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Insecticidal Properties of *Verbascum cheiranthifolium* Against *R. dominica* on Wheat and Barley

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Abstract: Tissues of higher plants contain novel natural substances that can be used to develop environmental safe methods for insect control. In this study, ethanol extract from flowers of *Verbascum cheiranthifolium* Boiss. (Scrophulariaceae) was examined for their effect on mortality and progeny production against adults of *Rhyzopertha dominica* (F.) on two commodities, wheat and barley. The botanical extract was applied at five dose rates, which 0.25, 0.5, 1.0, 2.0 and 3% (w/v). Adults of *R. dominica* were exposed to the treated wheat and peeled barley 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 commodities were checked for progeny production. In two commodities mortality increased with the increase of dose and exposure interval. Results indicated that on wheat, mortality was 100% after 14 days of exposure at the highest dose rate. Whereas, in the same conditions mortality of adults on barley was 63%. Thus plant extract was more effective against adults of *R. dominica* on wheat than application of barley. Interestingly in two diets, complete suppression (100%) of the progeny production was observed in the treated wheat and barley than in control even in the lowest dose rate.

Key words: Medicinal plants, progeny production, mortality, *Rhyzopertha dominica*

INTRODUCTION

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. *Rhyzopertha dominica* 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; Euturk *et al*., 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 workers (Essien, 2004; Erturk, 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. (Scrophulariaceae) is locally used to kill fishes and used in treatment of various skin diseases in Iran. However, flowers of this plant have not been studied yet for insecticidal activity.

The aim of this study was to produce crude extract from *V. cheiranthifolium* for to determine insecticidal

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activity and effect on progeny production against *R. dominica* on two different commodities, wheat and barley.

MATERIALS AND METHODS

Preparation of plant extract: Crude extract of botanical was used. *Verbascum cheiranthifolium* Boiss. (Scrophulariaceae) collected at flowering stage from Urmia, Iran, in July, 2006. The identification of this plant was carried out according to Flora of Iranica (Rechinger, 1982). Flowers of this plant 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. Hundred grams of the dried powders extracted with 70% ethanol.

The extract was 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 extract was 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 *R. dominica* 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*) and peeled barley (variety *Sahand*) 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. Fixed quantities (1 kg) of each commodity were 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. dominica* 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 day, 14 day and 21 day 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 day. Then, the glass pots were opened and the emerged individuals were counted. All the emerged *R. dominica* 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. of Progeny in control – No. of Progeny in treatment) /No. of 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 (commodity: F = 191.2; df = 1; exposure: F = 535.5; df = 4; dose: F = 239.1; df = 4; dose × commodity: F = 9.36; df = 4; commodity × exposure: F = 34.72; df = 4; dose × exposure: F = 8.37; df = 16).

Mortality of the exposed *R. dominica* adults increased with the increase of the exposure interval and dose rate on two commodities (Fig. 1A-E). On wheat treated with the lowest botanical dose rate almost 71% of the exposed adults were still alive at the 21 days exposure interval (Fig. 1A). Similarity, in peeled barley, adult mortality did not exceed 29% after 21 days (Fig. 1A). Also, after 14 days of exposure, adult mortality on wheat treated with 3% botanical dose rate was 100% (Fig. 1E). Whereas, after 21 days of exposure, adult mortality in highest extract dose rate on barley reached almost 79% (Fig. 1E).

The application of this plant material significantly reduced progeny production. No progeny was found in wheat treated, therefore, on two commodities, 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).

Our results in this study show that this botanical extract is effective against *R. dominica* on wheat and barley, but its effectiveness is highly determined by the

Table 1: The percentage of reduction in progeny production for *R. dominica* on wheat and peeled barley 45 days after the removal of the parental adults

	Dose % (w/v)				
Commodity	0.25	0.5	1	2	3
Barley	0	100	100	100	100
Wheat	100	100	100	100	100

