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Antifeedant effects of two plant extracts of (*Bidens pilosa* and *Rumex dentatus*) and neem oil on certain stored grains insects

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Abstract:

The present study was carried out to evaluate the antifeedant activities of methanolic extracts of two weedy plants leaves (*Bidens pilosa* L. and *Rumex dentatus* L.) at three different concentrations 3, 5 and 7% against three stored grain pests, saw-toothed grain beetle *Oryzaephilus surinamensis* (L.) (*Coleoptera*:*Silvanidae*), rice weevil *Sitophilus oryzae* (L.) (*Coleoptera*: Curculionidae) and bean weevil *Acanthoscelides obtectus* (*Say*) (*Coleoptera*: Chrysomelidae) compared to neem oil as a commercial product under the laboratory conditions. The obtained results revealed that all of the tested botanicals had antifeedant effects against the three tested stored grain pests Comparison between of the two plant extracts and neem oil effects on the three tested pests showed that *B. pilosa* extract causing the highest feeding deterrence indices (FDI) against *A. obtectus* at the three tested concentrations. While, the highest antifeedant effect was recorded with *R. dentatus* followed by neem oil, then *B. pilosa* extract against *O. surinamensis* at the same concentrations, but in case of both *S. oryzae* extracts and neem oil have the same antifeedant activity. The three botanical tested showed high antifeedant action and was directly proportional to the tested concentrations. Additionally, the methanol extract of *R. dentatus* showed strong inhibition on adult emergence of the three tested pests at the tested concentrations. In conclusion, the methanol extract of *R. dentatus* was the strongest antifeedant against *O. surinamensis* while, *B. pilosa* the most effective against *A. obtectus*. Finally, these results indicated that methanol extracts of *B. pilosa* and *R. dentatus* achieved significantly antifeedant activities against the three tested pests and can be incorporated used in IPM programs as grain protectants in the future.

Introduction

The groups of insect species associated with postharvest products are commonly called stored product pests. These insects can cause losses of 9-10 % in developing countries, while, the losses can be more than 50 % in undeveloping countries (Pimentel, 1991). Among these pests,three important store product pests, rice weevil *Sitophilus oryzae* (L.) (*Coleoptera*: Curculionidae) which is one of the most insect pests which cause heavy losses of cereal grains both quantitatively and qualitatively throughout the world (Saljoqi *et al.*, 2006), the saw-toothed grain beetle, *Oryzaephilus surinamensis* (L.) (*Coleoptera*:*Silvanidae*), is an important and widespread pest of stored grain and cereal products and it is usually found as a secondary pest on grain damaged by other insects (Hashem *et al*., 2012) and the bean weevil, *Acanthoscelides obtectus* (*Say*) (*Coleoptera*: Chrysomelidae) is a bruchid species that attacks seeds of various leguminous crops (Naroz *et al.*, 2019). Although, using of chemical pesticides and fumigants against stored product pests are effective, but repeated use led to many problems, including insect resistance, disrupted natural biological control systems, toxic residues in food grains, undesirable effects on no target organisms and environmental pollution. For this reason, effective, safe and eco-friendly alternatives to protect stored grain products and minimizing chemical pesticide use are necessary. In recent years, there is a growing interest in the use of plant extracts as alternatives to chemical pesticides in Integrated Pest Management (IPM) (Golob *et al*., 1999) and in this regard, recently, the use of plant-derived insect feeding inhibitors (Antifeedants) for crop protection has received increased emphasis (Khani *et al.,* 2013; Brari and Kumar, 2019 and Karakas, 2020). The term antifeedant is defined by Isman (2002) as ‘‘a peripherally mediated behavior–modifying substance that deters through a direct action on taste organs in insects and resulting in feeding deterrence’’. Pesticides based on plant extracts have demonstrated antifeedant properties against a range of stored product pests, such as *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) (Suthisut *et al.,* 2011), *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) (Hussain *et al*., 2008), *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae) (Suthisut *et al*., 2011 and Liu *et al*., 2012) *S. oryzae* (Rani *et al*., 2011 and Brari and Kumar, 2019), *Sitophilus granarius* Linnaeus (Coleoptera Curculionidae) (Ignatowicz and Wesolowska, 1994), *Rhyzopertha dominica* Fabricius (Coleoptera. : Bostrichidae) (Kłys´, 2004) and *Tribolium confusum* Jacquelin du Val (Coleoptera: Tenebrionidae) (Cis *et al.,* 2006).

