Effect of *Capsicum frutescens L.* (Solanaceae) Aqueous Pod Extract against *Aphis craccivora* (Homoptera: Aphididae)

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Abstract
The present study highlights the effects of aqueous pod extract of *Capsicum frutescens* ("Kochchi") as a soil drench and foliar spray on host location, survival and reproduction of *Aphis craccivora* infesting Yard-long bean plants. The findings showed that the extract negatively affected the survival and reproduction of females via the systemic activity when applied as a soil drench. Maximum reduction in survival and nymphal production were 50% and 86%, respectively. Moreover, foliar application of the extract served as the repellent against host location and oviposition deterrent of *A. craccivora*. The findings indicated that extract of *Capsicum frutescens* ("Kochchi could be used as an alternative candidate for synthetic chemicals for the management of *A. craccivora* in Integrated Pest Management systems.

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Introduction

Aphids (Homoptera: Aphididae) are reported to be destructive pests on various crops. Adults and nymphs directly damage plants by feeding on phloem sap using their piercing and sucking mouthparts. Excessive sap removal during feeding causes yellowing, and injection of toxic saliva leads to stunting and killing of infested plants (Emden and Harrington, 2006). Apart from that they indirectly do damage via transmission of viral diseases and excretion of honeydew (Mills 1989; Neeraj *et al.*1999). Previous reports indicated that *Aphis crassivora* is one of the most serious pests in Asia, Africa and Latin America (Singh and van Emden, 1979; Jackai and Daoust, 1986) on cowpea and related food legumes. In Sri Lanka too, it has been reported on leguminous plants particularly on cowpea (Edirisinghe, 1994) and acts as a vector of viral diseases (Stamm *et al.*, 2013). Often growers rely on synthetic insecticides for aphid control. However, excessive and repeated application of such insecticides, together with short generation times, high growth and reproductive potential of aphids cause quick development of resistance often fail control efforts (Georghiou, 1990). In addition, these insecticides create harmful effects on human health and the environment (Bailey *et al.*, 2010). Therefore, it is of crucial importance to find eco-friendly and safe control measures. Plant-derived chemicals serve as alternatives to synthetic chemicals with little or no harm to humans as well as to the environment. Thus, the objectives of this study were to determine the effectiveness of aqueous pod extract of *Capsicum frutescens* L. ("Kochchi") (Solanaceae) as a soil drench and foliar application on survival and reproduction of *A. craccivora* on the host location by *A. craccivora* infesting Yard-long beans, *Vigna unguiculata sesquipedalis*.

Methodology

Aphis craccivora was cultured on potted Yard-long beans (cv. "PolonMae") in screen cages. Mature fresh pods of *C. frutescens* were washed with tap water and macerated in SDW [i.e., at a ratio of 1:2 (w/v)] in a kitchen blender. The macerated suspension was left at the ambient temperature for 24 h. After 24 h, the suspension was stirred well and centrifuged at 3,000 rpm for 30 minutes. The supernatant was separated as a clear solution and used for the experiments.

In the first experiment, three-week old Yard-long bean seedlings (seedlings were grown in plastic modular trays) were transplanted in plastic pots (5cm diameter) containing steam-sterilized compost mixture. After seven days, 25ml of the extract was applied to the soil around the stem and repeated two days later. Untreated controls received only distilled water. One day after the second application, 20, freshly emerged females were placed on the plants. Treated and untreated pots were replicated five times and arranged as a circle in an alternating manner in a screen cage. At 24, 48 and 72h after placing aphids, number of surviving and dead females and nymphs on plants were recorded.

In the second experiment, three week-old Yard-long bean plants grown in plastic pots (13.2 cm diameter) were sprayed with the extract until run-off and allowed to dry for 30 minutes. Control plants were treated with distilled water alone. Five replications were used for the treatment and control and were arranged as in the first experiment in a screen cage. At the

middle of the circle, 30 freshly emerged adults were placed in a Petri dish. After 24 hours, number of females and nymphs found on plants was recorded.

Percentage mortalities of the females, number of nymphs and females between the treatment and control were compared using Student t test. One-way ANOVA was performed to compare the differences in mortalities and nymphal counts among the three time periods. Mean separation was done using Tukey's test. SAS statistical package was used for analysis at the 0.05 significant level.

Results and Discussion

When the *C. frutescens* extract applied as a soil drench, significantly higher ($P<0.0001$) percentage cumulative mortality (PCM) of adult females was detected on treated plants compared to untreated controls (control mortality = zero) while number of nymphs recorded on treated plants were significantly lower ($P<0.0001$) in comparison to controls, at 24, 48 and 72h (Figures 1a and 1b). In addition, significant differences in PCM ($P<0.0001$) were detected among the three time periods (Figure 1a). The highest PCM was recorded as 50.00 (±4.47) which was significantly higher compared to 24 and 48h. No significant difference in PCM was detected between 24 and 48h. At 72h, the highest percentage reduction of the nymphal count (86%) was recorded compared to the control. Moreover, nymphal counts differed significantly ($P<0.0001$) among the three time periods. At 24h, significantly lower nymphal count was recorded than the 48 and 24h whereas nymphs produced by females at 48 and 72 were not significantly different.

