*ACARINES, 9:55-61, 2015*

# Efficacy of Some Plant Extracts AgainstSome Stored Grain Pests

**Hala H. Al-Akhdar; Doaa M. Boraie and Mariam G. Habashy**
Plant Protec.Res. Inst., Agric. Res. Center, Dokki, Giza, Egypt.

## ABSTRACT

The efficacy of Fenugreek, *Trigonellafoenum graecum*, Celery, *Apium graveolens* Laurel, *Laurus nobilis* and Thyme, *Thymus vulgaris* extracts, against the four stored grains pests, rice weevil, *Sitophilus oryzae*, cowpea beetle, *Callosobruchus maculatus*, mould mite, *Tyrophagus putrescentiae* and house dust mite, *Dermatophagoides farinae* were investigated. Mortality (%) increased with increasing concentrations, exposure periods and varying from plant to plant. Petroleum ether extract of *A. graveolens* induced 100% mortality after two, eight and seven days of exposure for *C. maculates*, *S. oryzae* and *D. farinae*, respectively. *Foenum graecum* caused 100% mortality after four, five and seven days for *S.oryzae, D. farinae* and *T. putrescentiae*, respectively and 93.3% for *C. maculates* after five days. Petroleum ether extract of *L. nobilis* caused 100% mortality to *C. maculatus*, *T. putrescentiae* and *D. farina* but declined to48% with *S. oryzae*. *T. vulgaris* caused a complete reduction in $F_1$- progeny for *C. maculatus* but had no effect against *S. oryzae* moderate effect on *T. putrescentiae* and *D. farinae*. *A. graveolens* and *T. foenumgraecum* were the most toxic plants followed by *L. nobilis*; while *T. vulgaris*was the least. For all plants, petroleum ether extracts were more effective in mortality percentage and reduction in $F_1$- progeny than acetone extracts.

**Key words:** Stored grains; Plant extracts; Repellency; *Sitophilus oryzae*; *Callosobruchus maculatus*; *Tyrophagus putrescentiae*; *Dermatophagoides farinae*.

## INTRODUCTION

## INTRODUCTION

Stored product pests cause high economic losses by feeding on stored grains and endanger the public health by contamination of food. Prevent losses caused by insects and mites are easier, safer and less expensive than controlling them.

The rice weevil, *Sitophilus oryzae* (L.) and the cowpea weevil, *Callosobruchus maculatus* (F.) are the most two of widespread and destructive primary insect pests of stored cereals and legumes (Demitry *et al*., 2007). Control of these insect populations around the world primarily depends upon applications of fumigants (i.e. ecofume and phosphine).

Mites are also common pests of stored grains as some feed on the germ of cereals (Solomon, 1946a) and hollow out rapeseed leaving only the seed coat. Consequently, it reduce germination, decrease seed value and cause human and livestock allergies (Zdarkova, 1991).

This work aimed to study the toxicity and repellency effect of Petroleum ether and Acetone extracts of Fenugreek *Trigonellafoenum graecum* (Family: Fabaceae), Celery *Apium graveolens* (Family: Apiaceae) seeds and Laurel *Laurusn obilis* (Family: Lauraceae) and Thyme *Thymus vulgaris* (Family: Lamiaceae) leaves on four of the most abundant stored grain pests. These are adults of rice weevil, *Sitophilusoryzae* (Linnaeus)(Coleoptera: Curculionidae); cowpea beetle, *Callosobruchus maculatus* (Fabricius) (Coleoptera: Chrysomelidae); the mould mite, *Tyrophagus putrescentiae* (Shrank) (Acari: Acaridae) and *Dermatophagoides farinae* (Hughes) (Acari: Pyroglyphidae ) as a safe method to reduce their population without pollution.

## MATERIALS AND METHODS

Tested insects were reared separately in glass jars containing about 250 gm of cowpea for *C. maculatus* and wheat for *S. oryzae*. Each jar was covered with muslin cloth, fixed with rubber band for laying eggs and incubated at 30±2°C and 65±5 % R.H.

Strains of mould mites, *T. putrescentiae* and *D. farinae* were collected from infested wheat samples. To obtain a pure culture, adults were placed in rearing plastic rings containing crushed wheat at 30±2°C and 65±5 % R.H.

To obtain the plant extracts, seeds of Fenugreek and Celery and leaves of Laurel and Thyme, were ground. According to their polarity, petroleum ether and acetone were chosen to extract fractions from these plants. The ground plant material was soaked, shacked and evaporated (Su, 1985).Plant crude was weighted and dissolved by the same solvent; concentrations of 3, 2, 1 and 0.5(w/v) were prepared.

To investigate the effect of plant extracts on tested pests, 10 grams of cowpea and wheat were put separately into jars, mixed with plant extract. Twenty adult females of *C. maculatus*, *S. oryzae*, *T. putrescentiae and D. farinae* were confined to the treated seeds and each treatment was replicated three times. Mortality percentages were corrected using (Abbot's formula, 1925). The numbers of offsprings (progeny) were determined after 30 days from treatment for *C. maculatus* and 60 days for *S. oryzae*. Reduction percentages of offspring were calculated by the following equation (El-Lakwah *et al*., 1996).

Different concentrations (5, 10 and 15%) were prepared of petroleum etherextract of Fenugreek and Celery to test on adults of *S. oryzae* and *T. putrescentiae*. Area preference method was used; Data was taken after half, 6, 12and 24 hrs. Experiment was replicated three times and completely randomized design (Factorial) was followed (Sagheer *et al*., 2014).