The *Bidens pilosa* (Linn.) is a cosmopolitan weed, belonging to the family Asteraceae, originating from South America and common in all tropical and subtropical areas of the world climates (Alvarez *et al*., 1999). *B. pilosa* plant is reported as a noxious weed to crops in Egypt and over 40 countries because because it causes high reducing in the crop yields (Boulos, 2002). The second plant *Rumex dentatus* is a plant of Polygonaceae family is a weedy plant widely distributed in many countries including Egypt. Although, feeding inhibition in insect pests is the most important in the search for new and safer methods for pest control in stored grains, however, previous works investigating the antifeedant activities of the two weedy plants against stored product pests are scanty, so, the present study was carried out to investigate the antifeedant effects of the two plant weeds extracts of *B. pilosa* and *R. dentatus* against the three stored product insect pests, *A. obtectus (Say)* and *S. oryzae* as a models for primary insect pests on legume seeds and cereal grain, respectively and *O. surinamensis* as a model for secondary insect pests on cereal product compared with neem oil (Commercial product).

Materials and methods

1. Plants materials collection:

Naturally growing populations of *B. pilosa* and *R. dentatus* plants were identified and individually collected after the growing season from the different arable zones of fields located in Giza Research Station (GRS) that affiliated with Agricultural Research Center (ARC), Giza, Egypt.

2. Preparation of botanical extracts:

The two collected plant species root region were thoroughly cleaned by tapping, running water, then washed with distilled water and placed for a while on paper for semi-drying and finally, hung vertically upside down for complete air drying for 4 weeks in shade at room temperature 25°C. The dried plant materials were then pulverized into a coarse powder and sieved by 40 meshes to give equal particle size. The powdered leaves were successively extracted with methanol (98%) at room temperature for 48 hrs. The extracts were concentrated under low pressure using a rotary evaporator. The crude extracts were weighed and stored in refrigerator. Three concentrations (3, 5 and 7%) of the two plant species and neem oil were prepared in methanol.

3. Insects culture:

The culture of three tested species was obtained from a stock maintained in the Stored Grain and Product Insect Laboratory, Economic Entomology Department, Faculty of Agriculture, Cairo University. Adults of *A. obtectus* were reared on dry beans and maintained in glass jars (1kg capacity). Newly laid eggs were transferred onto fresh kidney beans to develop in subsequent stages until they reach the adult stage. Adults of *S. oryzae* reared on whole wheat in continuous darkness, while, *O. surinamensis* reared on sterilized oat seeds. The adults were then put into jars containing black cloths. All test insects were kept in a darkened incubator maintained at 27±2ºC and 65±5% relative humidity (r.h.).

4. Antifeedant activity:

Antifeedant activity of the two extracts (*B. pilosa* and *R.dentatus*) and neem oil was carried out as described by Brari and Kumar (2019) with some modifications. Different concentration levels of 3,5,7% of the two extracts and neem oil were prepared in methanol. For each treatment and control, five grams of clean and infestation-free, wheat grains, dry beans and oat seeds were separately placed in appropriate glass jars and treated with 1 ml of each concentration and shaken manually for 2 min to achieve complete distribution of extracts throughout the grains. After the complete evaporation of the solvent, ten adults of the three tested stored grain pests (*S. oryzae*, *A. obtecus* and *O. surinamensis* were transferred to each pre-weighed food media (Wheat, kidney and oat bean, respectively) in the glass jars. Four replicates for each concentration of treatments and control were prepared, then all jars were placed in the incubator at same previously mentioned insect rearing conditions. After feeding for 45 days of feeding, food media was collected and re-weighed. The weight loss % determined and calculated by the "count-and-weight" method described by Harris and Lindblad (1978) and at apply applying the following equation:

$$\%\ \text{Weight loss} = \frac{(\text{Wu} \times \text{Nd}) - (\text{Wd} \times \text{Nu})}{\text{Wu} \times (\text{Nd} + \text{Nu})} \times 100$$

Where

Number of undamaged grains (Nu)
Weight of undamaged grains (Wu)
Number of damaged grains (Nd)
Weight of damaged grains (Wd).

Feeding Deterrence was calculated by using the feeding deterrent index following Isman *et al*. (1990).

$$\text{FDI}\ (\%) = \frac{\text{C} - \text{T}}{\text{C}} \times 100$$

where, C = Weight loss in the control diet and T = Weight loss in the treated diet.

5. Evaluation adult emergence reduction:

The number of emerging adults of *S. oryzae* , *A. obtecus* and *O. surinamensis* was counted after 45 days of treatment. The reduction percentage in adult emergence of the three tested pests calculated by the following equation as described by El-Lakwah *et al*. (1992).

$$\% \text{ Reduction} = \frac{\text{MNEC} - \text{MNET}}{\text{MNEC}} \times 100$$

MNEC = Mean no. of emerged adults in the control.