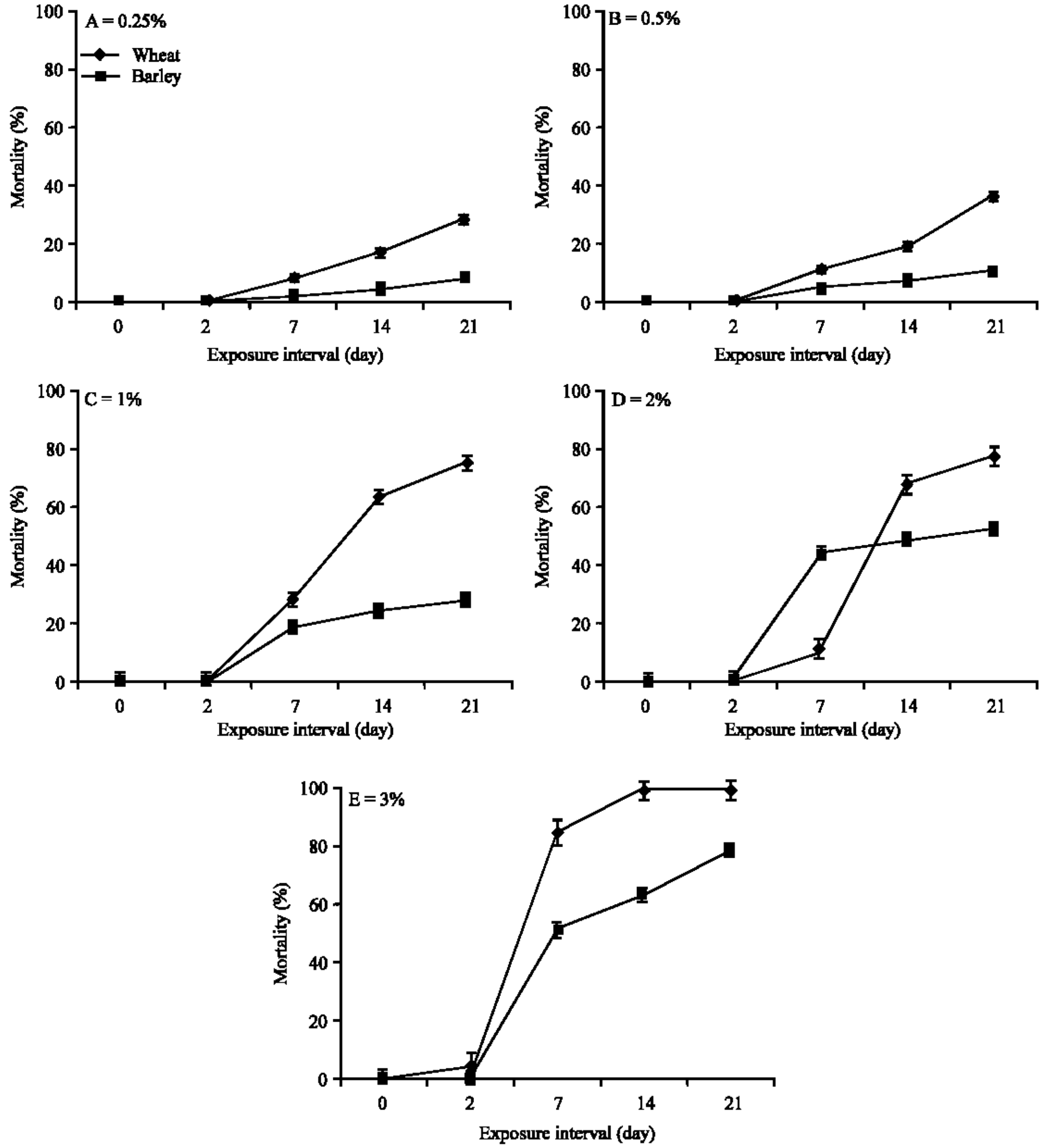

Fig. 1: Mean mortality (±SE) of *R. dominica* adults exposed for 1, 2, 7, 14 and 21 days on wheat and peeled barley treated with 0.25, 0.5, 1, 2 and 3% (w/v) botanical extract

characteristics of the commodity, dose rate and the exposure interval. One of the most interesting findings of the current study is the dissimilar efficacy of botanical material among wheat and barley, so that botanical was much more effective against *R. dominica* on wheat than on barley, except for effect on progeny production. Thus, at the same doses adult survival is higher in peeled barley than on wheat.