Data were subjected to analysis of variance and differences using ANOVA test (a computer program costate). Mean values were adjusted by Duncan's Multiple Range test Duncan (1951)at 0.05% level of significance with Statistical software version 6.3.0.3.

## RESULTS AND DISCUSSION

### Insecticidal Efficacy of Plant Extracts:

This experiment was conducted to evaluate the insecticidal activity of petroleum ether and acetone extracts of Celery, Fenugreek, Laurel and Thyme on mortality and reduction in $F_1$-progeny of the tested insects, *S. oryzae* and *C. maculatus*, tables (1, 2).

Results showed positive correlation between mortality percentage and the concentrations of each extract i.e., increasing of concentrations increased mortality percentage of the two insects.

Table (1): Toxicity of some plant extracts on *S. oryzae* adults infesting wheat seeds and reduction (%) of $F_1$-progeny at 30±2°C and 65±5% R.H.

| Plant | EXTRACT | Conc. (w/v)% | Adult mortality after indicated days | | | | | No. $F_1$ progeny after 60 days | % reduction in $F_1$ progeny |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 4 | 6 | 8 | 10 | | |
| Celery | Petroleum ether | 3 | 93.3$^{a}$±3.3 | 100$^{a}$±0 | 100$^{a}$±0 | 100a±0 | 100$^{a}$±0 | 0 | 100% |
| | | 2 | 83.3$^{a}$±3.3 | 100$^{a}$±0 | 100$^{a}$±0 | 100a±0 | 100$^{a}$±0 | 0 | 100% |
| | | 1 | 50$^{b}$±5.7 | 93.3$^{a}$±3.3 | 100$^{a}$±0 | 100a±0 | 100$^{a}$±0 | 43 | 56% |
| | | 0.5 | 23.3$^{c}$±8.7 | 53.3$^{b}$±14.4 | 70$^{b}$±11.5 | 73.3b±14.5 | 73.3$^{b}$±14.5 | 79 | 19.3% |
| | LSD 0.05 | | 1.88 | 2.4 | 1.88 | 2.4 | 2.4 | | |
| | Acetone | 3 | 83.3$^{a}$±12 | 86.6$^{a}$±8.7 | 96.6$^{a}$±3.3 | 100$^{a}$±0 | 100$^{a}$±0 | 3 | 97% |
| | | 2 | 60$^{ab}$±15.3 | 66.6$^{ab}$±12 | 73.3$^{ab}$±12 | 73.3$^{b}$±12 | 76.6$^{b}$±8.7 | 73 | 25.5% |
| | | 1 | 43.3$^{b}$±6.6 | 43.3$^{b}$±6.6 | 53.3$^{bc}$±8.7 | 63.3$^{bc}$±6.6 | 63.3$^{b}$±6.6 | 82 | 16.3% |
| | | 0.5 | 33.3$^{b}$±33 | 43.3$^{b}$±3.3 | 43.3$^{c}$±3.3 | 43.3$^{c}$±3.3 | 43.3$^{c}$±3.3 | 88 | 10.2% |
| | LSD 0.05 | | 3.4 | 2.7 | 2.5 | 2.3 | 1.88 | | |
| | CTRL | | | | | | | 98 | |
| Fenugreek | Petroleum ether | 3 | 96.6$^{a}$±3.3 | 100$^{a}$±0 | 100$^{a}$±0 | 100$^{a}$±0 | 100$^{a}$±0 | 0 | 100% |
| | | 2 | 76.6$^{b}$±8.7 | 96.6$^{a}$±3.3 | 96.6$^{a}$±3.3 | 100$^{a}$±0 | 100$^{a}$±0 | 0 | 100% |
| | | 1 | 23.3$^{c}$±6.6 | 66.6$^{b}$±6.6 | 83.3$^{a}$±3.3 | 100$^{a}$±0 | 100$^{a}$±0 | 7 | 90.7% |
| | | 0.5 | 0$^{d}$±0 | 0$^{c}$±0 | 16.6$^{b}$±8.8 | 23.3$^{b}$±8.8 | 23.3$^{b}$±8.8 | 43 | 43.3% |
| | LSD 0.05 | | 1.88 | 1.2 | 1.6 | 1.4 | 1.4 | | |
| | Acetone | 3 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 40 | 47.3% |
| | | 2 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 45 | 40.7% |
| | | 1 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 52 | 31.5% |
| | | 0.5 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 56 | 26.3% |
| | CTRL | | | | | | | 76 | |
| Laural | Petroleum ether | 3 | 13.3$^{a}$±1.7 | 30$^{a}$±2.9 | 36.6$^{a}$±3.3 | 41.6$^{a}$±1.7 | 48.3$^{a}$±1.7 | 0 | 100% |
| | | 2 | 5$^{b}$±2.9 | 11.6$^{b}$±4.4 | 15$^{b}$±2.9 | 16.6$^{b}$±4.4 | 18.3$^{b}$±4.4 | 26 | 72% |
| | | 1 | 1.7$^{b}$±1.7 | 1.7$^{c}$±1.7 | 5$^{c}$±2.9 | 6.7$^{c}$±1.7 | 10b$^{c}$±2.9 | 40 | 57% |
| | | 0.5 | 0$^{b}$±0 | 0$^{c}$±0 | 0$^{c}$±0 | 1.7$^{c}$±1.7 | 5$^{c}$±2.9 | 46 | 50.5% |
| | LSD 0.05 | | 1.2 | 1.8 | 1.7 | 1.7 | 2 | | |
| | Acetone | 3 | 3 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 62 |
| | | 2 | 2 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 74 |
| | | 1 | 1 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 75 |
| | | 0.5 | 0.5 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 79 |
| | CTRL | | | | | | | 93 | |
| Thyme | Petroleum ether | 3 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 83 | 25.2% |
| | | 2 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 84 | 24.3% |
| | | 1 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 92 | 17% |
| | | 0.5 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 97 | 12.6% |
| | Acetone | 3 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 87 | 21.6% |
| | | 2 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 90 | 18.9% |
| | | 1 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 103 | 7.2% |
| | | 0.5 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 106 | 4.5% |
| | CTRL | | | | | | | 111 | |