MNET = Mean no. of emerged adults in the treatment.

6. Statistical analysis:

All the data concerning mortality were corrected by using Abbott's formula (**Abbott, 1925**). Tests for insecticidal activity were performed in triplicate and data presented are mean ± SE. The mean values were compared by one-way ANOVA and Tukey's multiple comparison tests using software SPSS, version 11.5.

Results and discussion

1. Evaluation of antifeedant efficacy of botanical extracts:

Feeding deterrence indices (FDI) showed that, methanol extracts of *B. pilosa* , *R. dentatus* and neem oil had antifeedant action against the three tested insects the three tested concentrations of 3,5 and 7% (Tables 1-3).

2. Antifeedant activity of botanical extracts against *Acanthoscelides obtectus* :

Data in (Table 1) showed that, *B. pilosa* extract at its the highest the highest concentration 7% showed 92.52±1.90% Feeding deterrence index (FDI) with 4.45±1.20% minimum weight loss followed by *R. dentatus* resulted in obtaining 77.60±8.50% feeding deterrence with 13.30±5.10% weight loss, then neem oil that caused FDI 65.60±10.90% and weight loss 20.50±6.50% as compared to control 59.51± weight loss. Weight loss caused by *A. obtectus* was significantly reduced with the application of the botanical extracts.

Table (1): Antifeedant activity of three plant extracts against *Acanthoscelides obtectus* .

Plant Extracts	Concentrations (%)	Weight loss (%) (Means± SE)	FDI (%) (Means± SE)
Rumex dentatus	**3**	51.10±5.80^{ab}	14.20±9.70^{d}
	5	46.90±4.60^{b}	21.20±7.70^{d}
	7	13.30±5.10^{de}	77.60±8.50^{ab}
Bidens pilosa	**3**	10.90±0.40^{de}	81.7±0.70^{ab}
	5	8.70±1.10^{de}	85.30±1.60^{ab}
	7	4.45±1.20^{e}	92.52±1.90^{a}
Neem oil	**3**	48.5±0.90^{ab}	18.60±1.60^{d}
	5	26.10±1.20^{c}	56.10±2.10^{c}
	7	20.50±6.50^{cd}	65.60±10.90^{bc}
Control	**0.0**	59.50±3.30^{a}	
F value		30.160	24.107
P value		0.000	0.000

Values followed by different letters within a column are significantly different at p≤0.05 (Duncan's Multiple Range Tests).

3. Antifeedant activity of botanical extracts against *Sitophilus oryzae* :

Maximum feeding deterrence (100.00%) with 0.00±0.00% weight loss was exhibited by the three botanical extracts (*B. pilosa, R. dentatus* and neem oil) when applied with 7% concentration as compared to control 61.04±6.00 weight loss. There was low significant weight loss of food feedings by the three treatments (*B. pilosa*, *R. dentatus* and neem oil) against *S. oryzae*. *R. dentatus* was recorded as most effective (FDI 67.50±1.90, 96.20±4.60 and 100.00±0.00%) feeding deterrent at the three different concentrations (3,5,7%) against *S. oryzae* followed by *B. pilosa* (FDI 53.90±2.70, 95.30±1.10 and 100.00±0.00%) then neem oil (FDI 63.90±8.20,79.30±10.40and100.00±0. 00%),respectively at the same concentrations (Table 2).

Table (2): Antifeedant activity of three plant extracts against *Sitophilus oryzae* .

Plant Extracts	Concentrations (%)	Weight loss (%) (Means± SE)	FDI (%) (Means± SE)
Rumex dentatus	3	19.80±1.20[bc]	67.50±1.90[bc]
	5	2.30±2.80[d]	96.20±4.60[a]
	7	0.00±0.00[d]	100.00±0.00[a]
Bidens pilosa	3	28.10±1.70[b]	53.90±2.70[c]
	5	2.80±0.60[d]	95.30±1.10[a]
	7	0.00±0.00[d]	100.00±0.00[a]
Neem oil	3	21.90±5.00[b]	63.90±8.20[c]
	5	12.60±6.30[c]	79.30±10.40[b]
	7	0.00±0.00[d]	100.0±0.00[a]
Control	0.0	61.04±6.00[a]	
F value		47.266	14.161
P value		0.000	0.000

Values followed by different letters within a column are significantly different at p≤0.05 (Duncan's Multiple Range Tests).

