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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 11 (10): 1380-1384, 2008
ISSN 1028-8880

The Potential of Using Insecticidal Properties of Medicinal Plants Against Insect Pests

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Abstract: In this study, botanicals extracted from two the species of family Scrophulariaceae, *Verbascum cheiranthifolium* Boiss and *Verbascum speciosum* Schard, were examined for their effect on mortality and progeny production against adults of *Sitophilus oryzae* (L.). The plant extracts were applied at five dose rates, which 0.25, 0.5, 1.0, 2.0 and 3% (w/v). Adults of *S. oryzae* was exposed to the treated wheat at 25°C and 65% RH and mortality was assessed after 24 h, 48 h, 7 day, 14 day and 21 day of exposure. Then all adults were removed and the treated substrate remained at the same conditions for an additional 45 day after this interval, the commodity was checked for progeny production. In use two extracts the mortality of adults increased with the increase of dose and exposure interval so that; mortality was 100% after 21 days of exposure at the highest dose rate. Results indicated that applied of *V. cheiranthifolium* extract was more effective than *V. speciosum* against adult insects. Interestingly, in two cases complete suppression (100% reduction) of the progeny production (F1) was observed in the treated wheat than in control even in the lowest dose rate. Therefore, our results indicate that these medicinal plants can be used for protection of stored grain from infestations of stored-product insect pests.

Key words: Medicinal plants, progeny production, mortality, *Sitophilus oryzae*

INTRODUCTION

Higher plants are a rich source of novel natural substances that can be used to develop environmental safe methods for insect control (Jbilou *et al*., 2006).

The use of widely adopted method for grain protection against stored-grain pests. However, the extensive use of these substances has led to the development of resistance from several species (Benhalima *et al*., 2004; Talukder, 2006). Resistance, combined with consumer demand for residue-free food, encourages the development of alternative, reduced risk methods for stored-grain protection. *Sitophilus oryzae* is considered as major pests of stored grain. Control of this insect relies heavily on the use of synthetic insecticides and fumigants. But their widespread use has led to some serious problems.

Different types of plant preparations such as powders, solvent extracts, essential oils and whole plants are being investigated for their insecticidal activity including their action as fumigants, repellents, anti-feedants, anti-ovipositions and insect growth regulators (Isman, 2000; Weaver and Subramanyam, 2000; Koul, 2004; Mordue, 2004; Erturk, 2004; Negahban and Moharramipour, 2007). Higher plants are a rich source of novel natural substances that can be used to develop environmental safe methods for insect control (Jbilou *et al*., 2006).

Considerable efforts have been focused on plant derived materials, potentially useful as commercial insecticides. Toxic effects of plant products on some pests have been studied by many researchers (Essien, 2004; Erturk *et al*., 2004; Koona and Dorn, 2005; Chapagain and Wiesman, 2005). Roy *et al*. (2005) established leaf extracts of *Shiyalmutra* (*Blumea lacera*) as botanical insecticides against lesser grain bore and rice weevil. Christos *et al*. (2005) showed that there is a significant different between Application of vary commodities and insecticidal effects of plants.

Verbascum cheiranthifolium Boiss and *Verbascum speciosum* Schard are locally used to kill fishes and used in treatment of various skin diseases in Iran. However,

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flowers of this plant have not been studied yet for insecticidal activity.

The aim of this study was to produce crude extract from two species for to determine insecticidal activity and effect on progeny production against *S. oryzae* on wheat as general commodity.

MATERIALS AND METHODS

Preparation of plant extract: Crude extract of botanical was used. *Verbascum cheiranthifolium* and *Verbascum speciosum* collected at flowering stage from Urmia, Iran, in July, 2006. The identification of these species was carried out according to flora of iranica (Rechinger, 1982). Flowers of two plants were separated and dried naturally on laboratory benches at room temperature (23-24°C) for 10 days. The plant materials were powdered using an electric grinder. One hundred grams of the dried powders extracted with 70% ethanol.

The extracts were concentrated using a rotary evaporator at a maximum temperature of 45°C and were then further dried in an oven at 40°C for 48 h and powdered again. The dried extracts were then dissolved in distilled water to prepare solutions of different concentrations (0.25, 0.5, 1, 2 and 3% w/v).

Test insect and commodity: Adults of *S. oryzae* were used in the test. The adults used were taken from a culture that was kept in the laboratory on whole wheat at 27±1°C, 65±5% RH and continuous darkness. All individuals used in the test 7-10 days old.

Untreated, clean winter wheat (variety Zarrin) that obtained from Agricultural Research Center of west Azerbaijan, Urmia, Iran, was used in the tests.

