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Evaluation of contact activities of plant extracts against *Sitophilus zeamais* motschulsky (Coleoptera: Curculionidae)

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Abstract

Bioassays were made to determine contact activity of aqueous and acetone extracts of *Mirabilis jalapa*, *Ricinus communis*, *Euphorbia pulcherrima*, *Pilea microphylla*, *Pteridium aquilinum*, *Sansevieria trifasciata*, *Dahlia pinnata*, *Codiaeum variegatum*, *Agave angustifolia*, *Ruta graveolens*, *Malvaviscus arboreus*, *Santolina chamaecyparissus*, *Impatiens walleriana*, *Dieffenbachia brasiliensis* and *Allamanda cathartica* to control of *Sitophilus zeamais* adults. The contact effect was evaluated using the filter paper impregnation technique. Each filter paper, Whatman No. 1 with 7.0 cm diameter, received an aliquot of 0.5 mL of solution to 5 %. The dishes of paper were supported on pins points and the base was a small cork decreasing, to minimize the contact of the treated paper surface. After a period of drying, the dish papers treated, were transferred to Petri dishes and put to rest for 24 hours. Glasses rings 4.5 cm in diameter were covered with neutral talc used to confine the insects and prevent them from escaping. As a safety measure to avoid escape by flying, a transparent texture cover was also placed on the plates strapped by elastic bands. Five plots of 20 adults of *S. zeamais* constituted each treatment. To evaluate the responses was adopted the criterion of mortality rate after 72 hours under exposition. The aqueous extract of *D. pinnata* result in 56.0 % of mortality for *S. zeamais* adults. The aqueous extracts of

M. jalapa, *R. communis*, *P. aquilinum*, *S. trifasciata*, *A. angustifolia*, *R. graveolens*, *M. arboreus*, *S. chamaecyparissus* and *D. brasiliensis* resulting between 10.0 and 27.5 % of mortality. The acetonic extracts of *D. pinnata*, *R. graveolens*, and *D. brasiliensis* resulting in 87.0, 80.0 and 75.0 % of mortality for *S. zeamais* adults, respectively. The acetonic extracts of *P. aquilinum*, *S. trifasciata*, *A. angustifolia*, *M. arboreus*, *S. chamaecyparissus*, *M. jalapa* and *R. communis* resulting between 32.0 and 65.0 % of mortality.

Key words: *Sitophilus zeamais*, botanical insecticides, control.

Introduction

The society has demonstrated an increasing preoccupation with the impact from insecticides on agricultural and urban environments. The usage of substances from vegetable such as oil of native plants, medicinal plants, spices, herbs and forests essences have been evaluated with this aim many times ago. Many essential oils from plants affect insects and can be used to protect plants and control urban pests. Many families of plants have compounds with insecticide activity, such as: Amaranthaceae, Amaryllidaceae, Annonaceae, Araceae, Asteraceae, Chenopodiaceae, Compositae, Cruciferae, Cucurbitaceae, Euphorbiaceae, Labiatae,

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Leguminosae, Malvaceae, Meliaceae, Piperaceae, Poaceae, Rosaceae, Rutaceae, Solanaceae and others. The weevil *Sitophilus zeamais* is one of the main pests in stored grains as corn, wheat, rice and sorghum, preferring the corn to ovipositor. The presence of *S. zeamais* causes damages by strong weight reduction, depreciation of commercial value of the product and reduction of its nutritional value (Pacheco and Paula, 1995). By spreading fungus, and increasing moisture and raising temperature of grains due to its metabolism, it contributes to the early deterioration of stored products (Athie et al., 1998). The plant extracts have potential substances for pest control (Golob et al., 1999; Belmain et al., 2001). Su (1977) demonstrated insecticide activity of *Piper nigrum* stored grains pests. Nawrot et al. (1986) evaluated 49 compounds under *Sitophilus granarius* and *Tribolium confusum* adults. The major activities compounds were *bisabolangelone*, *helenalin*, *alantolactone*, *yatein* and *bakkenolide A*.

Weaver et. al. (1991) evaluated the linalol oil, present in *Ocimum canum*, to control of *S. oryzae*, *Zabrotes subfasciatus*, *A. obtectus* and *R. dominica* adults, obtained LC50 427 ug/cm² to *S. oryzae*. Alonso evaluated repellency active of organic extracts of *Austro eupatorium linaefolium* to *Sitophilus oryzae* control. The methanolic extracts showed repellency activity.

Xie et. al. (1995) reported that neem extracts were toxic to *Sitophilus oryzae*, *Cryptolestes ferrugineus* and *Tribolium castaneum*. The colepteran insects have sensibility to azadirachtin at 100-500 ppm (Murdue and Nisbet, 2000).

