

Morphological effects of some insect growth regulators on *Musca domestica*, (Diptera, Muscidae).

Khalil, M.S.; Assar, A. A.; Abo El-Mahasen, M. M. and Mahmoud, S.H..
Faculty of Science, Menofia University

ABSTRACT

The current work was carried out to evaluate the morphological effects of insect growth regulators e.g. : applaud (buprofezin), consult (hexaflumuron) and match (lufenuron) as chitin synthesis inhibitors (CSIs), mimic (tebufenozide) as ecdysone agonist (EA) and admiral (pyriproxyfen) as juvenile hormone analogue (JHA) against the housefly, *M. domestica*. Various morphological aberrations were induced in larvae, pupae and adults of *M. domestica*. The highest percentage of larval deformities caused by mimic, (can not molt or shrunk). Consult gave the highest percentage of malformation in the resulting pupae (C. shaped, elongated, distorted, two constricted, tapering anterior and broad posterior , cylindrical adult uncompleted). Admiral and mimic induced high percentage of abnormalities in the adult flies (small size body and curved legs, crumbled wings and curved abdomen). Larval-pupal intermediates and pupal-adult intermediates were induced as a result of these treatments.

Keywords: Insect growth regulators, *Musca domestica*

INTRODUCTION

The house fly, *Musca domestica* is the most common and widely distributed mechanical vector of several pathogenic organisms of human and animals. Resistance insects have been recorded for most insecticide. The use of IGRs against the house fly are considered environmentally safer alternatives to broad-spectrum insecticides because of their low toxicity to human, little likelihood that insects would develop resistance to compounds that mimic their own hormones and specificity for their insect targets. Thus, the application of IGRs remains one of promise for the future.

MATERIALS AND METHODS

The strain of insects was obtained from Research Institute of Medical Entomology, Dokki, Giza, Egypt. The colony was maintained according to Hashem and Youssef, (1991).The eggs were collected and transferred to larval medium, which contain wheat bran

(655 gm.) + Milk powder (50 gm.)+yeast powder (38 gm.)+ Tap water (600ml.). The pupae were transferred into cages until adult emergence. Different concentrations, (10, 100, 1000and 2000ppm) of insect growth regulators, buprofezin (applaud), hexaflumuron (consult), lufenuron (Match), tebufenzoide (Mimic) and pyriproxyfen (Admiral) were prepared by adding water. First instars larvae were divided into five groups, each consists of 20 larvae, put in plastic cups containing media which exposed to selected concentration. The morphological changed were recorded for larval, pupal and adult stages.

RESULTS AND DISCUSSIONS

Treatment of 1st larval instars of *M. domestica* with various concentrations of the tested IGRs gave rise to noticeable larval, pupal and adult abnormalities. The different abnormal forms in Table (1), can be described as follows:-

All tested IGRs induced larval deformities. The highest percentage of larval deformities caused by mimic, which was 3, 5 and 6% at 10,100 and 1000 ppm, respectively. In the survived larvae two forms of abnormalities were demonstrated,

Some larvae can't molt completely {plate (1) fig (B)}.

Some larvae with small sized {plate (1) fig (C)}.

Schaefer and Wilder (1973) reported that JH interfered with tyrosine metabolism resulting in a darkening of the cuticle of *C. pipiens*, *C. quinquefasciatus* and *Aedes nigromaculatus*.

Table 1: Morphogenic effects of the tested IGRs against *M. domestica* as 1st larval instar.