Means followed by the same superscript (s) are not significantly differed by the Least Significant Difference (p<0.05) (Duncan, 1955).

Table (2): Toxicity of some plant extracts on *C. maculates* adults infesting cowpea seeds and reduction (%) of $F_{-1}$ progeny at 30±2°C and 65±5% R.H.

| Plant | Extract | Conc. (w/v) % | Adult mortality after indicated days | | | | | NO. $F_1$ progeny after 30 days | % reduction in $F_1$ progeny |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | | |
| Celery | Petroleum ether | 3 | $93.3^{a}\pm3.3$ | $100^{a}\pm0$ | $100^{a}\pm0$ | $100^{a}\pm0$ | $100^{a}\pm0$ | 0 | 100% |
| | | 2 | 83.3a±3.3 | $100^{a}\pm0$ | $100^{a}\pm0$ | $100^{a}\pm0$ | $100^{a}\pm0$ | 0 | 100% |
| | | 1 | $50^{b}\pm5.7$ | $93.3^{a}\pm3.3$ | $100^{a}\pm0$ | $100^{a}\pm0$ | $100^{a}\pm0$ | 0 | 100% |
| | | 0.5 | $23.3^{c}\pm8.7$ | $53.3^{b}\pm14.4$ | $70^{b}\pm11.5$ | $73.3^{b}\pm14.5$ | $73.3^{b}\pm14.5$ | 0 | 100% |
| | LSD 0.05 | | 1.88 | 2.4 | 1.88 | 2.4 | 2.4 | | |
| | Acetone | 3 | $83.3^{a}\pm12$ | $86.6^{a}\pm8.7$ | $96.6^{a}\pm3.3$ | $100^{a}\pm0$ | $100^{a}\pm0$ | 0 | 100% |
| | | 2 | $60^{ab}\pm15.3$ | $66.6^{ab}\pm12$ | $73.3^{ab}\pm12$ | $73.3^{b}\pm12$ | $76.6^{b}\pm8.7$ | 0 | 100% |
| | | 1 | $43.3^{b}\pm6.6$ | $43.3^{b}\pm6.6$ | $53.3^{bc}\pm8.7$ | $63.3^{bc}\pm6.6$ | $63.3^{b}\pm6.6$ | 0 | 100% |
| | | 0.5 | $33.3^{b}\pm33$ | $43.3^{b}\pm3.3$ | $43.3^{c}\pm3.3$ | $43.3^{c}\pm3.3$ | $43.3^{c}\pm3.3$ | 0 | 100% |
| | LSD 0.05 | | 3.4 | 2.7 | 2.5 | 2.3 | 1.88 | | |
| | CTRL | | | | | | | 87 | |
| Fenugreek | Petroleum ether | 3 | $36.6^{a}\pm3.3$ | $63.3^{a}\pm3.3$ | $93.3^{a}\pm6.6$ | $93.3^{a}\pm6.6$ | $93.3^{a}\pm6.6$ | 0 | 100% |
| | | 2 | $16.6^{b}\pm8.7$ | $40^{ab}\pm10$ | $60^{b}\pm5.7$ | $60^{b}\pm5.7$ | $63.3^{b}\pm6.6$ | 0 | 100% |
| | | 1 | $0^{c}\pm0$ | $16.6^{bc}\pm8.7$ | $36.6^{bc}\pm13.2$ | $40^{bc}\pm10$ | $40^{b}\pm10$ | 0 | 100% |
| | | 0.5 | $0^{c}\pm0$ | $10^{c}\pm5.7$ | $13.3^{c}\pm6.6$ | $30^{c}\pm10$ | $33.3^{b}\pm12$ | 0 | 100% |
| | LSD 0.05 | | 1.5 | 2.4 | 2.8 | 2.7 | 2.9 | | |
| | Acetone | 3 | 0±0 | 6.6±6.6 | 23.3±8.8 | 23.3±8.8 | 23.3±8.8 | 0 | 100% |
| | | 2 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 6 | 93.6% |
| | | 1 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 12 | 87.2% |
| | | 0.5 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 19 | 79.8% |
| | CTRL | | | | | | | 94 | |
| Laural | Petroleum ether | 3 | $36.6^{a}\pm12$ | $83.3^{a}\pm8.7$ | $96.6^{a}\pm3.3$ | $100^{a}\pm0$ | $100^{a}\pm0$ | 0 | 100% |
| | | 2 | $23.3^{ab}\pm3.3$ | $66.6^{ab}\pm3.3$ | $76.6^{ab}\pm6.6$ | $76.6^{bc}\pm6.6$ | $83.3^{ab}\pm6.6$ | 0 | 100% |
| | | 1 | $10^{b}c\pm5.7$ | $50^{b}\pm11.5$ | $63.3^{b}\pm12$ | $63.3^{b}\pm12$ | $63.3^{b}\pm12$ | 1 | 98.3% |
| | | 0.5 | $0^{c}\pm0$ | $13.3^{c}\pm3.3$ | $16.6^{c}\pm3.3$ | $20^{c}\pm5.7$ | $20^{c}\pm5.7$ | 13 | 79% |
| | LSD 0.05 | | 2.3 | 2.5 | 2.4 | 2.4 | 2.6 | | |
| | Acetone | 3 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 6 | 90.3% |
| | | 2 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 9 | 85.5% |
| | | 1 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 16 | 74% |
| | | 0.5 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 21 | 66% |
| | CTRL | | | | | | | 62 | |
| Thyme | Petroleum ether | 3 | 0±0 | 16.6±6.6 | 20±5.7 | 20±5.7 | 20±5.7 | 0 | 100% |
| | | 2 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 5 | 94.3% |
| | | 1 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 8 | 91% |
| | | 0.5 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 12 | 86.5% |
| | Acetone | 3 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 3 | 96.6% |
| | | 2 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 7 | 92% |
| | | 1 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 14 | 84.2% |
| | | 0.5 | 0±0 | 0±0 | 0±0 | 0±0 | 0±0 | 26 | 70.8% |
| | CTRL | | | | | | | 89 | |