Bioassay: All tests were conducted at 25°C, 65% RH and continuous darkness. A fixed quantity (1 kg) of commodity was then sprayed with 100 mL of each solution, 0.25, 0.5, 1, 2 and 3% (w/v). Also, there was 1 kg of each grain which were sprayed with water alone and served as control. From each combination, four samples, of 50 g each, were taken. Each sample was placed in a small glass pots (7 cm diameter and 8.5 cm height). Twenty five *R. domonica* adults were introduced into each glass pots and then covered with nylon mesh secured with rubber bands. The pots were placed in incubators, at the conditions described above. Dead adults were counted 24 h, 48 h, 7, 14 and 21 days later. The same procedure was repeated four times. (Athanassiou *et al*., 2005).

Progeny production count: After the 21-day mortality count, all adults (dead and alive) were removed and the glass pots were left in the incubators at the same conditions for an additional period of 45 days. Then, the glass pots were opened and the emerged individuals were counted. All the emerged *S. oryzae* individuals were adults, because the larvae of this species develop inside the grain kernels.

Data analysis: Generally, control mortality was low and where it was considered necessary the mortality counts were corrected by using the formula of Abbott (1925). The data were arcsine transformed before analysis. The mortality counts were analyzed by using the GLM procedure (SAS, 1996), with insect mortality as the response variable and commodity, dose rate and exposure interval as main effects. The Percentage of reduction in progeny production was determined by the [(NO. Progeny in control-NO. Progeny in treatment)/NO. Progeny in control×100] formula (Aldryhim, 1995).

RESULTS AND DISCUSSION

All main effects as well as associated interactions were significant at the $p = 0.000$ level (*V. cheiranthifolim*: $F = 28.8$; $df = 4$ and *V. speciosum*: $F = 25.9$; $df = 4$).

Mortality of the exposed *S. oryzae* adults increased with the increase of the exposure interval and dose rate with use two botanicals (Fig. 1a-e). On wheat treated with *V. cheiranthifolim* extract mortality was 87.36% after 21 day of exposure at lowest dose rate (Fig. 1a). Similarity, in case of *V. speciosum* extract adult mortality did not exceed 81.52% after 21 days (Fig. 1a). Also, our results in other dose rates indicate that applied of *V. cheiranthifolium* extract was more effective than *V. speciosum* against adult insects (Fig. 1b-e). Interestingly, in two cases adult mortality was 100% after 21 days of exposure at 3% dose rate (Fig. 1e).

The application of these plant materials significantly reduced progeny production. With applications of two species no progeny was found in wheat treated (Table 1). Therefore, complete suppression of the progeny production was observed on the treated grains in comparison with the control, even in the lowest dose rate.

Table 1: The percentage of reduction in progeny production for *S. oryzae* on treated diet with *V. cheiranthifolim* and *V. speciosum* extracts 45 days after the removal of the parental adults

	Dose % (w/v)				
Commodity	0.25	0.5	1	2	3
V. cheiranthifolim	100	100	100	100	100
V. speciosum	100	100	100	100	100

