Original Research Article

Bio-efficacy of different botanical extracts on*Aphis craccivora*in Black gram

Abstract

The studies on “Bio-efficacy of botanical extracts against *Aphis craccivora* in black gram was carried out in the Department of Entomology, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu.The black gramaphid, *Aphis craccivora* Koch.(Hemiptera: Aphididae), is one of the major devastatingand cosmopolitan-sucking pests in Blackgram. Bio-efficacy of *Azadirachta indica* leaf extract 5 % and 10 %, *Pongamia pinnata* leaf extract 5 % and 10 %, *Annona squamosa* leaf extract 5 % and 10 %, *Andrographis panniculata* leaf extract 5 % and 10 % and *Catharanthus roseus* leaf extract 5 % and 10 % was evaluated on 3rd instars nymphs of Aphis craccivora by on topical bioassay andfeeding bioassay. In which *Catharanthus roseus* leaf extracts of 5 % and 10 % has shown the highest mortality rate.

Keywords: *aphids, blackgram,botanicals, contaminated food bioassay, periwinkle, topical bioassay*

1. INTRODUCTION

Aphis craccivora Koch (Hemiptera: Aphididae),is a widespread pest that infests various host plants, with a particular preference for the Fabaceae family, of all the insect pests affecting legume crops, A. *craccivora*stands out as the most destructive and globally distributed pest (Madahi et al. 2013). Both the nymphs and adults of the aphids feed on the sap from plant cells, leading to leaf distortion and stunted growth, ultimately resulting in the production of poor-quality pods. Furthermore, they secrete substantial amounts of honeydew, which encourages the growth of sooty mold and disrupts the plant's photosynthetic capabilities. Additionally, the bean aphid serves as a vector for various non-persistent viruses, contributing to the spread of diseases among multiple crops (Mohapatra et al. 2021).

Aphids are highly prolific breeders and insecticides are often applied randomly to achieve quick control. However, the use of chemical protection methods comes with numerous significant drawbacks. Their extensive and indiscriminate application leads to ecological imbalances, the development of pest resistance, pest resurgence, outbreaks of secondary pests, as well as phytotoxicity. It also results in residues in foods and feeds and can harm beneficial organisms within the ecosystem. Consequently, researchers and scientists worldwide are actively exploring alternative approaches to safeguard crops from insect pests. One promising avenue involves the utilization of natural products as an effective means of pest control (Yasmin et al. 2017). Many natural botanicals have been considered research interest because of the fewer hazards to non-target organisms, less environmental residue, the inability of pests to develop resistance, no adverse effect on plant growth, seed viability, and cooking quality of grains and it is less expensive, and easily available because of their natural occurrence (Prakash et al. 2008).

The primary objective of this study was to assess the efficacy of various botanical extracts against third-instar nymphs and adults of A. *craccivora* in a controlled laboratory environment. This investigation aimed togather data regarding the direct mortality of insect pests. The findings may pave the way for safer alternatives to chemical pesticides, thus reducing the ecological impact of agricultural practices.

2. MATERIALS AND METHODS

The experiments were carried out to evaluate the bio-efficacy of various botanical extracts at the Department of Entomology, Faculty of agriculture, Annamalai University, Chidambaram during Dec 2020 – April 2021.

2.1. Collection and rearing of test insect

The black gram aphid (A. *craccivora*) was mass cultured on blackgram seedlings raised on the plastic cups in a screen house. Aphids was collected from the infested blackgram plants in the campus of Annamalai University (Department of Entomology) were released on the blackgram seedlings in the screen house and were allowed to multiply. Once the blackgram seedlings became stunted andtheir leaves dried due to aphids feeding, the aphids were transferred to new seedlings. To maintain the aphid culture, black gram seedlings were raised at weekly intervals in the screenhouse. Aphids maintained in the screenhouse were used for various stuides. The rearing technique followed the method described by(Jaba et al. 2010). All the studies were conducted during 2020- 21 at the Department of Entomology, Faculty of agriculture, Annamalai University, Chidambaram.

2.2. Collection, Processing, and Preparation of test plant solution

Leaf extracts of *Catharanthus roseus* (Periwinkle), *Pongamia pinnata* (Pongam), *Azadirachtaindica* (Neem), *Annona squamosa* (Custard apple) and *Andrographis paniculata*(Siriyanangai) were prepared using the following method.

Fresh leaves were collected from mature plants in and around Annamalai Nagar. The leaves were washed thoroughly under tap water and dried in shade, after drying, the leaves were cut into small pieces and macerated. The macerated plant material was filtered using muslin cloth to obtain crude extract. To prepare the extracts, for a 5 % extract, 5 ml of leaf extract was mixed with 95 ml of distilled water and for a 10 % extract, 10 ml of leaf extract was mixed with 90 ml of distilled water.

2.3. Laboratory bioassay of botanical against black gram aphids

The biocidal efficacy of the prepared botanical extracts against *A. craccivora* was evaluated using two techniques: topical bioassay and feeding bioassay (contaminated food technique - no-choice test).

