
SUMMARY

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I- Laboratory Experiments:

1-Effect of Volatile oils "Apilife VAR" on controlling of wax moths larvae:

- The efficacy of volatile oils expressed as percentage of wax moths larvae mortality was investigated during this work. It was obviously increased with increasing concentration of "Apilife VAR" as well as by increasing time after treatment.

- Average mortality in control treatment was 42.86%. In case of applying plant volatile oils "Apilife VAR" the average mortality was increased from 71.07% to 97.5% by increasing concentrations of Apilife VAR in diet from 0.6 to 4.0 g / 100 g diet, respectively.

- The average mortality was increased from 48.5% to 100% by increasing time after treatment from 3 to 39 days, respectively. After 3 and 39 days the morality averages recorded in untreated-larvae (control) were 12.5% and 52.5%, respectively.

- The average mortality of wax-moths larvae reached to 97.5% and 100% 15 days after applying the volatile oils "Apilife Var" at 3.2, and 4.0 g / 100 g medium, respectively.

- The percentages of alive pupae, emerged adults as well as laying eggs per female adult were sharply decreased by increasing concentration of the Apilife VAR in artificial diet compared with control treatment. No adults were emerged when volatile oils mixture was used at rate of 2.8 g per 100 g of the feeding artificial diet. Meanwhile, the few adult females emerged on diet treated with volatile oils

mixture at rate of 2.0 or 2.4 g/100 gram diet failed to laying eggs.

2-Effect of *Datura stramonium* and *Melia azaderachta*-powder on the mortality of wax moths larvae:

- In this experiment, the fine powdered leaves of *Datura stramonium* and *Melia azedrachta* plants was used at different concentration for testing their efficacy on mortality of wax-moths larvae.

- The obtained results proved that powder of *D. stramonium* plant was more effective in general than powder of *M. azedrachta*. The averages of larval mortality caused by these two plant powders were 68.36% and 59.79%, respectively.

- Increasing concentration of both plant powders increased the average mortality. It was increased from 36.86% (in control treatment) to 59.14%, 67.14%, 70.57%, and 76.57% when powder of *Datura* plant was used at 1g, 4g, 8g and 20g, respectively. However, average mortality caused by using powder of *Melia* plant at the same four concentrations were 54.0%, 59.43%, 59.71%, and 66.0%, respectively.

- The average of larval mortality was increased by increasing time after plant powder-treatment. Increasing time after treatment from 3 to 39 days increased the average mortality from 16.0% to 100.0%, respectively (in case of powder of *Datura*-plant) and from 13.0% to 89.5%, respectively (in case of powder of *Melia*-plant).

- In general, the obtained results indicated that powder of *D. stramonium* plant was more effective in controlling wax-moths larvae than powder of *M. azedrachta*.

- The powdered leaves of *D. stramonium* and *M. azadarachta* plants exerted deleterious effect on life cycle of

the lesser wax moths *Achoria grisella* when added to their diets. Such adverse effect was increased by increasing concentration of a given plant powder. The powder of *Datura* plant resulted in complete suppress of oviposition even at the lowest tested rate (1g / 100 g diet).

3-Effect of carbon dioxide and phosphine on controlling of wax-moths larvae:

3.1- Efficacy of applying different concentrations of carbon dioxide against the larvae of wax-moths:

- In this experiment, controlling wax-moths larvae by exposure to carbon dioxide at different concentrations i.e. 0% (control), 25%, 50%, 75%, and 100% at two temperatures (23 and 30 °C) was investigated.

- The average larval mortality was increased by increasing concentrations of carbon dioxide up to 100%, prolonging exposure from 3 to 12 days and by elevating temperature from 20 °C to 30 °C.

- After exposing for 3 days at 20 °C, average % mortality was gradually increased from 10.0% (in control treatment) to 16.7%, 20.0%, 23.3% by increasing concentrations of carbon dioxide from 0% (in control treatment) to 25%, 50, and 75%, respectively. After 3 days at 30 °C, the same concentrations of carbon dioxide resulted, however, in 6.7%, 23.3%, 53.3%, and 60.0% mortality of wax-moths larvae, respectively.

- The same trend of the larvae mortality was noticed after 6 and 12 days. The averages mortality in larvae treated with 25%, 50%, and 75% of carbon dioxide and exposed at 30 °C were 36.7%, 86.7% and 90.0%, respectively.

- It could be concluded that the response of wax-moths larvae to the different concentration of CO_2 pressure tests (in term of % mortality) was more pronounced at the higher

temperature (30 °C) than the lower one (20 °C). This means that applying the highest concentrations of CO_2 i.e. 75% and 100% are the suitable conditions for controlling of wax-moths larvae especially in the hot weather or in the summer season.

3.2- Efficacy of applying phosphine alone or mixed with different concentrations of carbon dioxide on controlling the wax-moths larvae:

- In this experiment, wax-moths larvae were exposed for to a fixed concentration of phosphine (PH_3) either alone or mixed with different concentrations of CO_2 for 24, 48 or 72 h at two different temperatures (20 or 30 °C). Untreated wax-moths larvae, kept at the same temperatures for the same periods, was served as control.