After 24h of spraying, only 51% (±0.82) of the adult females released to screen cage located the Yard-long bean plants. Of these, significantly higher ($P<0.0001$) percentage of females, i.e., 88.13% (±1.38) was found on non-sprayed plants while the rest, i.e., 11.75% (±1.38) located the treated plants. Similarly, significantly higher number ($P<0.0001$) of nymphs was recorded on control plants than the treated plants.

The findings showed that the aqueous pod extract of *C. frutescens* applied as a soil drench affected the survival and reproduction of female *A. craccivora* indicating its systemic activity. Systemic toxicity of the extract could mainly affect the feeding of the aphids which in turn influenced the survival and reproduction. The highest PCM of female aphids recorded at 72h confirmed the toxic effect lasted 72 h post-

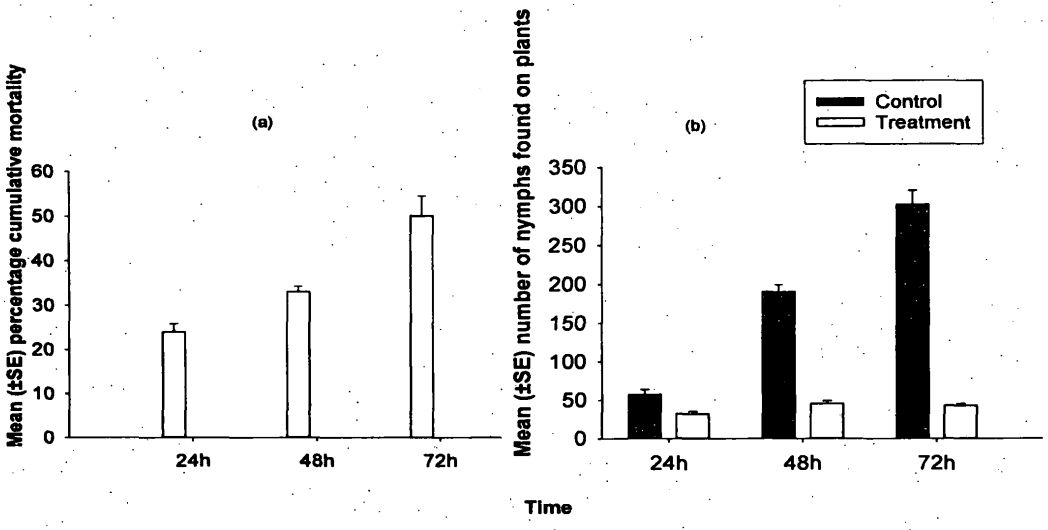

Figure 1: Mean (±SE) percentage cumulative mortality of adult females (a) and nymphal production (b) of Aphis crassivora on Yard-long bean plants which were treated with aqueous pod extract of *Capsicum frutescensas* a soil drench. The data on adult mortality and nymphal counts were recorded at 24, 48 and 72 hours after the second application of the extract.

application. In addition, foliar application of the extract served as a repellent which not only lowered the attraction of female aphids to the host plants but also affected the nymphal production of females which colonized the plants. Our previous investigations revealed that the aqueous pod extract of the *C. frutescens* showed direct contact toxicity against the survival of fameless and nymphs as well the reproduction of females of *A. craccivora* (Thakshila et al. 2017). In addition, it has been reported that fruit powder dust of *C. frutescens* was toxic to *Callosobruchus maculatus* in stored cowpea and *Sitophilus zeamais* in maize (Oni, 2011). The effectiveness of the extract could be resulted from the "pepperich" nature and pungency of the species due to the presence of capsacin (Ivbijaro and Agbaje, 1986). These findings showed that there is a potency of using pods of *C. frutescens* in controlling *A. craccivora. Capsicum frutescens* is a plant which can easily be grown even in backyard gardens. Moreover, growers can prepare the aqueous extract at home and apply whenever required. Thus, from the practical point of view it could serve as a good alternative for synthetic insecticides. Further studies are underway to identify the persistence of the extract and efficacy under field conditions.

References

Ivbijaro MF and Agbaje M 1986 Insecticidal activities of *Piper guineense* Schum and Thonn and *Capsicum species* on the cowpea bruchid, *Callosobruchus maculatus* F. Insect Sci. Appl.7: 521- 524.

Jackai LEN and Daoust RA 1986 Insect pests of Cowpeas. Annu. Rev. Entomol. 31: 95 – 119.

Oni MO 2011 Evaluation of Seed and Fruit Powders of *Capsicum annum* and *Capsicum frutescens* for Control of *Callosobruchus maculatus* in stored Cowpea and *Sitophilus zeamais* in Stored Maize. Int. J. Biol. 3: 185-188.

Singh SR and van Emden HF 1979 Insect pests of grain legumes. Annu. Rev. Entomol. 4: 255-278.

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