Means followed by the same superscript (s) are not significantly differed by the least significant Difference ($p<0.05$) (Duncan, 1955).

Celery petroleum ether extract induced 100% mortality after two and four days; while acetone extract caused the same result after four and eight days of exposing *C. maculatus*and *S. oryzae*, respectively to the treated grains. It gave 100% reduction in $F_1$-progeny at all tested concentrations with *C. maculates*; while high concentration only caused that with *S. oryzae.*

High concentration (3%) of Fenugreek petroleum ether extracts caused100% mortality after four days of exposure to *S. oryzae* and 93.3% after five days to *C. maculatus*. This extract indicated 100% reduction in $F_1$- progeny to *C. maculatus* in all concentrations. Acetone extract of Fenugreek showed no toxic effect on the two insects; while it caused complete reduction in $F_1$- progeny to *C. maculatus* (Tables1, 2).

Laurel induced 83% mortality after two days to *C. maculatus* and achieved 100% at four days after grains treatment with petroleum ether extract; while it had a moderate effect with *S. oryzae.* Acetone extract of Laurel had no effect on the two insects (Tables 1, 2).

Thyme induced 20% mortality after three days exposure to *C. maculates*; while had no insecticidal effect on *S. oryzae*. High concentration of Thyme caused a complete reduction in $F_1$- progeny of *C. maculatus* but not powerful against *S. oryzae* (Tables 1, 2).These results are in harmony with those obtained by Teotia and Pandey (1979) who reported that petroleum ether extract was the most toxic followed by ether and alcoholic extracts, indicating that petroleum ether is able to dissolve the insecticidal ingredients to relatively greater extent than other solvents. Mohammad and Abdullah (2007) indicated that, Celery seeds extract showed high significant effect on adult mortality of *C. maculatus* at 24 hrs after treatment. Ahmed J. Mhemed (2011) tested four seed powders to evaluate their effects on some biological aspects and mortality of *Trogoderma granarium* Everts, he proved that celery had the lead in mortality action to it.

Afifi *et al*. (1988) observed that acetone extract of seeds of *T. foenum-graecum* was toxic to *S. oryzae* and *Rhizopertha dominica* at 550 ppm, they recommended, fenugreek seeds to be used as addressing material at the rate of 500g /100kg of wheat grains flour. Insecticidal activity of seeds and leaves extracts of Fenugreek against the stored product pests *T. castaneum* and *Canthoscelides obtectus* was found by Jerome (1997).

Essential oil of Thyme had a low mortality effect on *S. oryzae* ranged from 0 to 17%,Wawrzyniak (2009).These results supported by the reports of Ali and Mohammed (2013) who observed that Celery *Apiumgra veolens* was able to induce more than 50% mortality to *T. confuseum* after 0.5 hr., and achieved 93.33% at 5 hrs after treatment. Khoshould and Khayamy (2008) referred to insecticidal effects of ethanolic extract from *Verbascum cheiranthifolium* Boiss against two insect pest species of stored-products and indicated that the mortality of the exposed insects increased with the increase of the exposure interval and dose rate.

### Acaricidal Efficacy of Plant Extract

This study was to evaluate the toxicity of the four plant extractson on the stored grain mites *T. putrescentiae* and *D. farinae*. The high concentration of Celerypetroleum ether extract caused 63.3% mortality to *D. farinae* after 24 hrs. of exposure to treated grains, then raised to 100% after seven days but it had a moderate effect on *T. putrescentiae*. Acetone extract of Celery had a toxic effect ranged

Table (3): Toxicity of some plant extracts on *D. farinae* adults infesting wheat seeds at 30±2°C and 65±5% R.H.