Moreover, results show that for this species application rates and/or longer exposure intervals are needed to obtain a satisfactory level of mortality.

However, our results indicated that higher concentrations of this botanical extract for a relatively short period are much more effective than lower concentrations for a long period. In contrast is its ability to reduce progeny production in the treated grain. In our tests, progeny production on two diets were 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 *R. dominica* 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.

Similar to results of Christos *et al*. (2005) using different commodities (oat and rye) cause creation of different mortality levels and survival adult insects.

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 (Mostafa *et al*., 1996; Musabyimana *et al*., 2001; Tinzaara *et al*., 2006).

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 extract of *V. cheiranthifolium* 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 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.

Our results have shown that *V. cheiranthifolium* Boiss. Posse's high insecticidal activity on *R. dominica*. 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 *V. cheiranthifolium* possesses toxic principles with significant insecticidal effect and could be a potential grains protectant against *R. dominica*.

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.

REFERENCES

Abbassi, K., Z. Atay-Kadir and S. Ghaout, 2003. Biological effects of alkaloids extracted from three plants of Moroccan arid areas on the desert locust. Physiol. Entomol., 26: 232-236.

Abbott, W.S., 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol., 18: 266-267.

Aldryhim, Y.N., 1995. Efficacy of the amorphous silica dust, Dryacide, against *Tribolium canfusum* Du Val and *Sitophilus oryzae* (L.) (Coleoptera: Tenebrionidae and Curculionidae). J. Stored Prod. Res., 26: 207-210.

Athanassiou, C.G., D.C. Kontodimas, N.G. Kavallieratos and M.A. Veroniki, 2005. Insecticidal effect of NeemAzal against three stored-product beetle species on rye and oats. J. Econ. Entomol., 98 (5): 1733-1738.

Benhalima, H., M.Q. Chaudhry, K.A. Millis and Price, 2004. Phosphine resistance in stored-product insect collected from various grain storage facilities in Morocco. J. Stored Prod. Res., 40 (3): 241-249.

Birch, L.C., 1945. The influence of temperature on the development of the different stages of *Calandra oryzae* L. (Coleoptera: Curculionidae) and *Rhyzopertha dominica* (F.) (Coleoptera: Bostrychidae). Aust. J. Exp. Biol. Med. Sci., 23: 29-35.

Chapagain, B. and Z. Wiesman, 2005. Larvicidal effects of aqueous extracts of balanites aegyptiaca (desert date) against the larvae of Culex pipiens mosquitoes. Afr. J. Biotechnol., 4 (11): 1351-1354.

Christos, G.A., C.K. Demetrius, G.K. Nickolas and A.V. Maria, 2005. Insecticidal effect of neemazal against tree stored-product beetle species on rye and oats. J. Econ. Entomol., 98 (5): 1733-1738.

Essien, J.P., 2004. Insecticidal potential of an orally administered metabolic extract of *Aspergillus niger* on *Chrysomya chloropyga* (Green bottle fly) larvae. J. Applied Environ. Manage., 8 (1): 45-48.

Euturk, O., 2004. Antifeedant and toxicity effects of some plant extracts on *Thaumetopoae solitaria* Frey. (Lep: Thaumetopoeidae). Turk. J. Biol., 30: 51-57.

Euturk, O., S. Vedat and Y.K. Ahmet Koc, 2004. Antifeedant and toxicity effects of some plants extracts on *Yponomeuta malinellus* Zell. (LEP: Yponomeutidae). J. Plant Prot. Res., 44: 3.

Golebiowska, Z., 1969. The feeding and fecundity of *Sitophilus granaries* (L.), *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) and *Rhyzopertha dominica* (F.) (Coleoptera: Bostrychidae) in wheat grain. J. Stored. Prod. Res., 5: 143-155.

Isman, M.B., 2000. Plant essential oils for pest and disease management. Crop Prot., 19: 603-608.

