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Evaluation of soluble powder formulation of alum and citric acid as alternative pesticides against mealy bugs under filed conditions

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ABSTRACT

Citric acid and alum were prepared as soluble powder formulations (Sp 90 %). The insecticidal activity of both formulations against the striped mealy bug, *Ferrisia virgata* (Cockerell) (Hemiptera: Pseudococcidae) on Sweet Acacia, *Acacia farnesiana* (L.) (Leguminosae) was evaluated under filed conditions. The obtained data indicated that, both tested compounds showed a slight activity after three days from treatment, then their activity increased gradually to give the highest effectiveness after 18 days. The reduction percentages after18 days were 93.3 and 85.9 at 125 ppm incase of citric acid and alum respectively, where as the respective LT_{50} values were 7.4 and 7.2 day. On other hand, there are significant differences were found between tested concentrations, exposure periods and the interaction between tested concentrations and exposure periods. According to our data citric acid and alum as soluble powder formulations exhibited highly activity and are potential candidates as new alternative pesticides for the control of mealy bug on Acacia plants.

Key Words: *Ferrisia virgata*, Soluble powder formulation (Sp) of Alum and Citric acid, Alternative Pesticides against Mealy Bugs

INTRODUCTION

The Striped mealy bug, *Ferrisia virgata* (Cockerell) (Hemiptera: Pseudococcidae**).** This species is one of the mealybug vectors of "swollen shoot" virus disease of cacao in West Africa Hanna *et al*. (1956). The scale insect, *F. virgata* attack wide range of ornamental plants in Egypt Nada, (1986). The white mealy bug *F. virgata*, which is a polyphagous pest, was also found causing serious damage to *S. rhombifolia*, desapping the plants from the tender portions Kumar, *et al*. (2002). *F. virgata* was observed causing considerable economic damage on mango (Godse, & Bhole, 2003). *F. virgata* is an important pest on ornamental plants and fruit trees Mangoud (2008). Damage is caused by *F. virgata* feeding on host tissues into host plants. In addition, *F. virgata* secrete a waste product, honeydew, which is a syrupy, sugary liquid that falls on the leaves, coating them with a shiny, sticky film. Honeydew serves as a medium for the growth of sooty mold fungus that reduces the plant's photosynthetic abilities and ruins the plant's appearance. Feeding by *F. virgata* can cause premature leaf drop, dieback, and may even kill plants if left unchecked.

Increasing incidence and development of pest resistance to conventional insecticides, and great public concern over the effects of chemicals on man and the environment have always generated a need for finding out materials having specific mode of action to replace the conventional insecticides Su *et al*. (1972). For these reasons, the best solution for this problem is using some pesticide alternatives that were more effective against pests, to remain for a short period in the field, safe and cheap

such as inorganic salts and antioxidant. The successful use of any active ingredient depends on its correct formulation into a preparation, which can be applied for crop protection with safety to these applying materials to animal life and to the environment. In general, formulation plays an important role in agriculture field; it makes a very small amount of active component to spread over a very large area. Also it facilitates the penetration of the active ingredient to reach its target and achieve its action (EL-Kady, 2008). Soluble powder formulations (sp) are the simplest formulations. The pesticide which can be formulated is limited by solubility and hydrolytic properties FAO, WHO Meeting (2002).

The purpose of this work is to evaluate of inorganic salt (alum) and organic acid (citric acid) as soluble powder formulation against *F. virgata* under filed conditions.

MATERIALS AND METHODS

Materials

Soluble powder, formulation (Sp 90%) were prepared according to method described with EL-Kady (2008).

Bioassay

The experiment was conducted in open filed according to the Ministry of Agriculture Protocol (1999) on *Acacia farnesiana* (L.) (Leguminosae) infested by the Striped mealybug *F. virgata* at Plant Protection Research Institute, Agriculture Research Center, Dokki, Giza, Egypt. Both alternatives compounds (Citric acid and Alum fromulation Sp 90%) were tested at 125, 250, 500 and 1000 ppm concentration and sprayed by CBR sprayer at 18, July, 2009. Infestation was assessed before spraying and then after 3, 6 and 18 days by collecting (10) branches from each treatment and untreatment plot. Inspection was done under binocular in laboratory to determine the number of each of considered sucking pests per branch. The pesticide efficiency was calculated as reduction percentage occurred in the population according to the equation adopted by Henderson and Tiltone (1995).

Statistical analysis

The pesticide efficiency was calculated as reduction percentage(% R) occurred in the population according to the equation adopted by Henderson and Tiltone (1995).

$$\% R = 1- (Cb / Ca \times Ta / Tb) \times 100$$

Where Cb = mean alive number of pest / leaf in untreated before spraying.

Ca = mean alive number of pest / leaf in untreated after spraying.

Tb = mean alive number of pest / leaf in treatment before spraying.

Ta= mean alive number of pest / leaf in treatment after spraying.

The results obtained were subjected to statistical analysis according to Snedecor (1996) and the least significant differences between treatments were calculated. The dosage-time regression lines were drawn according to method of Finney (1952).

Identification of *F. virgata* was carried out by using the insect cutes collection list.

