# RESPONSE OF *CORCYRA CEPHALONICA* STAINTON (LEPIDOPTERA GALLERIIDAE) TO THREE SYNTHETIC INSECT GROWTH REGULARORS

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***Abstract***

The three synthetic insect growth regulators ( IGRS), hydorprene, S - 31183 and IKI- 7899 were tested against the last instar larvae of *Corcyra cephlonica* using three different doses for hydroprene and S - 31183 and two doses for IKI- 7899.

The response of treated larvae was dose - dependent in the case of hydroprene and IKI 7899. The high doses affected more numbers of larvae expressed by inhibition of adult emergence. The effect of S-31183 was not dose dependent. IKI 7899 was the most effective compared with hydroprene and S- 31183.

Typical symptoms of toxicity of the three compounds could be indicated as follows:

1 - Inhibition of adult emergence.

2 - Production of adultoids with apparent morphogenetic changes such as deformed, short or reduced antennae, wrinkled wings and short and subsized body.

3 - Non viable intermediate forms ( larval - pupal and pupal - adult intermediates).

4- Ecdysal faliure of larvae.

## INTRODUCTION

Insect growth regulators are a group of insect control agents which adversely interfere with development and growth of insects, usually by either inhibiting chitin

synthesis or by mimicing juvenile hormones in interfering with metamorphosis. They show considerable promise in insect control because only the target insects are usually affected and their toxicity to mammals is low.

The use of these materials may become one of the most potential protective measures against stored grain insect pests. Their spectrum of biological activity was shown to range from ovicidal and larvicdal to lethal effects on pupae as well as adutls of these pests (Stockel and Edwards, 1981; David , 1979; Loschiavo, 1976; Lal and Mulla , 1982; Tan KengHong, 1974; David & William, 1982).

Two compounds of this group, hydroprene and methoprene, were found to be highly effective against some stored product coleopterous and lepidopterous insects ( Harrison & Krammer, 1975). IKI- 7899 and S - 31183 are another two promising novel compounds for the same purpose (Meisner *et al* ., 1986; *Attia et al.*, 1984). The present study aims at determining the effect of hydroprene , S - 31183 and IKI 7899 against the stored product insect pest, *Corcyra cephalonica* .

## MATERIALS AND METHODS

The original colony was started by collecting infested flour samples from Remaly wheat mills at Saieda Zeinab south of Cairo. The samples were Cleared from other insects and maintained in the incubator at $28\pm2^{o}$C and $70\pm5$R.H. until adults emergence. Adequate number of pairs of the emerged males and females were placed for mating in one litre capacity lantern glass covered with muslin and having a ottom of glazed paper fixed with rubber band. Five pairs were put in each glass. The eggs wre collected daily from the glazed paper then used for starting a new culture reared on sterilized wheat flour supplemented with 5% yeast extract. The colony was maintained in 2 kg muslin covered glass Jars.

Hydroprene 65.7 % EC was provided by Zeacon Corporation . Chlorfluazuron 5% EC ( IKI - 7899) and S- 31183 ( 10%EC) were provided by Sumitomo Chemicals Co., Ltd. Larval instars were obtained by placing rolls of corrugated paper in the stock culture . After a period of about 35 days , the corrugated papers containing the last larval instar were removed to collect the larvae for treatment.

The three IGRs were diluted in acetone. The larvae were topically treated with

I ul droplet containing the required dose / larva on the dorsal thoracic region by means of a micromerter driven syringe .

The doses used were 0.1, 0.1 and 10 ug/ ul for Hydroprene; 0.08 , 0.8 and 8ug/ul for S - 31183 and 0.4 and 4ug/ul for chlorfluazuron. The control larvae were topically treated with acetone only. Thirty insects were used for each dose and also for the control. The treated larvae were kept on glass discs to dry, placed individually on cotton plugged glass test vials ( 1.5 cmx 10cm ) together with a small amount of rearing medium and corrugated filter paper stripe to facilitate pupation.

Observations were made once a week for a period of five weeks after treatment . Percentages of adult emergence and percentages of deformities were determined .

Rearing and experimentation were carried out under constant temperature of $28\pm2^{o}C$ and 70 $\pm$ 5% R.H.

