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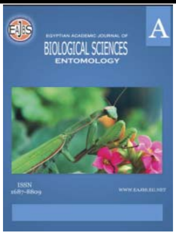

Using Certain Inorganic Salts as a Chemosterilant Against Cotton Leafworm *Spodopter alittoralis* (Boisd.)

Marwa, M. El-Sabagh[1]; Shimaa, M. Desoky[2] and Yasmein, E. Ahmed[1]
1-Plant Protection Institute, Agric. Research Centre, Dokki, Giza, Egypt
2-Botany and Microbiology Department, Faculty of Science, Suez University

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ABSTRACT

Six inorganic salts were evaluated as possible sterilants against the cotton leaf worm, *Spodoptera littoralis*, by applying the pupal dipping technique. Results showed that all of the tested salts adversely affected the adult emergence and reduced the egg laying capacity and egg hatchability. The salts, NaoH, Ca $(oH)_2$ and $ZnSO_4$ gave 100% percent sterility with all tested nontoxic concentrations. Percentage of sterility increased with the increase of the concentration. All other salts induced degrees of sterility ranging from 55 to 75%. Treatment with these inorganic salts also caused several malformations in pupae and resulted moths.

INTRODUCTION

The Egyptian cotton leafworm, *S. littoralis* (Boisd.) is an important pest in Egypt and other countries in Africa and Asia causing extensive economic losses in many cultivated crops (Frank *et al.,* 1990). The extensive use of insecticides for controlling *S. littoralis* caused harmful effects on humans, living organisms and environment (Franz, 1974; Chantelli-Forti *et al.,* 1993 and Chaudhuri *et al.*, 1999). Furthermore, this insect became resistant to various classes of insecticides (Denholm *et al.,* 1998). In order to avoid these hazards, there is a great need to develop alternative safe control agents with new modes of action.

The new trend of pest control is searching for safe and available alternative materials of dangerous insecticides. Among these alternative materials is chemo sterilization of the insects in adult stages, less effort has been made on treatment of the pupal stages. Pandery and Teotia (1980) tested 18 alkylating compounds, 10 antimetabolites and 8 compounds belonging to miscellaneous groups by pupal dipping methods, they found that the promising chemosterilant for *Sitotroga cerealella* (Oliver) are to be found among the aziridines especially Tepa, Metepa, Thiotepa and ENT50761 at low concentrations causing high sterility. Neerja and Upadhyay (1985) recorded that sterility can be induced in adults of rice moth Corcyra cephalonica (Stant) following pupal dipping methods in different amino acids: Ornithin, ά-Glutamine, Valine, Serine and Alanine. Sharaby (1987) found that twenty four inorganic salts evaluated as sterilants for the lesser cotton leafworm *Spodoptera exigua* (Hubn.), by applying the pupal dipping techniques in a screening program. A Compendium of inorganic substances used in European pest control before 1850 were recorded by Smith and Secoy (1976); a list of 24 inorganic chemicals used in

European agriculture up to 1850for pest control is given, together with description of their recorded. Attempts have been made to assess their possible efficacy. In the present study some inorganic salts were tested for their efficacy by pupal dipping techniques with a view to evaluate the promising and effective chemo-sterilants against cotton leaf worm *S. littoralis* (Boisd) as a new approach in its control programs.

MATERIALS AND METHODS

A-Rearing of *S. littoralis* (Boisd):

The culture of the cotton leafworm, *S. littoralis* (Boisd) was initiated from freshly collected eggs masses supplied from the division of cotton leafworm of plant protection research Institute, Dokki, Egypt, formed the basis of the culture designed to provide insects used in the present work. All stages of *S. littoralis* were cultured and tested at 27±2° C and 70± 5 % R.H. Larval stages were reared on caster bean leaves which were provided daily. The formed pupae were collected and placed in clean Jars with moist saw dust placed at the base to provide the pupation site. Adults were provided with 10% sugar solution.

B- The Tested Inorganic Salts:

Hydroxides: NaOH and Ca $(OH)_2$.