IGRs	Conc. ppm	*Malformed larvae %	*Larval pupal intermediaries %	**Malformed pupae %	**Pupal-adult intermediaries %	***Malformed adult %
Applaud	10	1	1	2.01	6.11	3
	100	2	3	3.25	8.3	5
	1000	3	4	4.38	19.22	-
	2000	5	6	6	23	-
Consult	10	1	2	40.2	14	2
	100	3	3	56.03	18	5.09
	1000	4	5	78	21.03	-
	2000	5	6	100	22	-
Match	10	1	3	15.03	13	1.2
	100	2	4	21.01	24.37	3.15
	1000	4	5	33.5	30.12	-
	2000	5	7	50.12	38.11	-
Mimic	10	3	2	4	15.1	4.2
	100	5	3	16	18.02	7.19
	1000	6	5	50.21	22	-
	2000	-	-	-	-	-
Admiral	10	1	4	12.12	15.11	6
	100	2	5	38	22.04	8
	1000	-	7	50	30	-
	2000	-	-	-	-	-

Similar malformations were reported on *M. domestica* with other IGRs, such as dimilin (El-Kordy, 1985), dimilin, BAY SIR and altosid (Bakr, 1986) and diflubenzuron and penfluron (Shafi *et al.*, 1987). Darvas *et al.* (1998) noticed molting disturbances (e.g. hanging larval

exuvium, head capsule slippage failure) and a more intensive sclerotization and melanization of the thorax of *A. aegypti* when treated with methoxyfenozide.

All tested IGRs induced larval - pupal intermediates. Admiral gave the highest percentage of malformed larval

– pupal intermediates, which induced 4, 5 and 7% at 10, 100 and 1000 ppm, respectively. The puparia of these forms were incomplete with retained parts of the last larval cuticle {plate (1) fig (D)}. Similar larval –pupal intermediate was induced by other IGRs on the same species, such as, dimilin (El-Kordy, 1985); diflubenzuron and penfluron (Shafi *et al.*, 1987); IGI, DC-902, denate, dimilin and amix-500 (Youssef *et al.*, 1990); IKI 7899, BAY-SIR; and methoxyfenozide and pyriproxyfen (Assar and Abo-Shaeshae, 2004).

These larval- pupal intermediates failed to complete the pupal period and died soon. Carton *et al.* (1998) stated that treatment of *S. exigua* larvae with methoxyfenozide led to induction of premature, lethal, larval molt, presence of a double head capsule and appearance of larval pupal intermediate. They stated that methoxyfenozide caused the larval thorax to bloat on the dorsoventral sides resulting in a larval-pupal intermediate of *A. aegypti*. All tested IGRs induced malformations in the pupae of *M. domestica*. Consult gave the highest percentage of malformation in the resulting pupae, which elicited 40.20, 56.03, 78.00 and 100% at 10, 100, 1000 and 2000 ppm, respectively. Whereas the lowest percentage was obtained by applaud, which induced 2.01, 3.25, 4.38 and 6% at 10, 100, 1000 and 2000 ppm, respectively. The other tested IGRs were comparable.

Six types of abnormalities that occurred in the pupae: Some pupae took C. shaped (plate (2) fig (B,C)), elongated {plate (2) fig (D,E)}, distorted {plate (3) (A,B,D)} pupae with conspicuous contractions in their puparia; rod-like larviform {plate (4) fig (A)}, tapering anterior and broad posterior {plate (4) fig (B)} and cylindrical {plate (4) fig (C,D)} and that they failed to transform to adult

stage.

Other IGRs induced similar malformations in the pupae of *M. domestica*, TH 6040 (diflubenzuron) [Wright (1974), El-Kordy (1985), and Shafi *et al.* (1987)]; BAY SIR (Moustafa, 1991); dimilin, BAY SIR and altosid (Bakr, 1986); IGI, DC 902, denate, dimilin and amix 500 (Youssef *et al.*, 1990); diflubenzuron and pyriproxyfen (Shalaby, 1994); and methoxyfenozide & pyriproxyfen (Assar and Abo-Shaeshae, 2004).