## RESULTS AND DISCUSSION

### Effects of Hydroprene

As shown in Table 1, the dose 0.1 ug/ul produced 3.3% larval mortality, 93.9% adult emergence and 3.3 failure in pupal emergence.

The dose 1 ug/ul resulted in 48.3% adult emergece , 30.7% out of them were malformed. The malformed adults showed apparent morphogentic changes ranging from mild or severe deformities in antennae and wings to subsized bodies . The deformed antennae were shorter than normal , reduced or totally absent. The deformed wings were either of normal size but attached to the body or greatly reduced that the dorsal side of the abdomen was almost uncovered. Out of the total larvae treated with that dose, 37.9% developed to pupae, 3.4% of them were pupal - adult intermediates. These pupal - adult intermediates showed well defined adult characteristics of the head and thorax, including sclerotization, while the abdomen retained the pupal like appearance. By the end of this experiment 10.3% were still larvae, 3.4% of them died.

At the higherst dose 10ug/ul , the percentage of normal adult emergence was

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only 3.3%, 6.7% developed to pupae, whereas the majority of the treated individuals (86%) remained as larvae of which 6.4 % died at the end of the experiment. These remaining larvae did not develop to pupae after five weeks from treatment and turned into giant ones. Some of the survivals continued to moult up to 92 days or longer and became super numerary larvae of oversized body. The retardation of larval development was dose dependent. Loschiavo ( 1976) reported that treament of the food with either methoprene or hydroprene caused failure of many of the larvae of the confused flour beetle , *Tribolium confusum* to pupate but remained alive and continued to moult for at least 150 days. Similar results were obtained by Tan King Hong ( 1974) using hydroprene and methoprene against last instar larvae of *Ephestia cautella* and *E. Kuehniella.* Slama *et al* ., 1974 believed that this type of ecdysal failure is due to dispropotionate growth of the different parts of the insect body.

The results of the present investigtion showed that the larvicidal effect of hydroprene was very low at 10 ug/ul since 80% of the treated larvae survived. This is in agreement with the findings of Jackob (1973) and Mulla *et al.*, (1975) using mosquito larvae and Ishaaya and Ascher (1977) using larvae of *Tribolium confusum.*

In the control experiment 6.9 % remained as pupae and 6.9 % as larvae , 3.74% of them died. It was noticed that the percentage of adult emetrgence in the control was less than that among the larvae treated with hydroprene at tthe dose of 0.1 ug/ul. This was due to the high percentage of pupae that failed to develop to adult stage.

S-33183 results are presented in Table 2 . At 0.08 ug/ul dose no adults emerged and 51.7% of the larvae changed to pupae, categorized by 17.2 % larval - pupal intermediates and 3.4% pupal - adult intermediates. The percentage of individuals that remained as larvae was 27.6%, 3.4 % of which died five weeks after treatment . At 0.8 ug/ul, 3.4 % emerged to moths and the percent of treated larvae that developed to pupae was 51.7 % with no intermediate forms among them . The percentage of individuals that remained as larvae was 44.8 % , out of these 31% died. At the dose 8 ug/ul , there was no adult emergence , 3.6 % changed to pupae and 96.4% remained as larveae, 78.5 of which remained alive and the rest died by the termination of the experiment. As in the case of Hydroprene, S 31183 Caused supernumerary larvae, some of them survived up to 106 days after treatment. These results indicated that ecdysis was handicaped by S - 31183 and was dose dependent.

The results of IKI - 7899 are presented Table 3. The dose 0.4 ug/ul resulted in 23.3% adult emergence , 20% transformed to pupae and the rest 56.7% remained as larvae which all died by the termination of the experiment . Out of the emerged adults, 28.7 % were malformed adultoids with small and wrinkled wings and reduced antennae.

Table 2. Effect of S - 31183 on *Corcyra cephalonica* last instar larvae.

| Dose (ug/Larvae) | Number of treated larvae | Percentage of adult emergence | Percentage of total in each stage at termination of experiment (a) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Pupae | Larval - pupal intermediate | Larval - adult intermediate | Larva | No. of dead larvae (b) |
| 0.08 | 29 | 0.0 (0) (c) | 51.7 | 17.2 | 3.4 | 27.6 | 3.4 |
| 0.8 | 29 | 3.4 (0) | 51.7 | 0.0 | 44.8 | 44.8 | 31.0 |
| 8.0 | 28 | 0.0 (0) | 3.6 | 0.0 | 0.0 | 96.4 | 17.9 |
| Control | 29 | 86.2 (0) | 6.9 | 0.0 | 6.9 | 6.9 | 3.4 |

a ) Five weeks after treatment

b) Number which died later than one week after treatment

c ) In parentheses, percentage of malformed adults out of total number of emerged adults.