RESULTS AND DISCUSSION

The percentage of reduction in population of *F. virgata* as influenced by different concentrations of Citric acid and Alum that were prepared as soluble powder (Sp) formulations, are presented in the tables 1&2. This reduction gradually increased by increasing the used concentration. Generally, the both tested compounds showed a slight effectiveness against *F. virgata* after three days from treatment and increased to give the highly effectiveness after 18 days. On the other hand, at three days citric acid was more effective than alum. Also,

the citric acid showed a regration relationship between tested concentrations and their percentages of reduction. On contrary all tested concentrations of alum recorded the nearest reduction values.

Table (1): Evaluation of locally formulate citric acid against *F. virgata* under filed conditions after three exposure time.

Days after treatment / Concentric ppm	Reduction %			General mean for Concentric
	3	6	18	
0	0	0	0	0
125	12.6	57.3	93.3	54.4
250	16.6	82.3	94.9	64.6
500	24.6	83.2	96	67.9
1000	57.8	87.9	97	80.9
General mean for time	22.3	62.14	76.2	

L.S.D for
Concentration = 9. 2
Time = 7.3
Concentration × Time = 4.8

Table (2): Evaluation of locally formulate Alum against *F. virgata* under filed conditions after three exposure time.

Days after treatment / Concentric ppm	Reduction %			General mean for Concentric
	3	6	18	
0	0	0	0	0
125	14.2	76.5	85.9	58.9
250	14.8	89.1	99.1	67.7
500	14.1	97.6	99.6	70.4
1000	14.7	97.9	99.7	70.8
General mean for time	11.6	72.2	76.9	

L.S.D for
Concentration = 5.5
Time = 4.1
Concentration × Time = 9.1

Regarding to general mean of citric acid and alum data clearly indicated significant decrease in the number of *F. virgata* at the four applied concentrations as compared with untreated control. The percentages of reduction were 54.4, 64.6, 67.9 and 80.9 incase of citric acid where as it was 58.9, 67.7, 70.4 and 70.8 incase of alum at the concentrations 0, 125, 250, 500 and 1000 ppm, respectively.

With other point of view, the percentages of reduction was increased significantly with increasing of exposure periods recording 22.3, 62.14 and 76.2 incase of citric acid and 11.6, 72.2 and 76.9 incase of alum at 3, 6 and 18 days respectively. Considering the interaction between four concentrations of both tested compounds and exposure periods was significant. The L.S.D. values were 4.8 and 9.1 incase of citric acid and alum, respectively. As show in table (3) both tested compounds showed nearest LT_{50} values 7.4day incase of citric acid and 7.2 incase of alum.

Table (3): LT_{50} of locally formulated compounds against *F. virgata*

locally formulated compounds	LT_{50}	LT_{90}	Slope
Citric acid sp 90 %	7.4	16	3.9
Alum sp 90 %	7.2	8.4	19.4

On contrary slop value of citric acid was less than alum. No phytotoxicity was noticed on treated plants. From above results it could be concluded that the two prepared formulations were effective against *F. virgata*. This effectiveness was noticed as slight reduction percentages after three days and increased gradually to give the highly effectiveness after 18 days from treatment. These results agree with those obtained by EL-Kady (2008).

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ARABIC SUMMARY

تقييم فاعلية كل من الشبة وحمض الستريك (المجهزين على صورة مسحوق قابل للذوبان فى الماء) كبدائل للمبيدات ضد البق الدقيقى تحت الظروف الحقلية

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تم تقييم كفاءة كل من حمض الستريك و الشبة و اللذان تم تجهيزهما على صورة مسحوق قابل للذوبان فى الماء (Sp٩٠ %) ضد حشرة البق الدقيقى (*F. virgata*) على نبات الكاسيا (*A. farnesiana*) تحت الظروف الحقلية . وقد أوضحت النتائج المتحصل عليها أن كل من المركبين لهما كفاءة إبادية ضد حشرة البق الدقيقى حيث يبدأ تأثيرهما طفيفاً فى الثلاث أيام الأولى من المعاملة ثم تزداد تدريجياً حتى تصل إلى أقصى فاعلية بعد اليوم الثامن عشر من المعاملة. وقد قدرت أعلى قيمة فاعلية للمركبين عند تركيز ١٢٥ جزء فى المليون بـ ٩٣,٣ % ٨٥,٩ % لكل من الشبة وحمض الستريك على الترتيب ومن ناحية أخرى فقد كان الوقت اللازم للتأثير على ٥٠ % من الأفراد المعاملة ٧,٢ & ٧,٤ يوم لكل من الشبة وحمض الستريك على الترتيب. و من ناحية أخرىفقد وجدت فروق معنوية مابين التركيزات المختبرة و كذلك مابين فترات التعريض و التداخل مابين التركيزات و فترات التعريض. يتضح من ذلك أن كل من المركبين بعد تجهيزاهما فى صورة مسحوق قابل للذوبان فى الماء أظهرا فاعلية عالية ضد حشرة البق الدقيقى مما يضعهما ضمن ا لبدائل الأمنة للمبيدات الكيماوية فى مكافحة البق الدقيقى على نبات الكاسيا.