Zinc sulfate as a growth disruptor for *Spodoptera littoralis* with reference to histological changes in larval endocrine glands

Aziza. M.Sharaby; Fatma.M. EL-Hawary and Sawsan.Moawad

Pests and Plant Protection Department, National Research Center, Cairo ,Egypt

sharabyaziza@yahoo.com

ABSTRACT

Zinc sulfate ($ZnSO_4 7 H_2O$) was toxicologically , biologically, and physiologically evaluated as insect development inhibitor and endocrine disruptors against the fourth instar larvae of the cotton leaf worm, *S .littoralis* . Zinc sulfate significantly increased both larval and pupal duration and decreased pupal weight and pupation percentages of compared to with control. The fecundity and fertility of females resulted from fed larvae in all mating combinations were remarkably decreased , compared with control. Results showed that females were more sensitive to Znic sulfate than males.Ultrastructure changes of the endocrine glands of larvae were discussed. Zinc sulfate may be used as growth disruptor for *S . littoralis* among other control methods for *S.littoralis* management.

Key words: *S .littoralis* larvae, zinc sulfate, growth disruption , endocrine glands, ultrastructure, histological changes , Electron microscope .

Introduction

Zinc sulfate($ZnSO_4 7 H_2O$) is crystal transparent odorless material , water soluble, stable at normal temperature and pressure . It is ideally suitable for providing the nutritional source of Zinc requirements in animal feeds. In agriculture zinc serves as a growth hormone (2)* and influence protein synthesis . Zinc deficiency often causes stunting of the plant , yellowing of the leaves, and decreased yield of seed, grains, vegetables or fruits. Zinc sulfate is often used on crops such as pecan, deciduas fruits, peanuts, cotton, corn , vegetables and especially citrus(1)*. A solution of zinc sulfate sprayed on soil can increase crop yield. It is also used in animal feed to increase appetite, control blood disorders and bone disease and prevent premature death. In general Zinc sulfate is considered to be of low toxicity. Industrial experiences has not identified any significant chronic effects from it to date. It is not listed as a carcinogenic by the Occupation Safety and Health Administration (OSHA), the National Toxicology Program (NTP), the International Agency for Research on Cancer (ARC), the American Conference of Governmental Industrial Hygienists (ACGH) or European Union (EU)(2)*. Zinc sulfate under the right circumstances and handling can be an extremely useful .

Endocrine disrupting compounds (EDC) are known as third generation insecticides. They act as insect growth regulators (IGR) and are considered as potential endocrine disruptors.They interfer with the hormonal system of insects causing adverse effects on the physiological function of the insect or on their progeny. Insects endocrinology is currently an active area of research because it offers the potential for disrupting the life cycle of the insect pest without harm to the environment. Some investigations proved that zinc is toxic to some insect species . Sastry *et al*. (1958) reported that Zinc sulfate higher than 800 ppm

is toxic to the larvae of the rice moth , *Corcyra cephalonica*(Stainton) ; Sell and Bodzinck (1971) reported that the pupation of *Heliothes virescens* (F.) was inhibited when the larval medium was supplemented with 0.1% or more of Zinc sulfate and caused sever growth depression . A significant growth depression was observed in *Bombyx mori* larvae fed on diet containing zinc salts at concentrations higher than 400 ppm (Sridhara and Bahat 1966). Sell and Schmidt (1968) recorded developmental abnormalities and inhibition of pupation of the cabbage looper, *Trichoplusia ni* when its larvae were fed on diet mixed with 0.5% chelatex zinc. Even at 0.05% concentration zinc delayed development and occasionally caused developmental abberations. Salama and Sharaby (1973) reported that zinc sulfate caused sterility of *S .littoralis* when it was mixed with the larval diet. At 0.1M they found that zinc sulfate has a deterrent feeding effect to the larvae. Sharaby (1987) evaluated Zinc sulfate as possible sterilants against *Spodoptera exigua* through pupal treatment. Sharaby *et al* .(2008) recorded that pupae of the red palm weevil , *Rhynchophorus ferrugineus* immersed in 0.5% Zinc sulfate solution for 2 minutes caused sterilizing effects to some of the resulted adults. This research aimed at evaluating the effect of zinc sulfate toxicity, on growth and development of *S.littoralis* .The ultra structure changes of the endocrine glands of the larvae as affected by zinc sulfate larval feeding was discussed.

Materials and methods

S .littoralis eggs were obtained from a standard laboratory culture maintained on fresh Castor bean leaves , *Ricinus communis* as larval food, under controlled laboratory condition of 27±2 °C and 65±5%RH according to Sharaby(1987).

*- Toxicity test: Zinc sulfate was obtained from El Gomhouria CO. Five different concentration as 10,5,3,2,0.5mg of zinc sulfate/ml. distilled water were prepared. Castor bean leaves was immersed in each concentration for 10 minutes,left to dry

at room temperature then offered to the newly moulted 4th instars larvae. Larvae were allowed to feed on the treated leaves for 72 hrs then provided daily with untreated leaves till pupation. Four replicates of (50 larvae each) were used for each concentration. Control (untreated) larvae were fed on Castor bean leaves dipped in distilled water only. The mortality percentages of treated larvae were calculated and corrected according to Abbott's formula (Abbott, 1925). Results were subjected to probit analysis (Finny,1971) to obtain the LC_{50} value.

*- Biological test: Newly moulted 4th instar larvae left to fed for 72 hrs on Castor leaves treated with LC_{50} concentration value of zinc sulfate at the LC_{50} level, then transferred to untreated leaves till pupation . The larval and pupal duration, pupal weight, percentage of pupation and moths emergence. Biological data obtained were statistically analyzed by (t)test for obtaining significance between the control and zinc sulfate fed larvae data. Numbers of deposited eggs by mated females and percentage of egg hatchability were estimated in each case. Mating process occurred according to the following combinations:

T females X T males , T females X N males , N females X T males and N females X N males

Where (T) treated , (N) untreated or normal moths.

*- Ultrastrucutre examinations : Newly moulted 4th instars larvae were fed for 72 hrs. on Castor leaves treated with the LC_{50} concentration of zinc sulfate then left for another 3 days on untreated leaves. The remained living larvae were taken for ultra structure investigations . They were fixed immediately in 4% glutaraldehyde . Untreated larvae of the same age were used as check. Head with thorax were cut from the treated and normal larvae. Specimens were kept in the fixative at 4 °C till processed. To investigate the ultra structure changes the brain neurosecretory cells , corpus cardiacum,corpus allatum and the prothoracic gland , were examined using