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Short Communication

Evaluation of Comparative Toxicity of Different Insecticides against Fruit Fly, *Bactrocera zonata* Saunders (Diptera: Tephritidae)

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ABSTRACT

Bacterocera zonata (Saunder) (Diptera: Tephritidae) is a major pest of fruits causing severe losses to the fruit production and quality in Pakistan. Its management has largely relied upon the indiscriminate and injudicious use of conventional insecticides resulting in problem of insecticide resistance, environmental pollution, fruit contamination and health hazards. The major goal of the present study was to evaluate the effectiveness of a bio-insecticide, emamectin benzoate with other conventionally used insecticides against *B. zonata*. The results revealed the high toxicity of emamectin benzoate with LC_{50} value of 38.25 followed by trichlorfon, λ-cyhalothrin and imidacloprid with LC_{50} values of 44.21, 58.98 and 187.81 ppm, after 24 h post treatment, respectively. Based on our experimental results it is concluded that emamectin benzoate is an effective and environmentally safe alternative to the other conventional insecticides used for the management of *B. zonata*.

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Authors' Contributions
RAK conceived and designed the study, performed analysis and wrote the article. MN performed experimental work and helped in data collection.e

Key words
Bactrocera zonata, Conventional insecticides, Emamectin benzoate, Environmentally safe insecticide, LC_{50}.

The fruit flies belonging to the family, Tephritidae which are known as the major pests of soft, fleshy fruits and remains the most significant order of dipterous pests of polyphagous nature (Robison and Hooper, 1989). Among the fruit fly, the peach fruit fly, *Bactrocera zonata* (Saunders) is the most abundant and severe pest infesting fruit orchards throughout the world (Anthony *et al*., 2005). This species attack fruit species such as mango, peach, guava, citrus, apricot, apple and fig. Besides fruits, it infests some vegetables such as pepper, tomato and eggplants as alternate hosts (El-Gendy, 2012; Ghanim, 2009; Hashem *et al*., 2004; El-Minshawy *et al*., 1999; White and Elson-Harris, 1992; Liquido *et al*., 1990; Kapoor and Agarwal, 1982).

The genus *Bactrocera* poses a serious risk to the horticultural crops owing to the wide range of hosts and invasiveness nature of the genus (Clarke *et al*., 2005). According to an estimate, losses recorded in fruits without management have been 21% in Pakistan (Stonehouse *et al*., 1997). Among the fruits infested by fruit flies in Pakistan are apple, ber, guava, mango, musk melon and bitter gourd (Khan and Musakhel, 1999; Sultan *et al*., 2000; Khan *et al*., 2005). Two well-known species of fruit flies in different parts of Pakistan include peach fruit fly, *B. zonata* (Saunders) and cucurbit fruit fly *B. cucurbitae* (Coquillett). In Pakistan, incidence and abundance of *B. zonata* has been recorded in areas of Baluchistan and Sindh near the coastal and sub-coastal, as well as semi-arid areas and plains of the northern Punjab. Its presence has been observed as an occasional pest in Peshawar valley and from the foothills of Islamabad (Marwat *et al*., 1992). A variety of insecticides like dipterex, triazophos, imidacloprid, and neem products are generally used to control the fruit flies.

The present study evaluated the toxicity of emamectin benzoate and compared it with other conventional insecticides used against *B. zonata.*

Materials and methods

Adults of *B. zonata* used in this study were isolated from the field infested fruits collected from orchards in Faisalabad, and then maintained in the rearing laboratory. The emerged larvae from the fruits were provided moist sand for pupation. These pupae were then isolated by wire mesh and placed in the Perspex cages for adult emergence.

Bioassays were performed under standard laboratory environment of 25± 5 ºC, 45±5% RH, 14:10 L photoperiod. The insecticides tested in this study were, Proclaim® 19 EC (emamectin benzoate), Diptrex® 800 SP (trichlorfon), Karate® 2.5 EC (λ-Cyhalothrin) and Confidor® 200 SL (imidacloprid). Distilled water was used as a control. Stock solutions of 500 ppm of all the insecticides were freshly prepared in distilled water and serially diluted four times to get the final concentration of 250, 125, 62.5 and 31.25 ppm, respectively (Table I).

