity. Whereas, Abdul *et al.* (2014) observed bioassay of neem oil with the combination of chemical pesticide on *Helicoverpa armigera* they found that neem oil significantly reduced the population of *H. armigera* in the laboratory condition. Satti *et al.* (2013) also described the similar results and reported that the neem seeds on store products and found significant mortality of sorghum insect pests. All the stored extracts showed significant effects observed for 7th days and compared with control.

We noticed that among plant extracts the tobacco extract significantly reduced the pest population (Figure 1-5). Similar findings were also observed in the previous research by Hussain *et al.* (2017) reported that tobacco extract showed a good control when applied against whitefly and jassid in the field condition. The results of Ts and Dwivedi (2021) revealed that tobacco extract managed the pest population and also enhanced the yield of the brinjal. The results of present studies were also supported by Pulvers *et al.* (2021) who observed *R. communis* response and recorded maximum larval mortality. In another study it is reported that a compound present in castor bean seed that have anti- tryptic activity in *Spodoptera frugiperda* (Keerio *et al.*, 2017). Tobacco has different mode of action like nerve poison, stomach poison or repellent. According to the findings of (Sarkar *et al.*, 2016) who noticed highest larval mortality of *G. molesta* caused by *N. tabacum* but *N. tabacum* and *A. sativum* extracts found efficient management of *G. molesta* of males and females.

Our results inline of Javed *et al.* (2021) who observed tobacco extract to be helpful for jassid, whitefly, thrips, psyllids, beetles and lepidopterans. We also agree with Kodjo *et al.* (2011) who documented that *N. tabacum* extract reduced 93.0% of *Plutella xylostella* population in a cabbage.

We observed plant extracts showed good control against insect pest while no adverse effect was observed on predators of brinjal crop. We also found the more number of predators on control treatment that was because of highest pest population. Our study agree with Kunbhar *et al.* (2018) who evaluated the toxicity of botanical insecticides against pest and their predators on brinjal crop and reported that plant extracts

significantly reduced pest population while not effect was observed on predators .

From the field experiment it was concluded that all tested plant extracts were significantly reduced the sucking and chewing pest population. Furthermore, we observed that among tested plant extracts neem seed, garlic extract were found more lethal to aphid, jassid, and white fly as compared with tobacco and eucalyptus leaf extract. Whereas, neem seed and garlic extract significantly reduced fruit borer damage as compared to tobacco and eucalyptus. However, no significant adverse effect was observed on natural enemies compared with control groups but it was observed that predator population was migrating to control treatment because of high pest (pray) population.

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