Jbilou, R., A. Ennabili and F. Sayaha, 2006. Insecticidal activity of four medicinal plant extracts against *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). Afr. J. Biotechnol., 5 (10): 936-940.

Jeyabalan, D., N. Arul and P. Thangamathi, 2003. Studies on effects of *Plargonium citrosa* leaf extracts on malarial vector, *Anopheles stephensi* Liston. Bioresour. Technol., 89: 185-189.

Koona, P. and S. Dorn, 2005. Extracts from Tephrosia vogelii for the protection of stored legume seeds against damage by three bruchid species. Ann. Applied Biol., 147: 43-47.

Koul, O., 2004. Neem: A Global Perspective. Neem: Today and in the New Millennium, Koul, O. and S. Wahab (Eds.). Kluwar Academic Publishers, Dordrecht, Boston, London, pp: 1-19.

Mordue, (Luntz) A.J., 2004. Present Concepts of the Mode of Action of Azadirachtin from Neem. Neem: Today and in the New Millennium, Koul, O. and S. Wahab (Eds.). Kluwar Academic Publishers, Dordrecht, Boston, London, pp: 229-242.

Mostafa, T.Y., S.M. Mahgoub and M.S. Ahmed, 1996. The efficiency of certain plant powders against cowpea weevil *Callosobruchus maculates* (F.) (Coleoptera: Bruchidae). Egypt J. Agric. Res., 74: 307-319.

Musabyimana, T., R.C. Saxena, E.W. Kairu, C.P.K.O. Ogol and Z.R. Khan, 2001. Effects of neem seed derivatives on behavioral and physiological responses of the *Cosmopolites sordidus* (Coleoptera: Curculioni-dae). Hort. Entomol., 94: 449-454.

Negahban, M. and S. Moharramipour, 2007. Fumigant toxicity of *Eucalyptus intertexta*, *Eucalyptus sargentii* and *Eucalyptus camaldulensis* against stored-product beetles. J. Applied Entomol., 131 (4): 256-261.

Rahman, S.S., M.D.M. Rahman, M.M Rahman Khan, S.A. Begum, B. Roy and S.M. Fakhrudin Shahed, 2007. Ethanolic extract of melgot (*Macaranga postulate*) for repellency, insecticidal activity against rice weevil (*Sitophilus oryzae*). Afr. J. Biotechnol., 6 (4): 379-383.

Rechinger, K.H., 1982. Flora Iranica. No. 150, Graz: Akademische Druck-u. Velagsanstalt, pp: 462.

Roy, B., R. Amin and M.N. Uddin, 2005. Leaf extracts of Shiyalmutra (*Blumea lacera*) as botanical insecticides against lesser grain borrer and rice weevil. J. Biol. Sci., 5 (2): 201-204.

Sadek, M.M., 2003. Antifeedant and toxic activity of *Adhatoda vasica* leaf extract against *Spodoptera littoralis* (Lep., Noctuidae). J. Applied Entomol., 127: 396-404.

SAS., 1996. SAS/STAT user's Guide. Release 6.12 Edn. Cary, NC.

Talukder, F.A., 2006. Plant products as potential stored-product insect management agents-A mini review. J. Agric. Sci., 18 (1): 17-32.

Tinzaara, W., W. Tushemereirwe, C.K. Nankinga, C.S. Gold and I. Kashaija, 2006. The potential of using botanical insecticides for the control of the banana weevil, Cosmopolite sordidus (Coleoptera: Curculionidae). Afr. J. Biotechnol., 5 (20): 1994-1998.

Weaver, D.K. and B. Subramanyam, 2000. Botanicals. In: Alternative to Pesticides in Stored-product IPM, Subramanyam, B.H. and D.W. Hagstrum (Eds.). Kluwer Academic Publishers, MA, pp: 303-320.

Zhong, G.H., M.Y. Hu, Q.F. Weng, A.Q. Ma and W.S. Xu, 2001. Laboratory and field evaluations of extracts from *Rhododendron molle* flowers as insect growth regulator to imported cabbage worm, *Pieris rapae* L. (Lepidoptera: Pieridae). J. Applied Entomol., 125: 563-596.