Chlorides: $LiCl_2$,

Sulphate: Mg So_4 and $ZnSo_4$

Bromide: KBr

To assess the inorganic salts for production of sterile adults of *S. littoralis*, different concentrations were prepared as follows: 5, 10 and 15% by dissolving in distilled water.

The experiments were carried out by placing the pupae in a small wire basket and immersed inside a beaker (500ml) containing the tested salt solution for 20min as dipping period. Treated pupae were washed with water and left to dry, then introduced into a glass jars, left till adult emergence. Both sexes of pupae were accordingly treated with the same treatment, while the control was treated with distilled water. Six pupae were used for each test; all testes were repeated three times. Observations on the percentage of adults emergence from pupae were recorded both from treated and untreated individuals, furthermore, any induced malformations were recorded, either in pupae or emerged moths.

To evaluate the fecundity of adults and egg hatchability, treated pupae were collected; sexed and emerged moths were placed in pairs in breeding glass globes, supplied with leaves of tafla, *Nerium oleander* (L.) as an oviposition site. Each globe was provided with 10 % honey solution soaked in cotton wool which was placed in small plastic cup for moths feeding. The honey solution was renewed daily to avoid fermentation and growth of microorganisms.

Egg laying (total number of eggs per female) calculated from daily counts of deposited eggs on piece of paper. Egg hatchability percentage calculated according to Zidan and Abdel-Megeed (1987) as follows:

$$\%\ \text{Egg hatchability} = \frac{\text{No. hatched eggs}}{\text{No. deposited eggs}} \quad X100$$

Sterility observed percentage calculated according to Zidan and Abdel-Megeed (1987) as follows:

% Sterility observed = 100 –Egg hatchability percentage

Furthermore, any induced malformations were recorded, either in pupae or emerged moths.

RESULTS AND DISSCUTION

Results for assess the 6 inorganic salts at various concentrations are given in Table (1). It is apparent from the results that three salts gave the best results where they gave 100% sterility at the different tested concentrations. The three salts were as follows: Hydroxides: NaOH, Ca (OH) $_2$ and Sulphate: $ZnSO_4$, Meanwhile both of $LiCl_2$and $ZnSo_4$gives the percentage of100%sterilityatthe high concentrations, all other salts induced degrees of sterility ranging from 55 to 75%. All tested salts adversely affected the adult emergence and reduced the egg laying capacity and egg hatchability comparing to the control test. The sterility produced was of a high level for most of the tested salts, percentages of fecundity and hatchability were significantly reduced by increasing the salt concentration.

Table 1: Effect of pupal dipping of *S. littoralis* in different concentrations of inorganic salts for on the adults fecundity and sterility.

Tested Salt	Concentration %	Dipping Period (min.)	Adult Emergence (%)	Mean no. of eggs/female ± S.E.	Mean no. hatched eggs/female ± S.E.	Eggs hatchability (%)	Sterility (%)
NaoH	5	20	78	303±0.588235***	-	0	100
	10	20	70	217±4.117647***	-	0	100
	15	20	61	201±1.764706***	-	0	100
$Ca(oH)_2$	5	20	60	476±1.176471***	-	0	100
	10	20	57	352±1.176471***	-	0	100
	15	20	40	264±2.352941***	-	0	100
$LiCl_2$	5	20	60	338±1.764706***	82±1.176471***	24.26	75.74
	10	20	54	209±4.705882***	-	0	100
	15	20	38	114±2.352941***	-	0	100
$MgSo_4$	5	20	73	509±3.529412***	228±4.705882***	44.79	55.21
	10	20	65	446±8.235294***	182±1.176471***	40.80	59.2
	15	20	43	411±4.117647***	-	0	100
$ZnSo_4$	5	20	68	983±1.764706***	354±2.352941***	0	100
	10	20	55	525±2.941176***	-	0	100
	15	20	39	85±1.764706***	-	0	100
KBr	5	20	71	777±4.117647***	330±0.588235***	42.47	57.53
	10	20	63	534±2.352941***	201±0.588235***	37.6	62.4
	15	20	42	390±2.941176***	103±0.588235***	26.41	73.59
Control	-	20	100	2532±1.176471	2489±2.352941	98.30	1.7