| Plant | Extract | Conc. (w/v)% | Adult mortality after indicated days | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 3 | 5 | 7 |
| Celery | Petroleum ether | 3 | 63.3$^{a}$±0.88 | 80$^{a}$ | 93.3$^{a}$±0.33 | 100$^{a}$ |
| | | 2 | 46.7$^{ab}$±0.88 | 73.3$^{a}$±0.88 | 90$^{a}$±0.57 | 100$^{a}$ |
| | | 1 | 40$^{b}$±0.57 | 46.7$^{b}$±0.33 | 70$^{b}$±0.57 | 90$^{a}$±0.57 |
| | | 0.5 | 16.7$^{c}$±0.33 | 40$^{b}$±0.57 | 56.7$^{b}$±0.33 | 70$^{b}$±0.57 |
| | | LSD 0.05 | 2.1 | 2.4 | 2.24 | 1.33 |
| | Acetone | 3 | 50±0.57$^{a}$ | 80$^{a}$±1.16 | 90$^{a}$±0.57 | 100$^{a}$ |
| | | 2 | 40.3±1.16$^{a}$ | 60$^{ab}$±1.16 | 73.3$^{ab}$±0.33 | 83.3ab±0.88 |
| | | 1 | 10.6$^{b}$±0.33 | 46.7$^{bc}$±0.88 | 56.7$^{b}$±2.9 | 70$^{ab}$±1.16 |
| | | 0.5 | 0.6±0.33$^{b}$ | 26.7$^{c}$±0.33 | 50$^{b}$±0.57 | 53.3$^{b}$±0.33 |
| | | LSD 0.05 | 1.33 | 2.24 | 2.4 | 3.2 |
| | CTRL | | 0 | 0 | 0 | 0 |
| Fenugreek | Petroleum ether | 3 | 83.3$^{a}$±0.33 | 93.3$^{a}$±0.33 | 100a | 100 $^{a}$ |
| | | 2 | 73.3$^{a}$±0.33 | 90$^{a}$±0.57 | 96.7 $^{a}$ ±0.33 | 100 $^{a}$ |
| | | 1 | 50 $^{b}$ ±0.57 | 73.3$^{b}$±0.33 | 80$^{ab}$±0.57 | 93.3 $^{a}$ ±0.33 |
| | | 0.5 | 33.3$^{c}$±0.88 | 53.3$^{c}$±0.88 | 73.3 $^{b}$ ±0.66 | 83.7 $^{b}$ ±0.33 |
| | | LSD 0.05 | 1.33 | 1.63 | 2.24 | 0.77 |
| | Acetone | 3 | 16.7$^{a}$±0.88 | 36.7$^{a}$±0.88 | 46.7$^{a}$±0.88 | 53.3$^{a}$±0.33 |
| | | 2 | 10$^{a}$±0.57 | 20$^{ab}$±1.16 | 30$^{a}$±0.57 | 36.7$^{ab}$±1.16 |
| | | 1 | 3.3$^{ab}$±0.33 | 13.3$^{b}$±0.33 | 20$^{a}$±0.57 | 30$^{b}$ ±057 |
| | | 0.5 | 0$^{b}$ | 3.3$^{b}$±0.33 | 10$^{b}$±0.57 | 20$^{b}$±0.57 |
| | LSD 0.05 | | 1.5 | 2.1 | 1.95 | 2.4 |
| | CTRL | | 0 | 0 | 0 | 0 |
| Laural | Petroleum ether | 3 | 70$^{a}$±0.57 | 83.3$^{a}$±0.33 | 96.7$^{a}$±0.33 | 100$^{a}$ |
| | | 2 | 63.3$^{a}$±0.57 | 80$^{a}$±0.57 | 93.3$^{a}$±0.57 | 96.7$^{a}$±0.57 |
| | | 1 | 56.7$^{a}$±0.88 | 73.3$^{ab}$±0.88 | 83.3$^{a}$±0.88 | 90$^{ab}$±0.88 |
| | | 0.5 | 53.3$^{a}$±0.33 | 63.3$^{b}$±0.33 | 80$^{a}$±0.57 | 86.7$^{b}$±0.33 |
| | | LSD 0.05 | 2.8 | 1.3 | 1.3 | 1.2 |
| | Acetone | 3 | 0 | 0 | 6.7$^{a}$±0.33 | 13.3$^{a}$±0.3 |
| | | 2 | 0 | 0 | 3.3$^{b}$±0.33 | 6.7$^{ab}$±0.33 |
| | | 1 | 0 | 0 | 0 | 0 |
| | | 0.5 | 0 | 0 | 0 | 0 |
| | LSD 0.05 | | 0 | 0 | 0.7 | 0.77 |
| | | CTRL | 0 | 0 | 0 | 0 |
| Thyme | Petroleum ether | 3 | 33$^{a}$±0.88 | 60$^{a}$±0.57 | 90$^{a}$±0.57 | 100$^{a}$±0 |
| | | 2 | 20$^{ab}$±0.81 | 30$^{b}$±0.89 | 70$^{a}$±0.57 | 93$^{a}$±0.3 |
| | | 1 | 10$^{bc}$±0.57 | 33$^{b}$±0.87 | 43$^{b}$±0.33 | 63$^{b}$±0.8 |
| | | 0.5 | 0$^{c}$±0 | 0.3$^{c}$±0.33 | 20$^{c}$±0.57 | 40$^{c}$±0.5 |
| | LSD 0.05 | | 1.7 | 1.5 | 1.5 | 1.2 |
| | Acetone | 3 | 0 | 0 | 0 | 0 |
| | | 2 | 0 | 0 | 0 | 0 |
| | | 1 | 0 | 0 | 0 | 0 |
| | | 0.5 | 0 | 0 | 0 | 0 |
| | CTRL | | 0 | 0 | 0 | 0 |

Means followed by the same superscript (s) are not significantly differed by the least significant Difference ($p<0.05$) (Duncan, 1955).

