



Effect of Methoxyfenozone on the Accessory Sex Glands of *Spodoptera Mauritia* Boisd (Lepidoptera: Noctuidae)

Thanuja A Mathew

Associate Professor, Department of Zoology, Little Flower College (Autonomous), Thrissur, Kerala



Manuscript ID:
BIJ-SPL1-NOV25-MD-106

Subject: Zoology

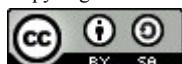
Received : 23.07.2025

Accepted : 05.08.2025

Published : 13.11.2025

DOI: 10.64938/biji.v10si1.25.Nov106

Copy Right:



This work is licensed under
a Creative Commons Attribution-
ShareAlike 4.0 International License.

Abstract

Spodoptera mauritia Boisd. (Paddy army Worm) is a sporadic pest of paddy with wide distribution in India. The rice being the staple diet in many parts of India, studies leading to check the reproductive success and multiplication of the pest are important. The effect of methoxyfenozone, an ecdysone agonist on the development, differentiation and the secretory activity of ASGs of *Spodoptera mauritia* has been investigated in the current study. Day 0 tanned male pupae treated with 3 μ g methoxyfenozone showed slightly voluminous and abnormally entangled ASGs on day 8 and their overall length was reduced. ASGs of females looked normal and slightly translucent. The day 0 tanned male pupae treated with 30 μ g methoxyfenozone showed malformed and defective ASGs on day 8 and their length was highly reduced. ASGs of females were thicker and abnormally shorter and their overall morphology was distorted.

Keywords: rice, sporadic pest, insect growth regulators, integrated pest management, ecdysone agonist, endocrine system, morphogenesis, secretions, development

Introduction

The endocrine system of insects is clearly the best studied and characterized among invertebrates due to the economic and ecological significance of insects in this biosphere. Further there is urgent need to control insects which are pests of agriculture and those which serve as vectors of disease causing germs. The discovery of compounds with hormonal and anti-hormonal activities have greatly facilitated studies on Insect Endocrinology. These compounds designated as Insect Growth Regulators (IGRs). Induce hormone deficiency or hormone excess in treated insects are excellent probes to analyze the role of hormones in insect metamorphosis and

reproduction as well as in Integrated Pest management (IPM) Programmes as insect control agents (Nair, 1993; Oetken *et al.*, 2000). The IGRs act as ecdysone agonists/ antagonists or JH analogues/ anti JH agents to disrupt the endocrine and reproductive physiology of insects to aid in their control.

Critical titer of ecdysteroids and juvenile hormone (JH) are necessary for the normal development of ASGs (Gillott and Gaines, 1992). The present study deals with the effect of Methoxyfenozone, an ecdysteroid agonist on the development, differentiation and the secretory activity of ASGs of *S. mauritia*



Materials and Methods

The ecdysteroid hormone agonist, Methoxyfenozone was obtained as a gift from Dr.Unnithan, G.C, University of Arizona, U.S.A. The compound was dissolved and diluted in distilled water to obtain different concentrations. Methoxyfenozone was dissolved and diluted in distilled water to obtain two different concentrations like $3\mu\text{g} / \text{l}$ and $30\mu\text{g} / \text{l}$ and applied topically on the abdominal region of day 0 (tanned) pupae using a $10\text{ }\mu\text{l}$ Hamilton microsyringe. Male and female larvae were segregated during 5th instar stage and from this stock culture about 100 pupae were used for each experimental study. Same number of pupae were kept as control and the control pupae received an equivalent volume of distilled water. Experimental and control pupae were kept in separate beakers covered with muslin cloth and they were checked daily for mortality and morphological abnormalities. Female ASGs were dissected out on day 7 and male ASGs were dissected out on day 8 and studied their morphogenetic changes.