- The present results indicated that, the mixture containing both carbon dioxide and phosphine was more effective in controlling wax-moths larvae than phosphine alone. Average mortality in case of applying phosphone alone was 27.2% compared with 6.13% in case of control treatment. However, phosphine mixed with 25%, 50%, 75%, and 100% carbon dioxide, increased averages of mortality to 83.33%, 88.88%, 85.55 and 100.0%, respectively.

- As for exposure temperatures, the same results showed no clear variations in the average mortality at the tested temperatures.

- It is worthy to state that mixture containing both phosphine and CO_2 accelerated the death of wax-moths larvae than phosphine or CO_2 each alone. The average mortality reached its maximum (100%) after 48 h only by using mixture containing phosphine + 50 CO_2 at 20 C or phosphine + 75 CO_2 30 C. Such level of mortality could be never obtained when CO_2 was used alone at these concentrations. Thus, the mixture containing phosphine and

50% or 75% of CO_2 could be recommended for controlling the wax moths larvae in stored bees-wax comps.

II- Applied Experiments:

1-Effect of treating healthy wax-combs in stored hive boxes with different plant powders on controlling the wax-moths larvae:

- In this field test, healthy combs (8 combs) were stored with other combs infested with wax-moths larvae (2 combs). Powdered leaves of *D. stramonium*, *D. plumieri*, and *M. azadarachta* were used for dusting healthy combs only. Efficacy of these plant powders expressed as % infested combs was recorded.

- The obtained results indicated clearly that the average of % infested combs were greatly varied and depended on type of the tested plant powder.

- The powdered leaves of *Datura*- plant produced the lowest average of infested combs (6.25%) followed by powdered leaves of *Melia*-plant (13.54%), powder of *Duranta* -plant leaves (18.75%). The average of infested combs in control treatment 7, 14, and 21 days were 33.33%, 41.67%, and 45.83%, respectively with a mean average of 38.54%.

- Whatever, responses with the tested plant powders was clearly varied through the period of experiment. In case of *Datura*-plant powder the percentages of infested combs were 4.17%, 12.5% , 0.0% after 7, 14, and 21 days, respectively. In case of powder of *Melia*-plant leaves averages of % infested combs were 8.33% , 16.67% , and 20.83% for the same periods, respectively.

2-Effect of applying Formic acid, Methyl salysilate and Acetic acid with two different methods in controlling wax-moths larvae in stored combs:

- In this experiment, Formic acid (FA), Methyl salysilate (MS) and Acetic acid (AA) were used for controlling wax-moths larvae in stored combs either by spraying health wax-combs twice (2 weeks in between) or by placing the varr-formic apparatus containing them inside hive boxe. Efficacy of these treatments in controlling wax-moths larvae compared with control (expressed in term of % infested combs) was recorded 2, 4, and 6 weeks after the initial treatment.

- The obtained results showed that spraying method was more effective and better than the varro-formic apparatus method for using any of the tested organic compounds in minimizing infestation of combs with wax-moths larvae.

- Percentage of infested combs in control treatment was 40.45%. However, spraying with MS, FA, and AA decreased it to12.5%, 4.17%, and 5.56%, compared with 12.5%, 31.94%, and 22.22% in case of the varro-formic apparatus, respectively.

- With varro-apparatus, MS was the superior compound for controlling wax-moths larvae in stored combs. However, MS solution must be replaced in varro-apparatus, at least every 3-4 weeks.

- With spraying method (using atomizer), both MS and FA lead to complete eradication of comb-infestation with wax-moths larvae (0.0%) after 6 weeks from the initial spray.

- The results concluded that infestation of wax-combs with the wax-moths larvae on stored combs could be lowered or completely eradicated by applying solutions of the organic compounds MS (by using varro-formic-apparatus placed inside hive boxes) or using atomizer spraying healthy combs every two weeks with FA solution.

3- Effect of spraying bees wax combs with mixture of volatile oils (Apilife VAR) on controlling wax moths larvae during storage:

- All tested concentrations of the mixture of volatile oils were effective in controlling wax comb infestation with wax moths larvae even at its lowest concentration.

- Infested combs % in control treatment was gradually increased by increasing storage period up to 7 weeks (average 43.29%) while it was gradually decreased in wax combs treated before storage.

- . Average percentage of infested combs (during 7 weeks) was decreased to 19.17%, 5.81%, 4.60%, 3.52%, 1.67%, 0.48% (with an average 5.88%) by spraying healthy beeswax combs, before storage, with watery solution containing 6%, 8%, 10%, 12%, 14% and 20% Apilife VAR, respectively.

- The infestation with wax moths larvae was completely disappeared (0.0 %) after 7, 5 and 3 weeks from spraying healthy beeswax combs by Apilif VAR at concentrations of 14%, 16%, and 20%, respectively.

- Spraying both healthy in infested wax combs, lead to complete eradication of infection with wax moths larvae (0.0% infested combs) 2, 5, 6, and 7 weeks after treating with Apilife VAR at concentrations 20%, 14%, 12% and 10%, respectively.