Table (4): Toxicity of some plant extracts on *T. putrescentiae* dults infesting wheat seeds at 30±2°C and 65±5% R.H.

| Plant | Extract | Conc. (w/v)% | Adult mortality after indicated days 1 | 3 | 5 | 7 |
|---|---|---|---|---|---|---|
| Celery | Petroleum ether | 3 | 33.3$^{a}$±0.33 | 36.7$^{a}$±1.33 | 50$^{a}$±1.52 | 56.7$^{a}$±1.46 |
| | | 2 | 10$^{b}$±0.57 | 13.3$^{b}$±2.9 | 23.3$^{b}$±0.33 | 23.3$^{b}$±0.33 |
| | | 1 | 7$^{b}$±0.33 | 7$^{b}$±0.33 | 16.7$^{b}$±0.33 | 16.7$^{bc}$±0.33 |
| | | 0.5 | 0$^{b}$ | 0$^{b}$ | 3.3$^{c}$±0.33 | 6.7$^{c}$±0.33 |
| | LSD 0.05 | | 1.8 | 2.1 | 1.3 | 1.4 |
| | Acetone | 3 | 63.3$^{a}$±0.66 | 76.7$^{a}$±0.66 | 90$^{a}$±0.57 | 96.7$^{a}$±0.33 |
| | | 2 | 43.3$^{ab}$±0.88 | 56.7$^{b}$±0.33 | 76.7$^{b}$±0.88 | 83.3$^{ab}$±0.33 |
| | | 1 | 33.3$^{b}$±0.88 | 43.3$^{b}$±0.33 | 63.3$^{b}$±0.88 | 76.7$^{bc}$±0.33 |
| | | 0.5 | 23.3$^{b}$±0.33 | 40$^{b}$±1 | 50$^{c}$±1.16 | 66.7$^{c}$±0.57 |
| | LSD 0.05 | | 2.55 | 2.1 | 1.33 | 1.88 |
| | CTRL | | 0 | 0 | 0 | 0 |
| Fenugreek | Petroleum ether | 3 | 70$^{a}$±0.57 | 83.3$^{a}$±0.33 | 96.7$^{a}$±0.33 | 100$^{a}$ |
| | | 2 | 63.3$^{ab}$±0.57 | 80$^{a}$±0.57 | 93.3$^{a}$±0.57 | 96.7$^{ab}$±0.57 |
| | | 1 | 56.7$^{ab}$±0.88 | 73.3$^{a}$±0.88 | 83.3$^{a}$±0.88 | 90$^{bc}$±0.88 |
| | | 0.5 | 53.3$^{b}$±0.33 | 63.3$^{a}$±0.33 | 80$^{a}$±0.57 | 86.7$^{c}$±0.33 |
| | LSD 0.05 | | 1.4 | 2 | 2.5 | 0.77 |
| | Acetone | 3 | 0 | 0 | 6.7$^{a}$±0.33 | 13.3$^{a}$±0.33 |
| | | 2 | 0 | 0 | 3.3$^{a}$±0.33 | 6.7$^{a}$±0.33 |
| | | 1 | 0 | 0 | 0 | 0 |
| | | 0.5 | 0 | 0 | 0 | 0 |
| | LSD 0.05 | | 0 | 0 | 0.77 | 1 |
| | CTRL | | 0 | 0 | 0 | 0 |
| Laural | Petroleum ether | 3 | 0 | 6.6±0.33 | 16.6$^{a}$±1.15 | 23.3$^{a}$±0.33 |
| | | 2 | 0 | 0 | 3.3$^{b}$±0.33 | 10.3$^{b}$±0.33 |
| | | 1 | 0 | 0 | 0 | 0 |
| | | 0.5 | 0 | 0 | 0 | 0 |
| | LSD 0.05 | | 0 | 0 | 2.3 | 2.3 |
| | Acetone | 3 | 0 | 0 | 6.7$^{a}$±0.33 | 13.3$^{a}$±0.3 |
| | | 2 | 0 | 0 | 3.3$^{a}$±0.33 | 6.7$^{a}$±0.33 |
| | | 1 | 0 | 0 | 0 | 0 |
| | | 0.5 | 0 | 0 | 0 | 0 |
| | LSD 0.05 | | 0 | 0 | 0.33 | 1 |
| | CTRL | | 0 | 0 | 0 | 0 |
| Thyme | Petroleum ether | 3 | 10$^{a}$±0.57 | 20$^{a}$±0.57 | 63.3$^{a}$±0.66 | 86.6$^{a}$±0.3 |
| | | 2 | 6.6$^{b}$±0.33 | 13.3$^{a}$±0.33 | 30$^{b}$±0.33 | 43.3$^{ab}$±0.8 |
| | | 1 | 3$^{b}$±0.33 | 13.3$^{b}$±0.33 | 26.6$^{bc}$±0.33 | 40$^{b}$±0.57 |
| | | 0.5 | 0$^{c}$ | 3.3$^{b}$±0.33 | 6.6$^{c}$±0.33 | 23.3$^{c}$±0.3 |
| | LSD 0.05 | | 1.7 | 1.63 | 2.4 | 2.6 |
| | Acetone | 3 | 20$^{a}$±1 | 23.3$^{a}$±1.16 | 36.7$^{a}$±0.88 | 46.7$^{a}$±0.66 |
| | | 2 | 13.3$^{a}$±0.33 | 16.7$^{b}$±0.33 | 20$^{ab}$±0.57 | 23.3$^{b}$±0.33 |
| | | 1 | 0 | 0 | 3.3$^{b}$±0.33 | 3.3$^{c}$±0.33 |
| | | 0.5 | 0 | 0 | 0 | 0 |
| | LSD 0.05 | | 0.7 | 1.5 | 1.2 | 1.8 |
| | CTRL | | 0 | 0 | 0 | 0 |

Means followed by the same superscript (s) are not significantly differed by the least significant Difference ($p<0.05$) (Duncan, 1955).