Findings & Results

Effects of $3\mu\text{g}$ Methoxyfenozone on the ASGs of Day 0 (Tanned) Pupae

The treated pupae showed 33% mortality by day 5. The survivors emerged into normal looking adults. Male ASGs were found to be slightly voluminous and abnormally entangled at many regions (Pl. XXIX: Fig. 82). The distal region of ASGs was very short and it measured 3 ± 0.096 mm while distal region of ASGs of control insects measured 16 ± 0.15 mm in length. Pairing was not distinctly seen at many places of mid region. The overall length of ASGs was found to be 37.17 ± 0.153 mm while ASGs of controls measured 77.13 ± 0.058 mm.

The female ASGs dissected out were slightly thicker and they looked normal but the reservoirs were looking abnormal (Pl. XXIX: Fig. 84).

Effects of $30\mu\text{g}$ Methoxyfenozone on the ASGs of Day 0 (Tanned) Pupae

This study was undertaken to investigate the effect of a high dose of methoxyfenozone on ASGs of *S. mauritia*. Mortality was 50 % in treated pupae and a

failure of emergence was exhibited by the survivors.

ASGs which were dissected out of the male adultoids (unemerged insects inside the pupal case) appeared malformed and defective (Pl. XXIX: Fig. 83). They measured only 20 ± 0.153 mm in length whereas ASGs of control insects measured 77.13 ± 0.58 mm in length (Pl. XXIX: Fig. 86). ASGs dissected out of female adultoids were abnormally thicker and shorter (Pl. XXIX: Fig. 85). The overall morphology of the reproductive system was distorted whereas the ASGs of control insects appeared normal (Pl. XXIX: Fig. 87).

Interpretations & Discussions

During pupal-adult metamorphosis ecdysteroids increase to a major peak during the first half of pupae i.e. pharate adult development which then declines to promote pupal-adult ecdysis (-Shaaya *et al.*, 1993). Our previous studies show that in *S. mauritia* haemolymph ecdysteroid titres increase on day 1 and form a significant peak on day 2 and thereafter decrease to minimum (Mona, 2001, Ph.D Thesis). Pupal ecdysteroid peak is required for the ongoing growth and differentiation of ASGs in monarch butterflies (Herman and Barker, 1976); *Tenebrio molitor* (Happ and Happ, 1982; Grimes and Happ, 1987). In *S. mauritia* also ASG development takes place in pupal period as observed in other insects. In the present study the treatment of male pupae with $3\mu\text{g}$ methoxyfenozone which exhibits strong ecdysone-like activity caused a slight increase in the size of the glands. Here the size of cells might have increased so as to produce a hypertrophic effect. However the overall length of ASGs was highly reduced. The female ASGs are also affected by the treatment. Happ (1990) suggested that 20-hydroxyecdysone promote the growth of ASGs by accelerating the cell cycle and thereby transforming the imaginal tissues to adult ASGs. The present findings demonstrate that though methoxyfenozone had acted to promote the growth of ASGs to a certain extent this effect could not be sustained. This could be related to the time of application of the methoxyfenozone as it is important for the ecdysteroid analogues/agonists as explained by Pszczolkowski *et al.* (1998).



Treatment of pupae with 30 μ g of methoxyfenozone induced development of adultoids in *S. mauritia*. This might be due to the maintenance of high titre of endogenous ecdysteroid titres since it is well accepted that eclosion hormone could be released only after a drop in ecdysteroid level (Truman, 1971; Riddiford, 1985). Treatment of male pupae with the high dose of methoxyfenozone caused an inhibitory effect on the development and differentiation of ASGs whereas no severe inhibition is observed in females though their ASGs show some retardation. In holometabolous insects development and differentiation of ASGs take place during pupal phase depending on a critical titre of ecdysteroids. Hence treatment of pupae with high dose of methoxyfenozone might have resulted hyperecdysonism and many of the coordinated processes in cell differentiation might have got disrupted. Inhibitory effects of ecdysteroids in high doses are reported. In experiments using *Drosophila* cell lines Wyss (1976) reported that low levels of ecdysone stimulated cell divisions and cell differentiation whereas high levels had an inhibitory effect.