4. Antifeedant activity of botanical extracts against *Oryzaephilus surinamensis*:

R. dentatus and neem oil at 7% showed high FDI of 100.00±0.00 and 97.40 ±1.10% with 0.00 ± 0.00 and 1.10±0.50% weight loss, while, *B. pilosa* recorded FDI of 86.80±17.50% with weight loss 4.70±6.90% as compared to 41.20±4.70% weight loss in control (Table 3). The effect of applying of 7% concentration of the two extracts and the neem oil on weight loss (%) caused by *O. surinamensis* can be arranged as: *B. pilosa* >Neem oil > *R. dentatus*.

Table (3): Antifeedant activity of three plant extracts against *Oryzaephilus surinamensis* .

Plant Extracts	Concentrations (%)	Weight loss (%) (Means± SE)	FDI (%) (Means± SE)
Rumex dentatus	3	14.40±4.30[bc]	65.00±10.50[a]
	5	2.60±4.40[bc]	93.50±10.70[a]
	7	0.00±0.00[c]	100.00±0.00[a]
Bidens pilosa	3	23.20±17.70[ab]	45.80±41.50[a]
	5	20.90±1.60[abc]	48.70±3.70[a]
	7	4.70±6.90[bc]	86.80±17.50[a]
Neem oil	3	20.30±0.90[abc]	50.50±2.10[a]
	5	2.10±0.90[bc]	94.90±2.40[a]
	7	1.10±0.50[c]	97.40±1.10[a]
Control	0.0	41.20±4.70[a]	
F value		4.202	2.087
P value		0.004	0.093

Values followed by different letters within a column are significantly different at p≤0.05 (Duncan's Multiple Range Tests).

Approximately at all concentrations of botanical extracts, *A. obtectus* caused the highest weight loss as compared to *S. oryzae* and *O. surinamensis* except with *B. pilosa* extract. Methanol extract of *R. dentatus* was the strongest antifeedant against *O. surinamensis* while, *B. pilosa* the most effective against *A. obtectus*. Both extracts have the same antifeedant activity with *S. oryzae*. In general, the two extracts *B. pilosa* and *R. dentatus* were found efficacious against *A. obtectus, S. oryzae* and *O. surinamensis* as antifeeding agent. As shown in Figures (1, 2 and 3), feeding inhibition was significantly increased with an increase in the concentration of plant extracts applied, resulting in reduction of the weight loss caused by the three tested pests *A. obtectus, S. oryzae and O. surinamensis* .

5. Effect of botanical extracts on adult emergence rate:

The effect of different extracts on emergence adults of *A. obtectus, S. oryzae* and *O. surinamensis* are shown in Tables (4-6). Treatments of *A. obtectus, S. oryzae and O. surinamensis* with different concentrations of *B. pilosa, R. dentatus* and neem oil caused significant strongly reduced adult emergence of the three insect species after 45 days of treatment when compared to control. All the treatments of methanol extract from *R. dentatus* strongly reduced adult emerged of *A. obtectus, S. oryzae and O. surinamensis* at the lowest concentrations 3%. The recorded adult's emergence reduction of *R. dentatus* and *B. pilosa* at the moderate concentration (5%) were (93.10±0.80, 90.90±1.10 and 95.80±0.70%) and (72.60± 0.50, 83.30±2.30 and 90.90±1.20%), while, adult's emergence reduction of neem oil were (88.90±0.70, 84.10±2.30 and 95.60±1.90%) against the same pests, respectively. Approximately the highest methanolic concentration (7%) of *R. dentatus* achieved complete adult's emergence reduction of *A. obtectus, S. oryzae* and *O. surinamensis* (98.00±0.10, 100.00±0.00 and 100.00±0.00 %, respectively), while the recorded adult's emergence reduction of *B. pilosa* were 85.10±0.30, 95.20±1.49 and 100.00±0.00 compared to adult's emergence reduction caused by neem oil (97.00±0.50, 100.00±0.00 and 96.10 %), against the same three pests, respectively at the same concentration. The number of the adults emerging by the three tested pests was significantly decreased in all treatments with increasing concentration of the tested plant extracts (*R. dentatus, B. pilosa* extracts and neem oil) compared to the control (Figures, 4, 5 and 6).

Table (4): Adult emergence and progeny reduction of *Acanthoscelides obtectus* exposed to different concentrations of of three plant extracts after 45 days of treatment.