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Table I.- Details of insecticides used in the experiment for their comparative toxicities.

Active ingredient	Trade name	Formulation	Manufacturer	Dose range (ppm)
Emamectin benzoate	Proclaim®	19 EC	Syngenta	31.25-500
Trichlorfon	Diptrex®	800 SP	Bayer	31.25-500
λ-Cyhalothrin	Karate®	2.5 EC	Syngenta	31.25-500
Imidacloprid	Confidor®	200 SL	Bayer	31.25-500

Table II.- LC_{50} values of different insecticides on adult *B. zonata* after 24 h post-treatment.

Treatments	LC_{50} (Fiducial Limits)	LC_{90}	Slope±SE	χ^2	TR*
Emamectin benzoate	38.25 (27.15-53.56)	238.74	1.61±0.24	0.99	4.91
Trichlorfon	44.21 (33.9-57.41)	297.57	1.54±0.23	0.65	4.25
λ-Cyhalothrin	58.98 (54.17-64.19)	511.40	1.36±0.21	7.21	3.19
Imidacloprid	187.81 (124.65-283.89)	1044.72	1.71±0.22	3.31	1.00

*Toxicity Ratio.

All the serially diluted solutions were applied to the 25 ml capacity transparent glass vials using a cotton swab and allowed to dry for 30 min. The experiments were replicated three times, each time using 10 adults per treatment. Residual contact toxicity was recorded after 24 h as percentage mortality.

All the bioassay data were subjected to probit analysis (Finney, 1971) using PoloPlus probit analysis software. Probit mortality graphs were prepared in MS-Excel 2007.

Results and discussion

The contact residual toxicity of the insecticides showed varying degrees of toxicities. Table II shows LC_{50}, LC_{90} and toxicity ratios of different insecticides against *B. zonata* adults. The gradation of toxicity of insecticides against adult *B. zonata* is Emamectin benzoate > Trichlorfon > λ- Cyhalothrin > Imidacloprid.

Emamectin benzoate proved to be the most effective among the insecticides used. It is an abamectin semisynthetic derivative, developed for the control of lepidopterous pests on vegetables worldwide (Jansson and Dybas, 1997; Babu, 1988). It raises the level of release of the neurotransmitter, γ-aminobutyric acid (Jansson and Dybas, 1997), which irreversibly paralysed the target invertebrates and causes death. Moreover, it displays the translaminar activity which is a characteristic of systemic insecticides. Emmamectin applied leaves retain a pool of active ingredient, consequently pest control achieved as a result of feeding by the larvae (Ishaaya *et al*., 2002). Degradation of emamectin benzoate on the surface of plant is quite fast (López *et al*., 2011) resulting in the minimum exposure to beneficial agents (Ishaaya *et al*., 2002).

In an earlier experiment, a bio-insecticide proclaim was found effective against *B. zonata* in a very low concentration (Fetoh *et al*., 2009). Our experimental results are in line with their results.

Tricholofon and λ-cyhalothrin are comparatively effective, which raises questions of development of insecticide resistance against populations of *B. zonata*. In an earlier experiment, high level of trichlorofon resistance and moderate level of λ-cyhalothrin resistance has been documented. The level of resistance in their experiment remained at 1.00 to 41.82 fold for trichlorfon and 1.07 to 18.24 fold for λ-cyhalothrin, respectively (Nadeem *et al*., 2012).

Imidacloprid proved to be the least effective in our experiment among the insecticides used. It may be due to its systemic mode of action and low residual toxicity. In the literature, there are conflicting reports of imidacloprid effectiveness. In one report imidacloprid was found to have LC_{50} value of 211 ppm with low level of resistance (Haider *et al*., 2011), whereas other reports suggest satisfactory results (Yee and Alston, 2006) with the use of imidacloprid.

Conclusion

Our present findings suggest that emamectin benzoate is comparatively a safe alternative to the insecticides in use for the control of *B. zonata*. Its use may also encourage beneficial organisms for being less toxic.

Conflict of interest statement

We declare that we have no conflict of interest.

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