***: Very highly significant at P> 0.001

Sharaby (1987**)** recorded that some inorganic salts had a promising effect as chemosterilant against *S. exigua* by appling the pupal dipping method in a screening program. Among the tested salts, $Ca(oH)_2$, $NaOH_2$, $LiCl_2$, $CuCl_2$, $NHCl_2$,CH_2COOLi, $ZnSo_4$, KBr and KI gave 100% sterility at the tested non toxic concentration under different pupal dipping periods, another salts induced various degrees of sterility ranging from 31-97%. Soluble inorganic salts are transported across cell membranes (Frings, 1946 and Dethier, 1955) and it was suggested that the penetration of the salts through the cell membrane is according to the order of ionic mobility which will determine the order of effectiveness. Effect of the tested salts might be a result of accumulation of salt ions in the tissues of the pupae after treatment and their interference with the biological processes of the pupae, causing retardation in development of the reproductive system. It might be also of some adverse effect on the viability of sperms and ovaries in either sex of *R. ferruginous* adults. Gehad *et al.* (2007) recorded the toxic effect of some inorganic groups (Copper sulfate, Copper hydroxide, Copper oxychloride) was great toxicity on some piercing sucking insects (Aphids, *Aphis gossypii.,* white fly*, Bemisia tabaci.,* Gassyd*, E. lybica.,* and Mites, *Tetranycus urtica*) that infested the small seedlings of cucumber plants. The tested materials have a great toxicity as acaricidal and insecticidal agents for controlling the pests without any harmful effect on the treated plant. Sharaby and Ibrahim. (2011) studied the ability of fifteen inorganic salts to be used as possible sterilants against the Red Palm Weevil (RPW) *R. ferrugineus*, by applying the pupal dipping method in a screening program, and the results showed that all tested salts adversely affected the adult emergence and reduced the egg laying capacity and egg hatchability. Salama and Sharaby (1973) discussed the effect of $ZnSO_4$ on the feeding and growth of *S. littoralis* and they found accumulation of Zinc in tissue of the larvae seems to be the factor inducing moth's sterility. Flint *et al.* (1968) conducted the screening test with several compounds including aziridines, methanesulphnates, nitrogen mustards, phosphor amides and urea derivatives bytopical application or feeding to adult *Heliothis virescens*. They showed that azirdines were the only promising chemosterilant to the Lepidopteras insects.

Our obtained results clearly indicate that the pupae treatments of *S. littoralis* with inorganic salts induced many malformations in both pupae and adults. The induced morphogenetic effects were observed as pupal-adult intermediates (Fig.1 A1). Many moths failed to spread their poorly developed wings (Fig.1 B1), while others failed to shed their puparium (Fig.1 B2).