Plant Extracts	Concentrations (%)	Adult emergence	Progeny reduction (%)
Rumex dentatus	**3**	51.70±4.60^{c}	58.30±3.70^{g}
	5	8.50±1.00^{fg}	93.10±0.80^{cd}
	7	2.40±0.06^{h}	98.00±0.10^{a}
Bidens pilosa	**3**	102.00±1.73^{b}	17.70±1.30^{h}
	5	34.00±0.57^{d}	72.60±0.50^{f}
	7	18.40±0.34^{e}	85.10±0.30^{e}
Neem oil	**3**	18.00±1.15^{e}	85.50±0.90^{e}
	5	13.70±0.88^{ef}	88.90±0.70^{de}
	7	3. 70±0.66^{gh}	97.00±0.50^{bc}
Control	**0.0**	124.00±4.00^{a}	
F value		538.70	320.00
P value		0.000	0.000

Values followed by different letters within a column are significantly different at p≤0.05 (Duncan's Multiple Range Tests).

Table (5): Adult emergence and progeny reduction of *Sitophilus oryzae* exposed to different concentrations of of three plant extracts after 45 days of treatment.

Plant Extracts	Concentrations (%)	Adult emergence	Progeny reduction (%)
Rumex dentatus	**3**	12.60±0.30[bc]	56.80±1.10[e]
	5	2.60±0.30[ef]	90.90±1.10[b]
	7	0.00±0.00[f]	100.00±0.00[a]
Bidens pilosa	**3**	14.60±0.80[b]	49.90±3.00[f]
	5	4.90±0.60[e]	83.30±2.30[c]
	7	1.40±0.40[ef]	95.20±1.49[ab]
Neem oil	**3**	9.60±0.60[d]	67.10±2.30[d]
	5	4.60±0.60[e]	84.10±2.30[c]
	7	0.00±0.00[f]	100.00±0.00[a]
Control	**0.0**	29.30±3.40[a]	
F value		56.499	105.985
P value		0.000	0.000

Values followed by different letters within a column are significantly different at p≤0.05 (Duncan's Multiple Range Tests).

Table (6): Adult emergence and progeny reduction of *Oryzaephilus surinamensis* exposed to different concentrations of of three plant extracts after 45 days of treatment.

Plant Extracts	Concentrations (%)	Adult emergence	Progeny reduction (%)
Rumex dentatus	**3**	19.30±2.00[d]	87.40±2.30[d]
	5	6.40±0.70[e]	95.80±0.70[b]
	7	0.00±0.00[f]	100.00±0.00[a]
Bidens pilosa	**3**	42.00±3.20[b]	72.70±3.60[d]
	5	14.00±1.10[d]	90.90±1.20[c]
	7	0.00±0.00[f]	100.00±0.00[a]
Neem oil	**3**	30.00±1.70[c]	80.50±1.90[e]
	5	6.70±1.70[e]	95.60±1.90[b]
	7	6.00±1.10[e]	96.10±1.20[b]
Control	**0.0**	154.00±3.50[a]	
F value		604.687	78.28
P value		0.000	0.000

Values followed by different letters within a column are significantly different at p≤0.05 (Duncan's Multiple Range Tests).

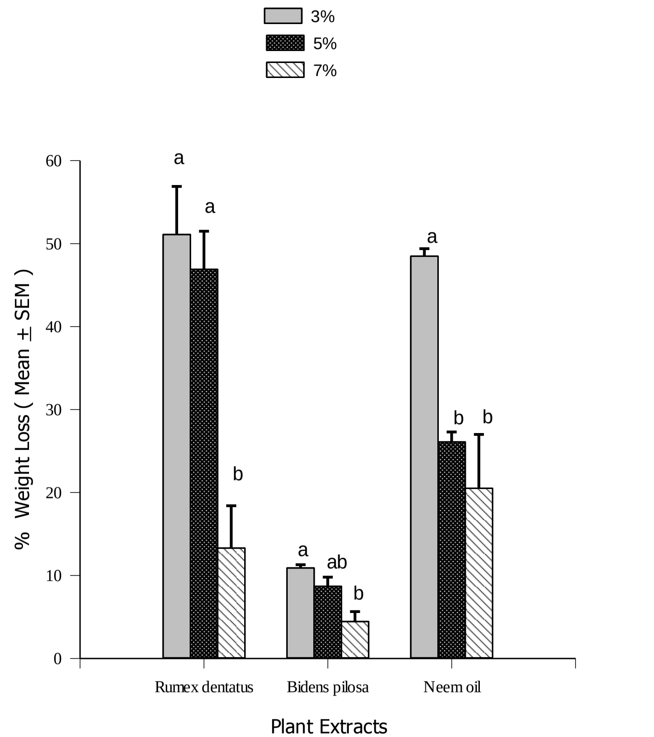

Figure (1): Weight loss % caused by *Acanthoscelides obtectus* **at different concentrations of *Rumex dentatus, Bidens pilosa* and neem oil.**