Table (5): Repellency of celery & fenugreek petroleum ether extracts on *S. oryzae* and *T. putrescentiae* adults infesting wheat after indicated times

| Petroleum ether Extract | Conc. (w/v)% | Mite | % repellency after indicated times 1/2 | 6 | 12 | 24 |
|---|---|---|---|---|---|---|
| Celery | 5% | *S. oryzae* | 63.3 | 66.7 | 70 | 88 |
| | | *T. putrescentiae* | 86.6 | 83.3 | 80 | 86.6 |
| | 10% | *S. oryzae* | 68.3 | 78.3 | 96.6 | 93.3 |
| | | *T. putrescentiae* | 93.3 | 83.3 | 86.6 | 90 |
| | 15% | *S. oryzae* | 70 | 80 | 100 | 100 |
| | | *T. putrescentiae* | 93.3 | 96.6 | 100 | 100 |
| Fenugreek | 5% | *S. oryzae* | 53.3 | 60 | 70 | 75 |
| | | *T. putrescentiae* | 46.6 | 70 | 53.3 | 80 |
| | 10% | *S. oryzae* | 65 | 68.7 | 73.3 | 73.3 |
| | | *T. putrescentiae* | 63.3 | 66.6 | 83.3 | 93.3 |
| | 15% | *S. oryzae* | 70 | 73.3 | 83 | 88 |
| | | *T. putrescentiae* | 90 | 93.3 | 93.3 | 100 |

from 53.3:100% and 66.7:96.7% after seven days for *D. farinae* and *T. putrescentiae* at the tested concentrations, respectively (tables 3,4).

Tables (3, 4) indicated the toxicity of Fenugreek extracts to *D. farinae* and *T. putrescentiae*; petroleum ether extract had high efficacy on both of them (83.7:100%) and (86.6.7:100%), respectively afterseven days. In comparison with acetone extracts which had a moderate effect on *D. farinae* and low on *T. putrescentiae*.

Low concentration of Laurel petroleum ether extractscaused86.7% mortality to *D. farinae* after seven days; while no effect occurred on other mite. while mean acetone extract of Laurel had no toxicity to the two tested mites (Tables3, 4).

Thyme petroleum ether extract caused 100% and 86 % mortality to *D. farinae* and *T. putrescentiae*, respectively, after a week of experiment. On the other hand, the toxicity of Thyme acetone extracts was moderate to *T. putrescentiae*.

Our results are comparable to Afifi and Hafez (1988) who assessed the toxicity of different plant extracts against *T. putrescentiae* when mixed with flour. At 12 ppm complete mortality was achieved after 72 hrs. with the fenugreek extracts; while at 100 ppm, complete mortality was achieved after 24 hrs. exposure. Pemonge *et al*. (1997) also found that the presence of leaves or seeds of *Trigonella* in closed space and volume arena induced adult mortality of *Acanthoscelides obtectus*. All the above mentioned data support the results of the present investigation, the effectiveness of the essential oils of laurel against *Dermatophagoides farinae*. Laurel oil at conc. of 3.3% killed 77.5% of mites after 24 hrs. Kalpaklioglu *et al*. (1996).

**Repellency Experiment:**

As indicated in Table (5), petroleum ether extract of Celery caused 100% repellent effect to *S. oryzae* and *T. putrescentiae* after 12 hrs. of exposure to the high concentration 15% ; while the lowest concentration 5% caused 88 and 86.6% repellency after 24hrs, respectively. On the other hand, Fenugreek caused 88, 100% and 75, 80% repellency after 24hrs. of exposure for 15and5% to *S. oryzae* and *T. putrescentiae***,** respectively.

Concentrations have a definite impact on repellent action because of increasing in active metabolites present in extracts. Usually, insect repellents are acting by providing a vapor barrier deterring the arthropod from coming into contact with the surface, Brown and Hebert (1997). Among them, essential oils, complex mixtures of volatile compounds isolated from a large number of plants, have been found to have these properties against various arthropods, some of them being the basis of commercial repellent formulations As part of future strategies for stored-product insect control, essential oils with repellent and/or insecticidal properties should be studied Curtis *et al.* (1989).

Many studies were conducted to assess the repellent properties of many plants against stored grain pests as a valuable natural resource. Papachristos and Stamopoulos (2002) reported the repellent efficacy of extracts of leaves and stems of *A. graveolens* and *L. nobilis* against *Acanthoscelides obtectus* and extracts of the leaves of *O. basilicum* as a repellent to *C. maculatus*. Ho (1995) reported that non-polar clove extracts were very effective as a repellent to *S. oryzae.*

Therefore, the present investigations indicate that, botanic derivatives may be useful as store insect control agents for commercial use. This study show food repellency and toxicity effects of plant species on each of adult mortality and progeny reduction. The effect of these botanical extracts on the insects and mites can be explained by several hypothesis as following; ovicidal effect on the eggs, the toxic effect on early or first instar larvae, the toxic effect on the adults, the oviposition repellency to the insects and mites. Thus, more studies are needed on these plants to establish their potential sources which may lead to their improvement as protectants in direct application assay.