All tested IGRs induced pupal–adult intermediates. Match, admiral and mimic gave the highest percentage of malformations. Match induced 13, 24.37, 30.12 and 38.11% pupal-adult intermediates at 10, 100, 1000 and 2000 ppm respectively. Deformed pupae failed to complete their metamorphosis properly which could not emerge completely and remain concealed in the puparia until they die. Consequently incomplete adult eclosion dominated. In some cases the head and thorax ecdysed while in other cases, the head, thorax and part of the abdomen with the fore wings were released but the rest of the body still attached to the puparia (Plate 5). Other IGRs induced larval-pupal intermediates on *M. domestica*, BAY SIR (Moustafa, 1991); diflubenzuron and pyriproxyfen (Shalaby, 1994); and methoxyfenozide & pyriproxyfen (Assar and Abo-Shaeshae, 2004)

All tested IGRs induced adult malformations. Admiral and mimic induced high percentage of abnormalities. Admiral elicited 6 and 8% abnormalities at 10 and 100 ppm, respectively, while mimic caused 4.2 and 7.19% abnormalities at 10 and 100 ppm, respectively. The tested IGRs induced adult with small sized body and curled legs {(plate (6) fig (C and D))}, some adults were with crumpled wings while others were with curved abdomen {(plate (6), Fig (E, F))}. The

same abnormalities were reported by some investigators on the same insect species using other IGRs, JHA (Cerf and Georghiou, 1974); diflubenzuron (El-Kordy, 1985); dimilin, BAY SIR and altosid (Baker, 1986); diflubenzuron (Shafi *et al.*, 1987); IGI-DC 902, denate, dimilin and amix-500 (Youssef *et al.*, 1990); BAY SIR (Moustafa, 1991); diflubenzuron and pyriproxyfen (Shalaby, 1994); pyriproxyfen (Osman 1998); and pyriproxyfen and methoxyfenozide (Assar and Abo-Shaeshae, 2004). Carton *et al.* (1998) found that treatment of *S.exigua* larvae with methoxyfenozide led to malformation in wings, the emerging adults often had problem in discarding the pupal exuvium.

Application of pyriproxyfen to the German cockroach, *Blattella germanica* (10-100µg) induced molting of nymphs into supernumerary nymph, (Reid *et al.*, 1994). They said that pyriproxyfen and fenoxycarb induced significant developmental delays and levels of morphogenetic wing.

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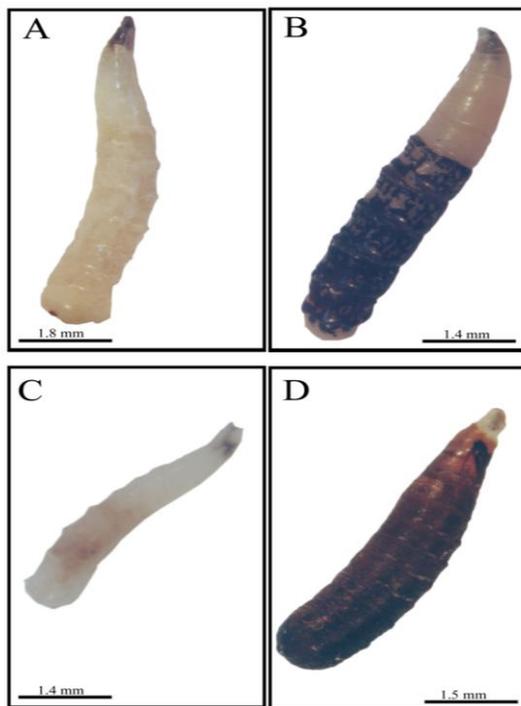


Plate (1): Larvae & larval-pupal intermediate of *M. domestica*
 Normal larva (untreated)
 Malformed larvae: B-treated with consult and admiral .
 C- treated with match, mimic and applaud.
 D-Malformed larval-pupal intermediate treated with all tested IGRs.