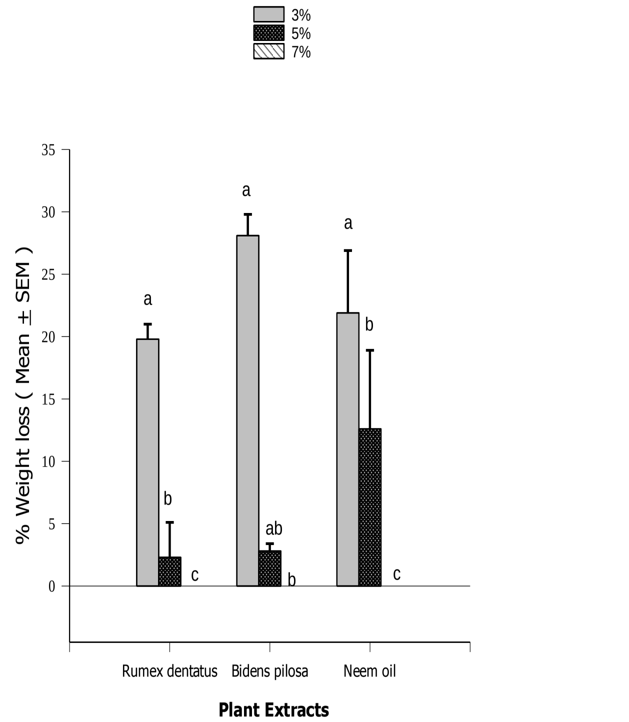

Figure (2): Weight loss % caused by *Sitophilus oryzae* **at different concentrations of *Rumex dentatus, Bidens pilosa* and neem oil.**

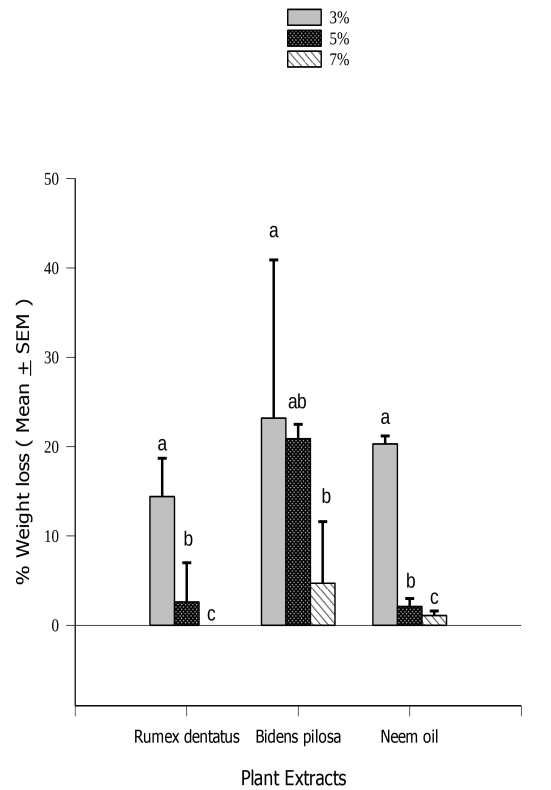

Figure (3): Weight loss % caused by *Oryzaephilus surinamensis* **at different concentrations of *Rumex dentatus, Bidens pilosa* and neem oil.**

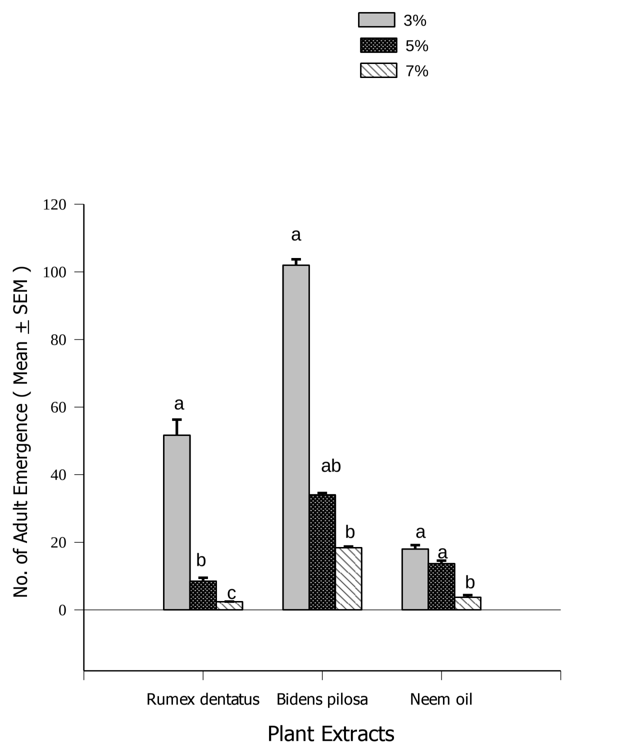

Figure (4): *Acanthoscelides obtectus* **adult emergence from dry beans treated with methanol extracts of** *Rumex* ***dentatus,*** *Bidens* ***pilosa*** **and neem oil at different concentrations.**