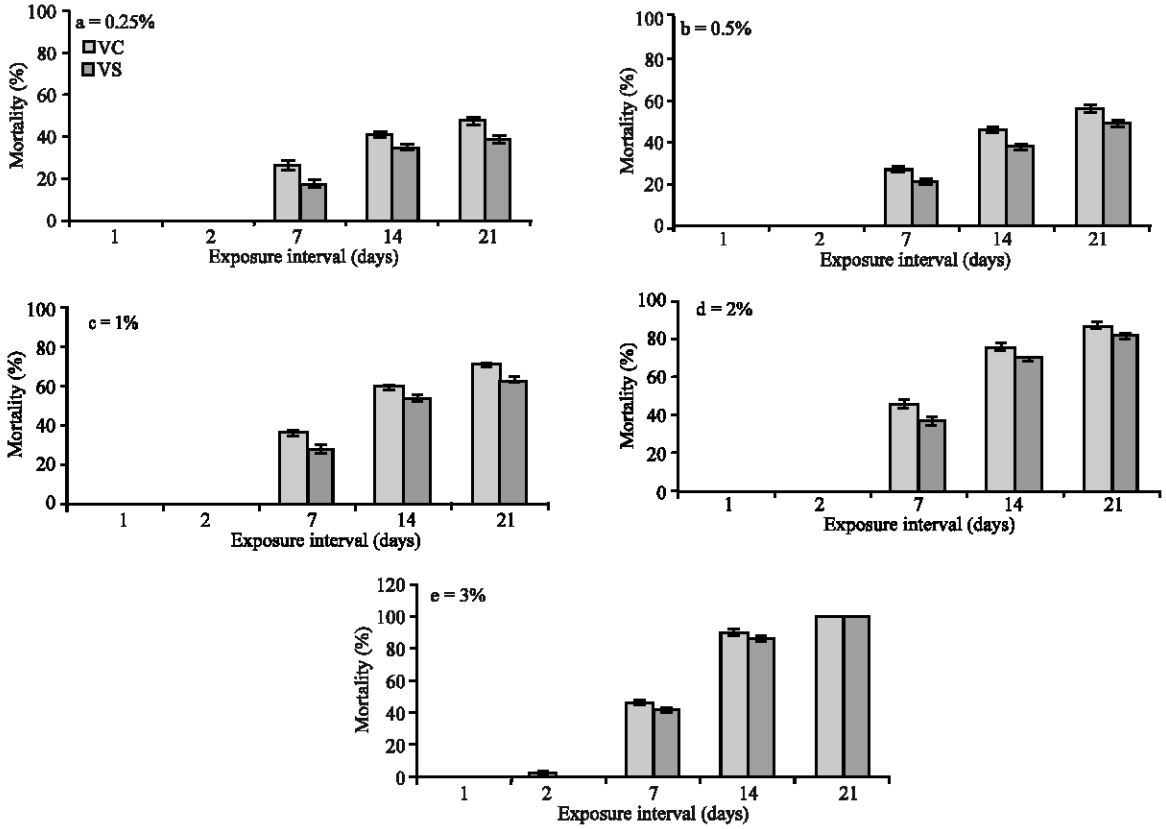

Fig. 1: Mean mortality (±SE) of *S. oryzae* adults exposed for 1, 2, 7, 14 and 21 days on wheat treated with 0.25, 0.5, 1, 2 and 3% (w/v) botanical extracts

Present results in this study show that these botanical extracts is effective against *S. oryzae* on wheat, but its effectiveness is highly determined by the characteristics of the plant, dose rate and the exposure interval. One of the most interesting findings of the current study is the dissimilar efficacy of botanical material among plant species so that; *V. cheiranthifolim* extract was much more effective against *S. oryzae* on treated wheat than other species, except for effect on progeny production. Moreover, results show that for this insect application rates and/or longer exposure intervals are needed to obtain a satisfactory level of mortality.

However, the present results indicated that higher concentrations of these plant extracts for a relatively short period are much more effective than lower concentrations for a long period. One of the basic characteristics of an effective grain protectant is ability to reduce progeny production in the treated grain that in our tests, with using two natural insecticides progeny production on treated commodity was inhibited completely in all the dose rates, indicating that even if oviposition occurred before death, the activity of botanical extract during the first molt of larvae was satisfactory.

Females of *S. oryzae* lay their eggs in the external part of the kernel (Birch, 1945; Golebiowska, 1969) and it is likely that newly hatched larvae are exposed to botanical before entering the kernel.

From the progeny production of this insect, emergence of adult's insects from all control samples indicated that tested insects were capable of effective oviposition and that prevention of progeny emergence was exclusively due to treatment. Thus extracts of *V. cheiranthifolium* and *V. speciosum* either suppressed oviposition or killed the larvae hatching from eggs laid in the medium culture. These results suggest that there may be different compounds in extracts possessing different bioactivities.

Similar to this study, Negahban and Moharramipour (2007) showed that different species of Eucalyptus genus can be have variety effect on insect pests.

The finding of our study agree to earlier reports that indicated that most plant extracts have insecticidal properties and can control pests through affecting other biological activities (Schmutterer, 1995; Mostafa *et al*., 1996; Musabyimana *et al*., 2001; Tinzaara *et al*., 2006).

Similar observations on other plant extracts effect on several insects have been reported. For example, Sadek (2003) showed that the time of pupation of *Spodoptera littoralis* (Boisduval) of larvae increased by the extract of *Adhatoda vasica* (Nees). Jeyabalan *et al*. (2003) have reported that extract of *Pelargonium citrosa* (Van leenii), prolonged the duration of larval instars and the total developmental time of *Anopheles stephensi* (liston). Zhong *et al*. (2001) have also highlighted that extract from *Rhododendron molle* (G.Dorn) flowers extend the duration of developmental of *Pieris rapae* L.

Abbassi *et al*. (2003) have found that same effect on desert locust *Schistocerca gregaria* (Forskal). Rahman *et al*. (2007) were investigated ethanol extract of Melgota for its insecticidal activity against *S. oryzae*.

We can conclude that this study suggest that ethanol extract of verbascum genus possesses toxic principles with significant insecticidal effect and could be a potential grains protectant against *S. oryzae*. On the other hand, the species used of the plant and its interaction with the target insect are important when applied.

Today, the environmental safety of an insecticide is considered to be of paramount importance. The world flora has a variety of plant species and in order to increase the number of plants used for pest control, more studies should be carried out. Thus, a variety of effective substance found in different plant species could be discovered. Consequently, substances alternative too many chemical pesticides, with pollute our natural sources and threaten our future, can be found. In addition, cheaper pesticides can be obtained and environmental pollution will gradually decrease.

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