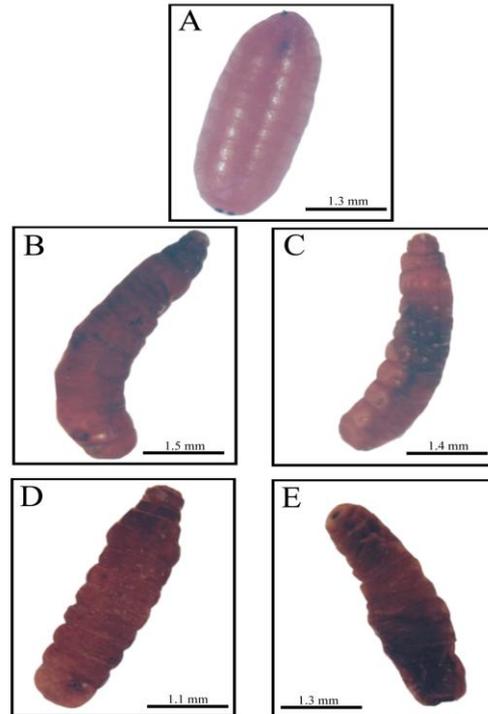


Plate (2): Pupae of *M. domestica*
 A-Normal pupa. Malformed pupae:
 B- treated with match, consult and mimic.
 C- treated with applaud and admiral.
 D- treated with applaud, consult and mimic, and
 E -treated with admiral and match

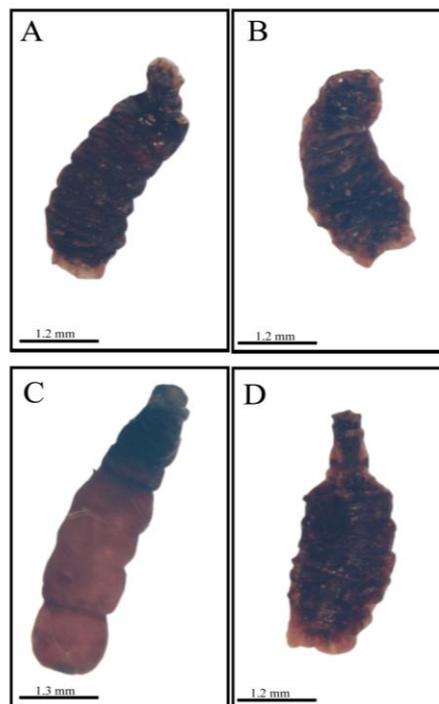


Plate (3): Malformed pupae of *M. domestica*
 Malformed pupae: A- treated with match, admiral and applaud. B- treated with match, consult and mimic. C & D treated with consult.

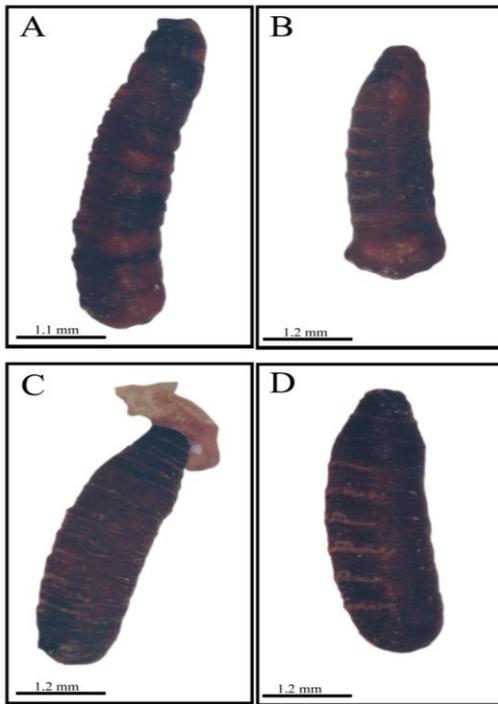


Plate (4): Malformed pupae of *M. domestica*
 A-treated with consult and mimic B-
 C- &D- treated with consult