2.3.1. Topical Bioassay:

Third-instar nymphs of *A. craccivora* were topically sprayed with 2 mL/replication of 5% and 10% extract concentrations using a sprayer. After 30 minutes, 5-10 nymphs were released onto separate untreated host plants using a soft camel hair brush. Mortality of all life stages (until adult emergence) was monitored for 24, 48, and 72 hours. Percent mortality was then calculated.

2.3.2. Contaminated food bioassay:

Black gram seedlings were sown in cups for each treatment (10 treatments with 3 replicates each). Five pre-starved (3 hours) third-instar nymphs were released onto leaves treated with the extracts in petri dishes under laboratory conditions. Nymph establishment on treated leaves and mortality (including malformations) were observed at 24, 48, and 72 hours.

2.4. Stastical analysis

The data recorded in the experiments were subjected to analysis of variance (ANOVA) under randomized block design (RBD) by adopting the procedures described by Gomez (1984). Necessary data transformation was made before analysis and OPSTAT was used for the calculation.

3. Results and Discussion

3.1. Nymphal mortality of *A. craccivora* on Topical Bioassay technique

Five plant extracts (Neem, Periwinkle, Andrographis, Annona, and Pungam) were tested at two concentrations (5% and 10%) against *A. craccivora* nymphs. The effects were evaluated at 24, 48, and 72 hours after treatment.

At 24 hours, Periwinkle extract at 10% concentration caused the highest nymphal mortality (45.55%), followed by Periwinkle extract at 5% (41.36%). The lowest mortality (19.77%) was observed in Pungam extract at 5% concentration. There was no mortality in the untreated control group.

At 48 hours, Periwinkle extract at 10% concentration again showed the highest nymphal mortality (62.45%), followed by Periwinkle extract at 5% (59.87%). The lowest mortality (39.67%) was still observed in Pungam extract at 5% concentration. The untreated control group remained unaffected.

Finally, at 72 hours, Periwinkle extract at 10% concentration caused the maximum nymphal mortality (85.54%), followed by Periwinkle extract at 5% (82.23%). Pungam extract at 5% concentration showed the least effectiveness (61.96%). As before, there was no mortality in the untreated control group (Fig.1).

3.2. Nymphal mortality of *A. craccivora* on contaminated food bioassay technique

Periwinkle leaf extract proved to be the most effective botanical against *A. craccivora* nymphs in the contaminated food bioassay.

At 24 hours after treatment, Periwinkle extract at 10% concentration caused the highest nymphal mortality (52.56%), followed by Periwinkle extract at 5% (50.23%). The least mortality (28.26%) was observed in Pungam extract at 5% concentration. There was no mortality in the untreated control group.

This trend continued at 48 hours. Periwinkle extract at 10% concentration again showed the highest nymphal mortality (65.49%), followed by Periwinkle extract at 5% (62.56%). The

lowest mortality (40.18%) was still observed in Pungam extract at 5% concentration. The untreated control group remained unaffected.

Finally, at 72 hours, Periwinkle extract at 10% concentration caused the maximum nymphal mortality (84.34%), followed by Periwinkle extract at 5% (82.19%). Pungam extract at 5% concentration showed the least effectiveness (62.34%). As before, there was no mortality in the untreated control group (Fig. 2).

Our finding was supported by Ramya, 2008 reported that the *H. armigera*was controlled by the extracts of *C. roseus* leaf extract.

This is in consistent with the report of (Dutra et al. 2020) who found that the *Allium tuberosum* leaf, *Caesalpinia ferrea* leaf, *Piper aduncum* leaf, *Carica papaya*seed, *Dieffenbachia picta* leaf, *Cucurbita moschata* seed, and *Annona squamosa*seed had the maximum efficacy (50%) against *A. craccivora* nymphs, among these highest mortality rate was recorded from the extracts of *Dieffenbachia picta* leaf and Cucurbita moschata seed.

Our findings are consistent with those of (Das et al.2008)who found that neem seed kernel extract (97.50%) and neem leaf extract 10% (61.88%) hadshown the highest number of nymphal deaths.

This was partially in line with the findings of(Prabal et al. 2000), who discovered that the hot water extract of *Polygonum hydropiper* (94.5 percent -nymphal mortality rate) was more effective than *A. indica* (80.47–80.96 percent -nymphal mortality rate).Other hot and cold extracts also appeared to be more useful as pesticides for *A. craccivora*.