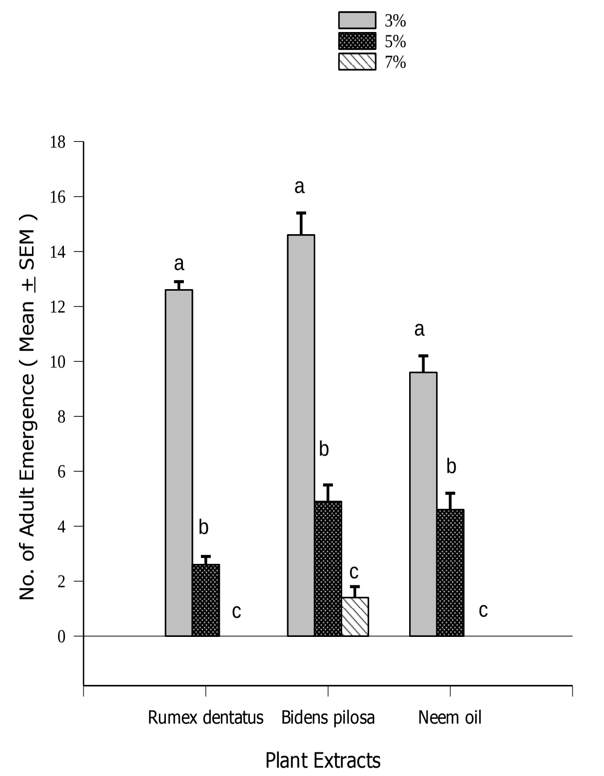

Figure (5): *Sitophilus oryzae* **adult emergence from whole wheat treated with methanol extracts of** *Rumex* ***dentatus,*** *Bidens* ***pilosa*** **and neem oil at different. Concentrations.**

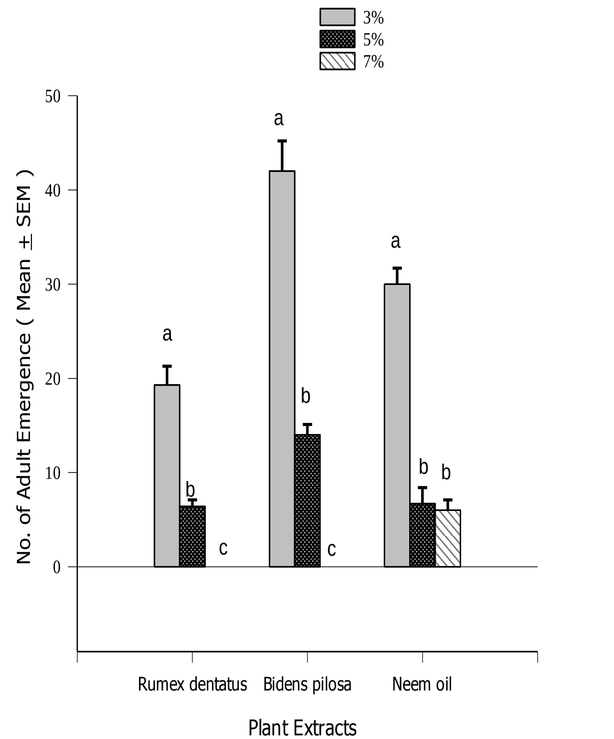

Figure (6): *Oryzaephilus surinamensis* **adult emergence from oat seeds treated with methanol extracts of** *Rumex* ***dentatus,*** *Bidens* ***pilosa*** **and neem oil at different concentrations.**

Means followed by the same letters are not significantly different at $p \leq 0.05$