Conclusion

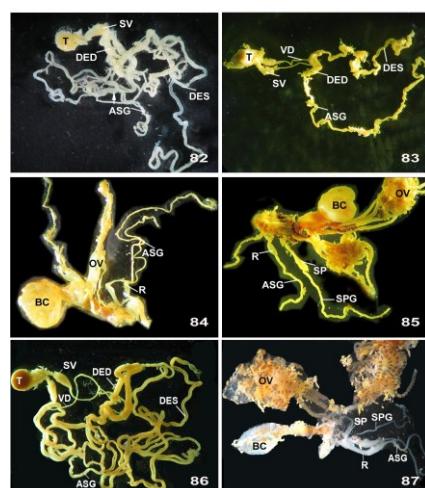
Day 0 tanned pupae treated with 3 μ g methoxyfenozone showed 33% mortality by day 5 and the ASGs of emerged adults males were found to be slightly voluminous and abnormally entangled at many regions. Pairing was not distinctly seen at many places of mid region. The distal region of ASGs was very short and measured 3 ± 0.096 mm. The overall length of ASGs got reduced to 37.17 ± 0.153 mm. ASGs of emerged adult females looked normal and slightly translucent. ASGs of adult males and females kept as controls showed normal development. The day 0 tanned pupae treated with 30 μ g methoxyfenozone showed 50% mortality and a failure of emergence. ASGs of the male adultoids appeared malformed and defective. They measured only 20 ± 0.153 mm in length. ASGs of female adultoids were thicker and abnormally shorter and the overall morphology of the reproductive system was distorted. ASGs of adult

males and females kept as controls showed normal development.

Acknowledgements

This work was carried out by the author in the Department of Zoology, University of Calicut with the financial assistance of DST (Govt. of India, New Delhi) under Woman Scientist Scheme. The author was the Principal Investigator.

PLATE XXIX



References

Gillott, C., and Gaines S. B. (1992). Endocrine regulation of male accessory gland development and activity. *Can. Ent.*, 124, 871-886

Grimnes, K.A. and Happ G.M. (1987). Ecdysteroids *invitro* promote differentiation in the accessory glands of male mealworms beetles. *Experientia.*, 43, 906- 907.

Happ, G.M. (1990). Ecdysteroids and the development of male accessory glands of insects. *Adv. Invert. Reprod.*, 5, 181-18

Happ, G.M. and Happ, C.M. (1982). Cytodifferentiation in the accessory glands of *Tenebrio molitor* X. Ultrastructure of the tubular gland in the male pupa. *J. Morphol.*, 172, 97-112.

Mona, P.M. (2001). On the developmental profile of hormones in *Spodoptera mauritia* Boisd. (Lepidoptera: Noctuidae). Ph.D Thesis, University of Calicut



Oetken, M; Bachmann, J., Schulte-Oehlmann, U. and Oehlmann, J. (2004). Evidence for endocrine disruption in invertebrates. *International review of cytology.*, 236, 1- 44.

Pszczolkowski, M., Kuszczak, B. Smagghe, G. (1988). Endocrine background of how 20-hydroxyecdysone agonist, RH 5849, influences diurnal pattern of pupation in *Spodopteralittoralis Entomologia Experimentalis et Applicata Entomologia Experimentalis et Applicata* ., 87 (387 (3), 255 – 261.

Riddiford, L. M. (1985). Hormone action at the cellular level. 37-84 in Kerkut, G.A., and Gilbert L.I (Eds.) *Compr.Insect Physiol. Biochem. Pharmacol.*, 8, 595pp. Pergamon Press, Oxford.

Shaaya, E., Calderon, M., Pisarev, V., Spindler, K.D. (1991). Effect of a juvenile hormone analogue on the life span, egg laying, and ecdysteroid titer of virgin *Ephestia cautella* females. *Arch. Insect Biochem. Physiol.*, 17 (2-3), 183-188.

Truman, J.W. (1971). Physiology of insect ecdysis. I. The eclosion behaviour of saturnid moths and its hormone release. *J. Exp.Biol.*, 54, 805.

Wyss, C. (1976). Juvenile hormone analogue counteracts growth stimulation and inhibition by ecdysones in clonal *Drosophila* cell line. *Experientia.*, 32, 1272- 1274.