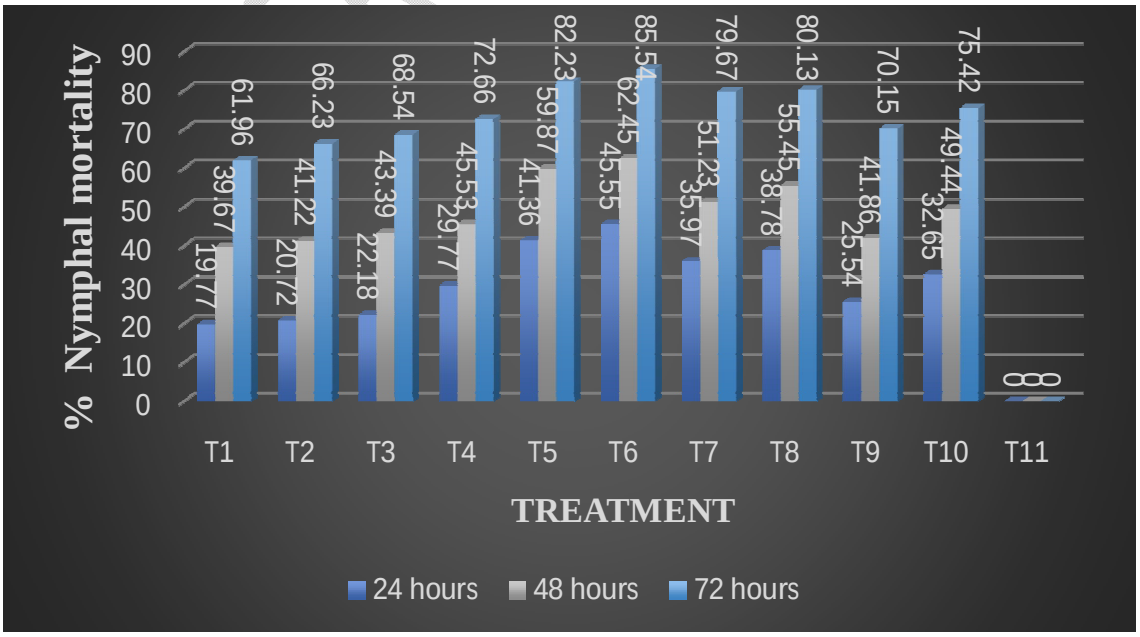

Fig.1. Mortality rate of *A. craccivora* nymphs(Topical Bioassay)

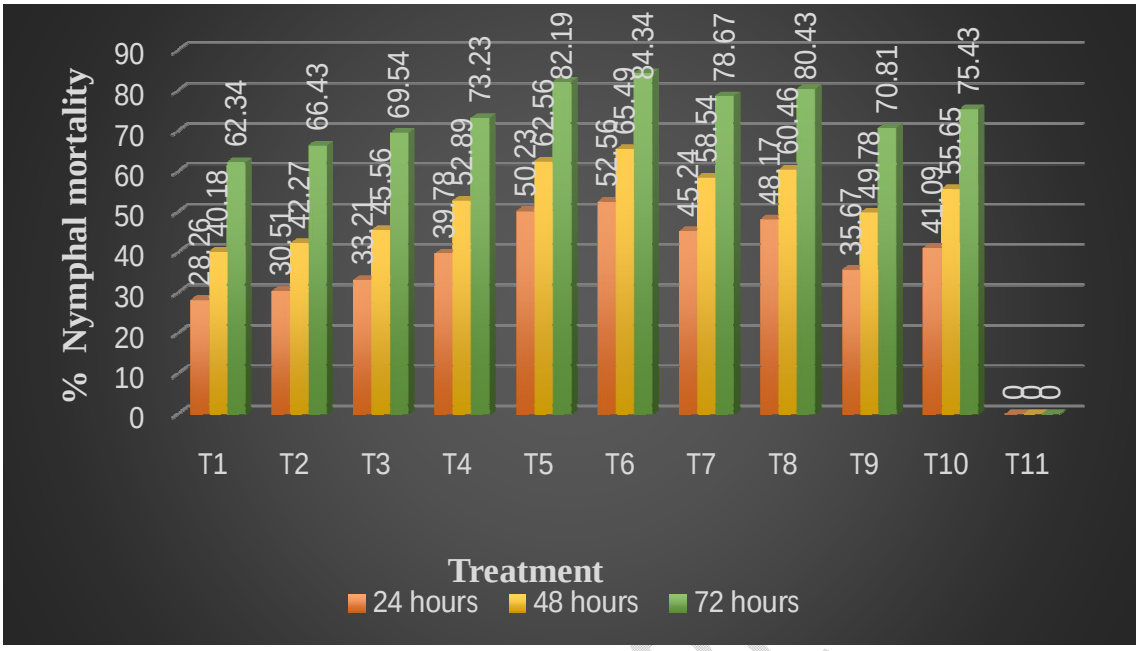

Fig.2. Mortality rate of *A. craccivora* nymphs(Contaminated food bioassay technique)

T1 - Pungam leaf extract 5%, T2 – Pungam leaf extract 10%, T3 – Annona leaf extract 5% , T4 – Annona leaf extract 10%, T5 – Periwinkle leaf extract 5%, T6 – Periwinkle leaf extract 10%, T7 – *Andrographis* leaf extract 5%, T8 – *Andrographis* leaf extract 10%, T9 – Neem leaf extract 5%, T10 - Neem leaf extract 10% and T11 – Control (Untreated

4. CONCLUSION

Among the five botanical extracts periwinkle leaf extract has shown the highest mortality rate in both topical bioassay and contaminated food bioassay techniques at every 24, 48 and 72 hrs. These finding suggest that periwinkle leaf extract has promising potential as a botanical insecticide for controlling *A. craccivora*nymphs. Further investigations are needed to ecplore the specific bioactive compounds responsible for periwinkle's leaf extract's insecticidal properties and to optimize its application for field use.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that No generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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