## REFERENCES


Abbot, W. J. 1925.A method for computing the effectiveness of an insecticide. J. Econ. Entomol., 18: 265-276.

Afifi, F. A. and Hafez, S. M. 1988. Effect of different plant extracts on the toxicity and behavior of *Tyrophagus putrescentiae* Shrank (Acari: Acaridae). Ann. of Agric. Sci. Cairo, 33 (2): 1375-1385.

Afifi, F. A.; Hekal, A. M. and Selem, M.1988. Fenugreek seed extracts as protectants of wheat grains against certain stored product insects. Ann. Agric. Sci., Cairo, 33 (2): 1331-1341.

Ali, W. K. and Mohammed, H. H.2013.Toxic Effect of Some Plant Extracts on the Mortality of Flour Beetle *Tribolium confusum* (Duval) (Coleoptera: Tenebrionidae). Entomol. Ornithol. Herpetol., 2: 115.

Brown, M. and Hebert, A. A. 1997. Insect repellents: an overview. J. Am. Acad. Dermatol., 36: 243–249.

Curtis, C.; Lines, J.; Lu, B. and Renz, A. 1989.Natural and synthetic repellents. In: Curtis, C.F. (Ed.), Appropriate Technology in Vector Control. CRC Press, Florida. Chapter 4.

Dimetry, N. Z.; El-Gengaihi, S. and AbdElSalam, A. M. E. 2007.Protection of stored cowpea from *Callosobruchus maculates* (F.) attack by some plant extract formulations in different storage sacks. Herpa. Polonica., 53(1): 71-84.

Duncan, D. B. 1951.A significance test for differences between ranked treatments in an analysis of variance. Virginia J. of Sci., 2:171–189.

El-Lakwah, F. A.; Darwish, A. A. and Halawa, Z. A. 1996.Toxic effect of extracts and powders of some plants against the cowpea beetle, *Callosobruchus maculatus*(F).Ann. of Agric. Sci. Moshtohor, 34(4): 1849-1859.

Ho, S. H. 1995.Grain quality maintenance through the use of bioactive compounds from spices. 17ASEAN Technical Seminar on Grain Postharvest Technology, Perak, Malaysia.

Jerome, P.; Jesus, P. M. and Catherine, R. 1997. Effects of material and extracts of *Trigonellafoenum graecum* L. against the stored product pests *Tribolium castaneum* (Herbst) (Coleoptera:Tenebrionidae) and *Acanthoscelides obtectus* (Say) (Coleoptera: Bruchidae). J. of Stored Product Res., 33(3): 209–217.

Kalpaklioglu, A. F.; Ferizli, A. G.;Misirligil, Z.; Demirel, Y. S. and Gurbuz, L. 1996. The effectiveness of benzyl benzoate and different chemicals as acaricides. Allergy, 51(3): 164-170.

Khoshould, H. and Khayamy, M. 2004. Insecticidal affect of ethanolic extract from *Verbascumcheir anthifolium* boiss. against two stored-producy insect pests species. J. Bio. Sci., 8(1):191-195.

Mhemed, A. J. 2011. The efficacy of seed powders on some biological aspects and mortality of Khapra beetle. The Iraqi J. of Agric. Sci., 42(6):112 – 123.

Mohammad, O. S. and Abdullah, B. S. 2007. Host preference of *Callosobruchus maculates* (Fab.) and their effect on biological characters with particular reference to its control. Al Rafidane Agric. J., 35(3): 122 –130.

Papachristos, D. P. andStamopoulos, D. C. 2002. Repellent, toxic and reproduction inhibitory effects of essential oil vapours on *Acanthoscelides obtectus* (Say) (Coleoptera: Bruchidae). J. Stored Prod. Res., 38: 117–128.

Pemonge, J.; Pascual- Villalobos, M. J. and Regnault-Roger, C. 1997. Effects of material and extracts of *Trigonellafoenum graecum* L. against the stored product pests *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) and *Acanthoscelides obtectus* (Say) (Coleoptera: Bruchidae). J. of Stored Products Res., 33:209-217.

Sagheer, M.; Mansoor, H.; Malik, N.; Muhammad, F.; Fawad, Z. A. K. 2014. Repellent effects of selected medicinal plant extracts against rust-red flour beetle, *Tribolium castaneum*(Herbst) (Coleoptera: Tenebrionidae). J. of Entomol. and Zool., 2(3): 107-110.

Solomon, M. E. 1946. Tyroglyphid mites in stored products. Nature and amount of damage to wheat. Ann. Appl. Biol., 33: 280-289.

Su, H. C. F. 1985. Laboratory study on effects of *Anetiumgra veoleus* seeds on four species of stored product insects. J. Econ. Entomol., 78: 451-453.

Teotia, T. P. S. and Pandey, G. P. 1979.Insecticidal properties of rhizomes of sweet flag *Acorus calamus* against rice weevil *Sitophilus oryzae* Linn. Ind. J. Entomol., 41(1): 91-94.

Wawrzyniak, M. M. 2009.Effect of plant essential oil on the development and fertility of grain weevil (*Sitophilus granaries* L.). J. Cen. Euro. Agric., 10(4):357-360.

Zdarkova, E.1991.Stored product acarology. In: Dusbabek, F., Burkva, V. (Eds.), Modern Acarology 1, Academic Press, Prague: 211-218.