SEM: Standard error of the mean

Our findings coincide with Goudoum *et al.* (2016) who observed that, essential oil of *B. pilosa* reduced weight loss of Bambara groundnut *C. maculatus* and Feeding deterrence index (FDI) increase with increasing of concentration essential oil of *B. pilosa*. The LC_{50}, LC_{80} and LC_{99} of *B. pilosa*, reduced respectively 62.33, 85.00 and 98.00% of damages of *C. maculatus*. These observations were supported by (Feng *et al.*, 2012) who revealed that, significant antifeedant activity was induced by extract of *B. pilosa* when applied against *Spodoptera exigua*. As for antifeedant activity of *R. dentatus* extract, Shoukry *et al*. (2003) showed that, *R. dentatus* oil effects on the biochemical activities of *Plodia interpunctella* larvae and leading to disturbances in carbohydrate, lipid and protein levels in the haemolymph, this disturbance may cause antifeedant activities (Kalavathi *et al*., 1991). In other study, the aqueous extracts (5%) of eight plant species including *Rumex nepaiensis* Spreng reflected varying degree of antifeedant effect against major insect pests infesting cabbage viz., diamondback moth, *Plutella xylostella* (L.), cabbage white butterfly, *Pieris brassicae* (L.) and cabbage aphid, *Brevicoryne brassicae* (L.) (Mehta *et al* ., 2005). In a related study, Mehta *et al.* (2002) concluded that among five plant species evaluated against cabbage butterfly, *P. brassicae* (L.), *Artemisia brevifolia* Wall. extract resulted in significantly high antifeedant activity followed by *R. nepalensis* and *Melia azedarach (L.)* at 1.25, 2.5 and 5.0% concentrations. Also, Sharma (2016) studied efficacy of antifeedant activities of different extracts including *R. nepalensis* at 1.25, 2.5 and 5.0% concentrations against the same pest. Plant extracts applied at 5.0% concentration resulted in significantly high antifeedant effect against the third instar caterpillar of *P. brassicae* as compared to the 2.5 and 1.25% concentration. Our results of adults emergence reduction are in conformity with Renuka *et al* . (2014) who reported that, methanol and acetone extracts of *B. pilosa* has proved effective and resulted a significant reduction in F1 progenies of *A. obtectus* and *Zabrotes subfasciatus*. The methanolic concentration (8%) of *B. pilosa* caused high reduction in F1 adult's emergence of *A. obtectus* and *Zabrotes subfasciatus*, while the other concentrations 2,4 and 6% of methanol and acetone extracts of *B. pilosa* significantly reduced the emergence of F1 adults of *A. obtectus*. There was a significant reduction in F1 progenies with increase in treatment dosage. In this regard, Jovanovic *et al*. (2007) showed that, *Utrica dioica* and *Taraxacum officinale* extracts efficiently killed 100% of adults of *A. obtectus* and significant level of reduction in F1 progeny was also achieved. On the other hand, the effect of plant extracts on the reduction of progeny of adults of *O. surinamensis*, revealed that *Conyza discorides* was the highest (92.93%) followed by *Cymbopogon nardus* spreng (88.68%), then *Moringa oliefera* (70.80%) (Omran *et al.,* 2020). In another study Shafaie *et al* . (2019) showed that, essential oils, extracts and powders of *Cupressus arizonica* Greene, *Juniperus communis* L. and *Mentha longifolia* L recorded a high level of reduction in F1-Progeny against the three stored product pests *Callosobruchus maculatus* Fabricus, *S. granarius* L. and *O. surinamensis* L. The Inhibition of progeny emergence resulted from activities of plant extracts against grain stored pests has been reported by many studies; *Sitophilus oryzae* (Khani *et al*., 2011 and 2017); *A. obtectus* (Karakas, 2020); *Trogoderma granarium* (Derbalah, 2012);*Callosobruchus maculatus* F. (Hussain *et al*., 2008 and Vanmathi *et al*., 2010) and *Corcyra cephalonica* (Khani *et al.*, 2013).

The observed antifeedant effect of the two botanical extracts (*R. dentatus and B.*

pilosa) indicates presence of toxic bioactive components. The present findings suggest that the leaves of these plants possess certain bioactive components which require further investigation to determine the exact mode of action of these active components and their effect on non-target organisms. The present study, therefore, revealed that both *R. dentatus* and *B. pilosa* possess antifeedant effects against *A. obtectus, S. oryzae* and *O. surinamensis.* Weight loss caused by the three tested pests was considerably decreased with the application of these two botanical extracts. Based on the results of the present study, it is possible to claim that the effects of the two botanical extracts achieved a high adult emergence reduction when applied against *A. obtectus, S. oryzae and O. surinamensis*. Finally, *R. dentatus* extract was concluded as the most effective feeding deterrent among tested botanical extracts and as this plant is available and easy to be found among the Egyptian flora, therefore, it could be used as a potential botanical insecticide and a wonderful substitute of synthetic chemicals for the management of stored grain pests.

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