Bekele et al. (1997) described biological activity of leaf extracts of *Ocimum kenyense* in the maize and sorghum grains treatment to prevent *S. zeamais* attack. Dried leafs of *O. kenyense* don't showed activity, however, the essential oil at 0.3 % caused 35.0 % and 90.0 % mortality in *S. zeamais* and *R. dominica*, respectively.

This work aims at evaluating the effects of the aqueous and acetonc extracts of *Dahlia pinnata* Cav., *Agave angustifolia* Haw, *Codiaeum variegatum* (L.), *Ruta graveolens* L., *Dieffenbachia*

brasiliensis (Veiech), *Allamanda cathartica* L, *Malvaviscus arboreus* Cav., *Santolina chamaecyparissus* L., *Impatiens walleriana* Hook., *Sansevieria trifasciata* var. Laurentti (De Wild.), *Euphorbia pulcherrima* Willd., *Pteridium aquilinum* L. Kuhn, *Mirabilis jalapa* L., *Ricinus communis* L., *Pilea microphylla* L., in order to identify new substances for integrated pest management (IPM). Thus, the mortality on adults of *S. zeamais* that were exposed by contact to the extracts were determined.

Materials And methods

The bioassay was developed in the laboratories of Centro de sanidade Vegetal/IB/APTA. The leaves of *Dahlia pinnata*, *Agave angustifolia*, *Ricinus communis*, *Codiaeum variegatum*, *Ruta graveolens*, *Dieffenbachia brasiliensis*, *Allamanda cathartica*, *Malvaviscus arboreus*, *Santolina chamaecyparissus*, *Impatiens walleriana*, *Sansevieria trifasciata*, *Euphorbia pulcherrima*, *Pteridium aquilinum*, *Mirabilis jalapa*, *Pilea microphylla* were collected in Jarinú and São Paulo/SP. **Acetonc extract:** the leaves were dried in sterilized at 40 °C and triturated to obtain dust. The dust was submitted to acetonc extraction at environmental temperature for three days for three times. The solvents were filtered and evaporated. The residue was utilized to bioassays. **Aqueous extract:** The leaves were dried and grind, submitted at water distillation for 14 hours, percolation and lyophilized. The residue was utilized. In the moment at utilization, the extracts were diluted at 5.0 %.

The rearing of *S. zeamais* was in the recipients of glass with 25 cm x 15 cm, contained 1 kg of maize grains. The glass were maintained at room temperature 27 ± 2 °C.

Bioassay

The technique of filter paper impregnation (Takematsu, 1983) was used in the bioassay to investigate effect to *S. zeamais* adults. Each paper

with 7 cm of diameter, received an aliquot of 1.0 mL of solution to 10 % in acetone. To avoid losses of products by contact, the dishes of paper were supported on pins points and the base was a small cork decreasing, this way, to minimum the contact of the treated paper surface. After a little period of drying, the dish papers treated in this way, were transferred to plates of Petri, and put to rest for 24 hours. To confining of insects, inciting them to direct contact with treated surfaces with insecticides. Glasses rings 4.5 cm in diameter with covered with talc were used to confine the insects and prevent them from escaping the contact with the treated surface. As a safety measure to avoid escape by flying, a transparent texture cover was also placed on the plates strapped by elastic bands of height, treated previously with pure talc avoided that the weevils go up by rings walls. Each treatment has 5 plots constituted by 20 adults of *S. zeamais*. To evaluate the responses was adopted the criterion of mortality rate after 72 hours under exposition. Insects strongly affected that exhibited entirely disordered movement with little or no leg motion were considered dead. The statistical approach uses was entirely casual and included with 5 repetitions. The results (based on the square root (root de $x + 0.5$)) were submitted to the "f" and Tukey tests at the 5 % confidence level.

Results

The aqueous extracts of *R. graveolens*, *C. variegatum*, *I. walleriana*, *A. cathartica*, *M. arboreus*, *S. chamaecyparissus* and *D. brasiliensis* resulting between 5.0 and 27.5 % of mortality (Table 1).

The major result of aqueous extracts was obtained with the extract of *D. pinnata* this resulted in 56.0 % of mortality for *S. zeamais* adults and *A. angustifolia*, *P. aquilinum*, *S. trifasciata*, *R. communis*, *E. pulcherrima*, *M. jalapa* and *P. microphylla* resulting between 5.0 and 25.0 of mortality (Table 2).

The acetonic extracts of *R. graveolens*, and *D. brasiliensis* resulted in 80.0 and 75.0% of mortality for *S. zeamais* adults, respectively. The acetonic extracts of *C. variegatum*, *I. walleriana*, *A. cathartica*, *M. arboreus* and *S. chamaecyparissus* resulted between 27.0 and 42.0 % of mortality (Table 3).