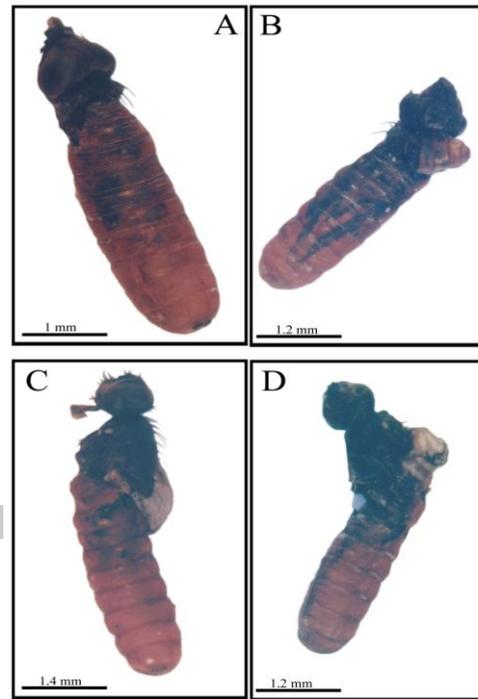


Plate (5): Pupal-adult intermediates of
M. domestica, A,B, C and D:
 Adult which can not emerge
 completely when treated with
 all tested IGRs.

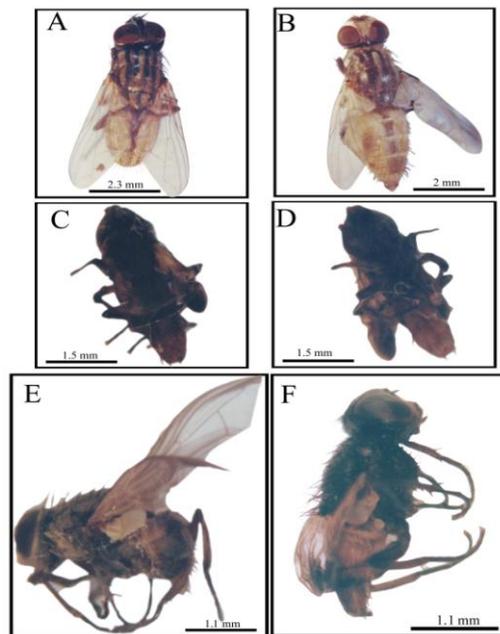


Plate (6): Adult of *M. domestica*
 A, B: Normal male and female.
 Malformed adults: C, D: treated with
 match, consult and applaud. E-&F-:
 treated with mimic and admiral.

ARABIC SUMMARY

الآثار المورفولوجية لبعض منظمات النمو الحشرية علي الذبابة المنزلية, مسكا دومستيكا(ذات الجناحين – مسيدي).

محمد الهريد خليل - عباده أبو ذكري عرص- ماجدة محمد أبو المحاسن - شيماء حسين محمود
قسم علم الحيوان - كلية العلوم - جامعة المنوفية

تم اختبار الآثار المورفولوجية لمنظمات النمو الحشرية التالية:-
مثبطات تكوين الكيتين (البيرروفيزين (ابلويد) والهيكسافلوميرون (كونسلت) والليوفينورون (ماتش) والنيوفينوزيد(ميمك) كمشابهه لهرمون الانسلاخ والبيربروكسيفين (أدميرال) كمشابه لهرمون الحدائة، وذلك علي يرقات وعدادى و الطور الهالغ للذبابة المنزلية. وذلك عن طريق تغذية الطور اليرقى الأول بتركيزات مختلفة منها وهي 10-100-1000-2000 جزء من المليون.
وقد تسبب الميمك في ظهور اكبر نسبة تشوهات في اليرقات (عدم استكمال الانسلاخ اوالتكرمش)، بينما تسبب الكونسلت في إحداث اكبر نسبة تشوهات في العذارى الناتجة(استطالتها أو تحولها الى شكل حرف C أو ظهور اختناقات أو خلل فى الشكل أو تحولها الى شكل اسطواني أو تدبب الطرف الامامى او عدم القدرة على خروج الطور الكامل)، و تسبب الأدميرال و الميمك في حدوث اكبر نسبة من التشوهات في الطور البالغ (صغر الحجم أو نفوس الأرجل أو تكرمش أالجناحة أو نفوس الجسم). وقد ارتفعت هذه الآثار مع ارتفاع تركيز هذه المركبات. هذا بالإضافة إلى ظهور أطوار وسطية بين اليرقات و العذارى , وكذلك أطوار بين العذارى والأطوار البالغة.