Table 3. Effect of S - 31183 on *Corcyra cephalonica* last instar larvae.

| Dose (ug/Larvae) | Number of treated larvae | Percentage of adult emergence | Percentage of total in each stage at termination of experiment (a) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Pupae | Larval - pupal intermediate | Larval - adult intermediate | Larva | No. of dead larvae (b) |
| 0.4 | 30 | 23.3 (28.7) (c) | 20.0 | 0 | 0 | 65.7 | 65.7 |
| 4.0 | 30 | 6.7 (3.3) | 3.3 | 0 | 0 | 90.0 | 90.0 |
| Control | 29 | 86.2(0.0) | 6.9 | 0 | 0 | 6.9 | 3.4 |

a ) Five weeks after treatment.

b) Number which died later than one week after treatment.

c ) In parentheses, percentage of malformed adults out of total number of emerged adults.

At 4 ug/ul , 6.7% emerged to adults , 3.3 remained as pupae and the remaining 90% were malformed larvae . Out of the total number of the emerged adults the percentage of malformation was 3.3%. IKI 7899 at the two doses used, caused high percentages of larval mortality and malformed adults. All the larvae died by the termination of the experiment especially during ecdysis with the old exuviae remaining attached to the body and only a small portion of the larvae tried to get rid of the old cuticle while the rest of the body remained trapped inside. These results indicated that ecdysis is handicapped by IKI - 7899 , and that it is dose - dependent . IKI - 7899 also caused high larval mortality. as a result of ecdysal failure due to inhibition of chitin synthesis. Post *et al.*, (1974), Ascher and Nemny (1976), Clark *et al.*, (1977), Sahota and Ibaraki (1980) Concuded that the juvenoids interfere with chitin synthesis , causing formation of weak integument that ruptures easily under the pressure exerted.

the deformed adultoids showed small and wrinkled wings, reduced or totally missing antennae and subsized body as compared with normal moths. Slama *et al.*, (1974), stated that malformed elytra and crumpled hind wings resulting from treatments with juvenoids can not be attributed to abnormal quantities of microtubules. Das and Gupta (1976) attributed the malformed wings in the German roach , *Blatella germanica* to failure of wings to expand and flatten after adult emergence.

## REFERENCES

1. Acher, K.R.S. and N.E. Nemny. 1976. Contactivity of diflubenzuron against *Spodoptera littoralis* larvae (Lep., Noctuidae). Pestic., 7 (5): 447 - 452
2 . Attia, M.B., A. Ghattas and M. R. Abo - Elghar 1984. Chitin synthesis inhibitor IKI- 7899 , its efficiency and resduality against cotton leafworm as compared to diflubenzuron and triflumuron. 5 th Ann. Conf. Afr.
3 . Clark, L., G.H. R. Temple and J.F.V. Vincent. 1977 The effect of chitin inhibitor Dimilin on the production of peritophic membrane in the locust, *Locusta Migratoria*. J. Insect Physiol ., 22 : 241 - 246.
4 . Das , Y. and A. P. Gupta. 1976. Abnormalites in the development and reproduction of *Blatella germanica* (L.) Dictyoptera: Blattidae) treated with insect growth regularors with juvenile hormone activity. Experimentia, 33/7 968 - 970.
5 . David , A.Nickle. 1979 . Insect growth rgulators : New protectants against the almond moth in stored inshel peanuts J. Econ. Entomol. 72 :816 - 819

6 . David, J.W. and A.A william 1982. A laboratory evaluation of the effectiveness of diflubenzuron against *Dermestes maculatus* de Geer and other storage insect pests. Pestic. Sci. 13: 595 - 601

7 . Harrison, E. Mc Gregor and K. J. Kramer 1975 . Activity of insect growth regulors , hydroprene and methoprene , on wheat and corn against several stored - grain insects. J. Econ. Entomol. 68 : 668 - 670

8 . Ishaaya and K. R. S. Ascher. 1977. Effect of diflubenzuron on growth and carbohydrate hydrolysis of *Tribolium castaneum.* phytoparasitica. 5 (3) 149 - 158

9 . Jakob , W. L. 1973. Development inhibition of mosquitoes and the housefly by urea analogues. J. Med. Entomol . 10:452 - 455.