The acetonic extracts of *D. pinnata* resulted in 87.0 % of mortality for *S. zeamais* adults. The acetone extracts of *A. angustifolia*, *P. aquilinum*, *S. trifasciata*, *R. communis*, *E. pulcherrima*, *M. jalapa* and *P. microphylla* resulted between 28.0 and 68.0 % of mortality (Table 4).

Table 1. Evaluation of aqueous extracts to control of *Sitophilus zeamais*, mortality (mean*) and % of efficiency (% Ef.). São Paulo/SP, May of 2005.

| Botanical extract | Mean* | % Ef. |
|-----------------------------------|---------|-------|
| <i>Malvaviscus arboreus</i> | 2.75 a | 27.50 |
| <i>Codiaeum variegatum</i> | 2.70 c | 27.00 |
| <i>Dieffenbachia brasiliensis</i> | 1.20 b | 12.00 |
| <i>Ruta graveolens</i> | 1.20 b | 12.00 |
| <i>Santolina chamaecyparissus</i> | 1.00 bc | 10.00 |
| <i>Impatiens walleriana</i> | 1.00 bc | 10.00 |
| <i>Allamanda cathartica</i> | 0.50 c | 5.00 |
| Control | 0.00 d | - |
| C.V. (%)** | 3.15 | |

* The use of the same letters indicates that there is no significant difference among the figures at the f 5 % confidence level.

** Changing coefficient.

Table 2. Evaluation of aqueous extracts to control of *Sitophilus zeamais*, mortality (mean*) and % of efficiency (% Ef.). São Paulo/SP, June of 2005.

| Botanical extract | Mean* | % Ef. |
|--------------------------------|---------|-------|
| <i>Dahlia pinnata</i> | 5.60 a | 56.00 |
| <i>Sansevieria trifasciata</i> | 2.50 b | 25.00 |
| <i>Agave angustifolia</i> | 2.00 bc | 25.00 |
| <i>Ricinus communis</i> | 2.00 bc | 20.00 |
| <i>Euphorbia pulcherrima</i> | 1.00 cd | 10.00 |
| <i>Pteridium aquilinum</i> | 1.00 cd | 10.00 |
| <i>Mirabilis jalapa</i> | 1.00 cd | 10.00 |
| <i>Pilea microphylla</i> | 0.50 de | 5.00 |
| Control | 0.00 e | - |
| C.V. (%)** | 4.16 | |

* The use of the same letters indicates that there is no significant difference among the figures at the f 5% confidence level.

** Changing coefficient.

Table 3. Evaluation of acetonic extracts to control of *Sitophilus zeamais*, mortality (mean*) and % of efficiency (% Ef.). São Paulo/SP, July of 2005.

| Botanical extract | Mean* | % Ef. |
|-----------------------------------|--------|-------|
| <i>Ruta graveolens</i> | 8.00 a | 80.0 |
| <i>Dieffenbachia brasiliensis</i> | 7.50 a | 75.0 |
| <i>Malvaviscus arboreus</i> | 4.20 b | 42.0 |
| <i>Santolina chamaecyparissus</i> | 3.80 b | 38.0 |
| <i>Impatiens walleriana</i> | 3.00 c | 30.0 |
| <i>Allamanda cathartica</i> | 2.90 c | 29.0 |
| <i>Codiaeum variegatum</i> | 2.70 c | 27.0 |
| Control | 0.00 d | - |
| C.V. (%)** | 3.11 | |

* The use of the same letters indicates that there is no significant difference among the figures at the f 5% confidence level.

** Changing coefficient.

Table 4. Evaluation of acetonic extracts to control of *Sitophilus zeamais*, mortality (mean*) and % of efficiency (% Ef.). São Paulo/SP, August of 2005.

| Botanical extract | Mean* | % Ef. |
|--------------------------------|---------|-------|
| <i>Dahlia pinnata</i> | 8.70a | 87.0 |
| <i>Ricinus communis</i> | 6.80 b | 68.0 |
| <i>Sansevieria trifasciata</i> | 4.20 c | 42.0 |
| <i>Euphorbia pulcherrima</i> | 3.40 d | 34.0 |
| <i>Agave angustifolia</i> | 3.40 d | 34.0 |
| <i>Pteridium aquilinum</i> | 3.30 d | 33.0 |
| <i>Mirabilis jalapa</i> | 3.20 de | 32.0 |
| <i>Pilea microphylla</i> | 2.80 e | 28.0 |
| Control | 0.00 f | - |
| C.V. (%)** | 3.32 | |

* The use of the same letters indicates that there is no significant difference among the figures at the f 5% confidence level.

** Changing coefficient.

The results indicated that aqueous extract of *D. pinnata* and acetonic extracts of *D. pinnata*, *R. graveolens* and *D. brasiliensis* significantly changed efficiency of the several extracts tested in killing *S. zeamais* by contact.

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