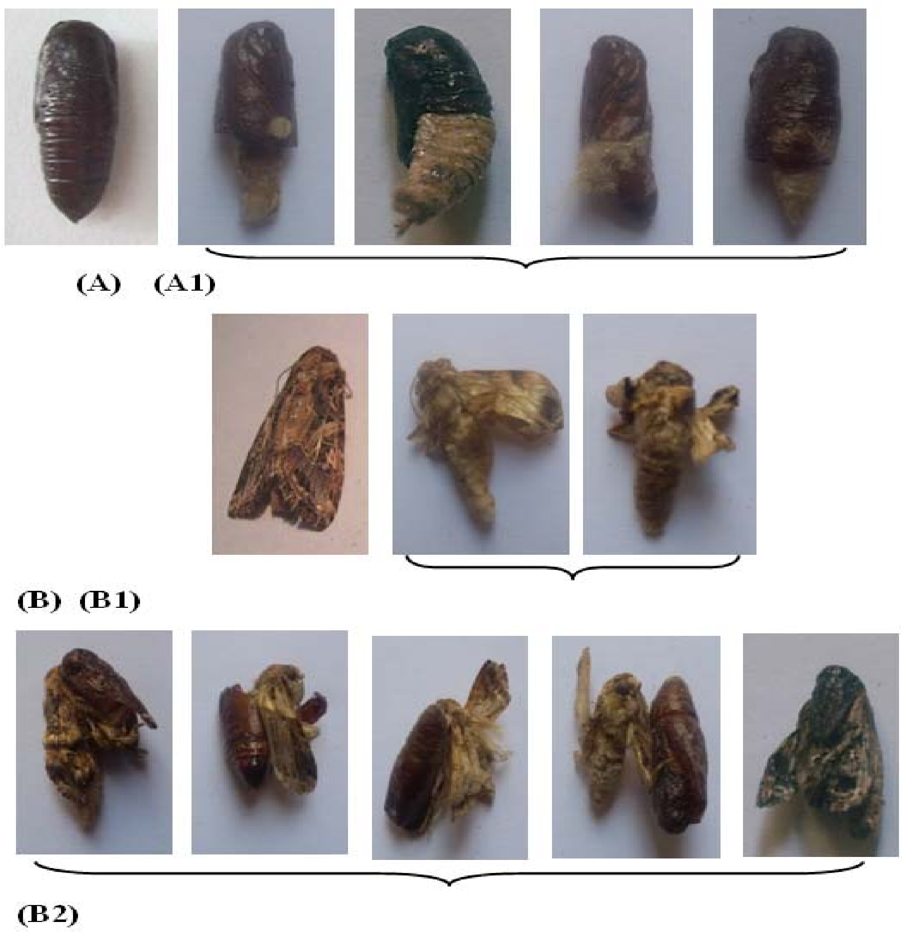

Fig. 1: Morphological malformation in pupae and adults of *S. littoralis* as induced by treatment pupa with inorganic salts.

(A) Normal pupa. (A1) pupal-adult intermediates.

(B) Normal *S. littoralis* moth.(B1)Adults with poorly developed wings.

(B2) Adults failed to shed their puparium.

CONCLUSION

The present work aims to study the effectiveness of six inorganic salts to be used at non toxic concentrations in order to sterile adult stage of cotton leafworm *S. littoralis* and the results proved the efficiency of the six salts so we recommend using these inorganic salts as a new approach in integrated pest management(IPM) program against *S. littoralis* by applying these six salts on the pupae where they are in the partially moist places in the field.

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ARABIC SUMMERY

إستخدام بعض الأملاح غير العضوية كمعقمات كيميائية ضد دودة ورق القطن

مروة محمد محمود الصباغ[1]- شيماء محمد احمد دسوقي[2] - ياسمين السيد احمد[1]
1. قسم بحوث دودة ورق القطن- معهد بحوث وقاية النباتات – مركز البحوث الزراعية
2. قسم النبات و الميكروبيولوجي - كليه العلوم- جامعة السويس

تم تقييم أثر ستة من الأملاح غير العضوية كمواد مسببة للعقم ضد دودة ورق القطن وذلك بإتباع طريقة غمر طور العذراء في محاليل الأملاح المختبرة، اظهرت النتائج ان جميع الأملاح المستخدمة كان لها تاثير واضح علي طور الحشرة الكاملة الناتجة من معاملة طور العذراء بالغمر في الأملاح غير العضوية واثرت علي قدرة الحشرة الكاملة علي وضع البيض وعلي خصوبتها، وقد كان لاملاح $Ca(oH)_2$,NaoH، $ZnSO_4$ اثر واضح علي عقم الفراشات وصل الي 100% عند استخدامها بتركيزات غير سامة ،كما ظهرت زيادة في نسبة العقم تتناسب طردياً مع زيادة التركيز للاملاح المستخدمة، وقد كان هناك تفاوت علي تاثير الاملاح المستخدمة علي نسبة العقم بنسب متفاوتة تراوحت بين 75:55 %، كما ظهرت بعض التشوهات في كلا من العذاري والحشرات الكاملة الناتجة من معاملة طور العذراء بالاملاح غير العضوية محل الدراسة.