10 . Lal , S. M. and Mir S . Mulla 1982. Biological acgivity of IGRs against four stored product coleopterans. J. Econ. Entomol., 75 : 80- 85.

11 . Loschiavo , S . T . 1979 . Effect of the synthetic insect growth regulators methoprene and hydroprene on survival , development or reproduction of six species of stored product insects. J. Econ. Entomol . 69 (3) : 395 - 399.

12 . Meisner , J. M. Klein and K. R. S. Ascher. 1986. The effect of some benzoyl phenylureas on the larvae of *Earias insulana* . Phytoparasitica, 14(1) : 3 - 9.

13 . Mulla , M. S., H. A. Dawarzeh and R. L. Norland 1975. Activity and longevity of insect growth regulator against mosquitoes . J. Econ. Entomol. 68 ( 6) : 791 - 794.

14 . Post , L. C., T. B. de long and W. R. Vincent 1974 . 1 ( 2,6 - disubstituted benzoyl) 3 - phenyl urea insecticides inhibitors of chitin synthesis . Post . Biochem. Physiol. 4:473 - 483.

15 . Slama , K. M. Romanuk and F. Sorm 1974. Insect hormones and bioanalouges. Springer Verlag, New York , pp. 1 - 477 .

16 . Sahota, T. S. and A. Ibrakai 1980. Prolonged inhibition of broad production in *Dendroctonus rufipennis* ( Coleoptera : Scolytidae ) by Dimilin. Can. Entomol. 112 ( 1) 85 - 88 .

17 . Stockel , J. and Edwards 1981. Susceptibility of *Sitotroga cerealella* ( Oliv) . (Lep. - Gelechiidae) to two insect hormone analouges . J. Stored Prod. Res. Vol . 17:137 - 141.

18 . Tan Keng Hong 1974. Effects of a synthetic juvenile hormone and some analogues on *ephestia* spp. ( lepidoptera : Phycitidae) . Ann. Appl. Biol.,80 : 137 - 145.

# تأثير منظمات النمو هيدروبرين ، IKI - 7899 , S- 3118 علي حشرة فراشة الأرز

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تم في هذه الدراسة اختبار تأثير مجموعة من منظمات النمو الحشريه علي حشرة فراشة الأرز *Corcyra cephalonica* وعوملت يرقات العمر الأخير بثلاث جرعات لكل من مادتي الهيدروبرين (١,٠ ، ١,٠ ، ١٠,٠ ميكروجرام / ميكروليتر) والـ S - 31183 (٠,٠٨ ، ٠,٠٨ ، ٠,٨ ، ٨,٠ ميكروجرام / ميكروليتر) وجرعتان فقط من مادة IKI-7899 (٠,٠٤ ، ٠,٠٤ ميكروجرام / ميكروليتر) . وقد لوحظ التناسب الطردي لاستجابة الحشرة مع الجرعة للمادة الأخيرة ومادة الهيدروبرين ، بمعني أنه كلما ارتفعت الجرعة زاد الأثر التثبيطي ضد الأفة. كانت مادة ال IKI - 7899 هي أكثر تأثيراً من المادتين الأخريتين .

ويمكن تلخيص الظواهر الأساسية نتيجة السميه للمواد الثلاثه فيما يلي :

١ – تثبيط ظهور الحشرات الكاملة

٢ – ظهور أفراد مشوهة ذات تغيرات مورفولوجيه واضحة مثل قصر قرون الاستشعار أو اختفائها وتجعد الأجنحة وصغر حجم الجسم وصغر الجسم بصفه عامه عن الحجم العادي.

٣ – ظهور أفراد وسطيه عديمه الحيوية كالأطوار الوسطية بين اليرقة والعذراء ثم بين العذراء والحشرة الكاملة.

٤ – فشل عملية الإنسلاخ في اليرقات .