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EFFECTS OF HYDROPRENE AND METHOPRENE ON THE DEVELOPMENT AND METAMORPHOSIS OF POST-DIAPAUSE PUPA OF RICE STEM BORER *SCIRPOPHAGA INCERTULAS* WLK. (LEPIDOPTERA : PYRALIDAE)

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Juvenoids hydroprene (Altozar or ZR-0512) and methoprene (Altosid or ZR-0515) when applied topically to 0-24-hr-old post-diapause pupae of rice stem borer *Scirpophaga incertulas* Wlk caused defective imaginal differentiation. Treated pupae developed either into defective adultoids which failed to emerge or, into adultoids which showed significant reduction of life span. There was no significant change in the duration of pupal life. Pre-emergence mortality was high in hydroprene treatments.

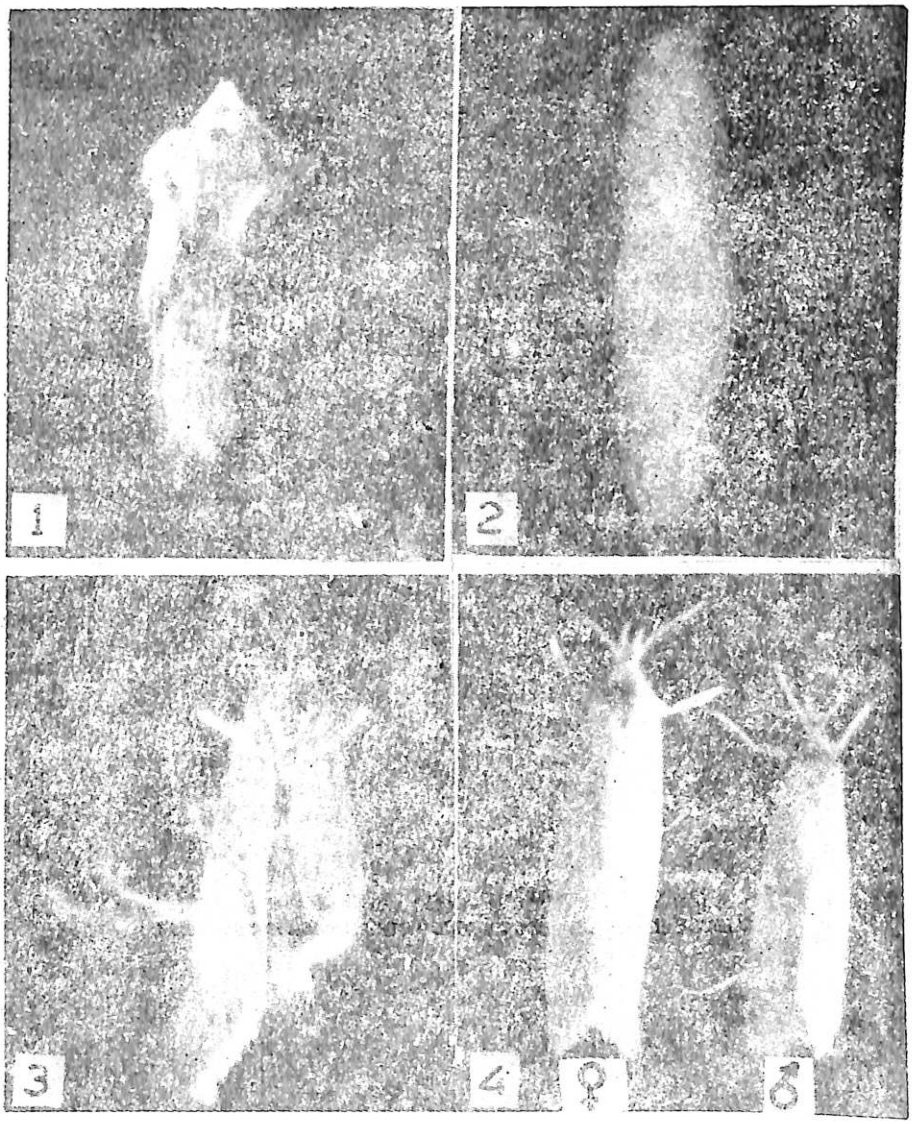
INTRODUCTION

Juvenile hormone (JH) and its bio-analogues when applied to a sensitive period of pupal life inhibit imaginal differentiation of various insects, including several representatives of Lepidoptera (Abdallah *et al*, 1974; Tan, 1975; Sehnal *et al.*, 1976; Orphanidis, 1977; Ciemior *et al*, 1979; Shaheen & Dsmani, 1980; Robertson & Kimball, 1981; Deb & Chakravorty, 1985; Ghosh & Chakravorty, 1985). The present investigation, however, is the first attempt to study the effects of the juvenoids hydroprene (Altozar or ZR-0512) and methoprene (Altosid or ZR-0515) on the development and metamorphosis of post-diapause pupa of *Scirpophaga incertulas* Wlk. (Lepidoptera : Pyralidae).

MATERIAL AND METHODS

The post-diapause partly exarate pupae (Issac & Venkatraman, 1941) of *S. incertulas* were obtained from the laboratory stock of diapausing larvae which

were collected by incising the tillers of rice stubbles in the first week of December and, were reared individually inside the pieces of small glass tubes (5 cm long, 5 mm bore) with moist cotton plugging at both ends and wrapped with black paper. The tubes were kept in petridishes inside the rearing chamber having temperature 23±1° C, light-dark cycle 11-13 hours and relative humidity 70-80 %. The treated and control pupae were reared similarly in the rearing chamber at 29±1°C, light-dark cycle 14-10 hours and relative humidity 80-90 %.



Figs. 1-4 1 Non-emerged adultoid obtained from 10 μg hydroprene treatment 2. Non-emerged adultoid obtained from 100 μg methoprene treatment 3. Emerged adultoid obtained from 100 μg hydroprene treatment. 4. Normal moths.

Table I. Percentage of resultant forms and mortality occurred after application of hydroprene (H) and methoprene (M) on 0–24-hr-old pupae of *S incertulas*. Range Values are inside parentheses

Dose (μg/ind)	Total No. treated	Resultant forms & mortality * (m)	(%)	Duration (days) of pupal stage Mean ± S. E.	Life span (days) Mean ± S E
H					
100	30	DP	30 00		
		A	20 00	11.00 ± 1 09 (10 — 13)	1. 40 ± 0 48 (1 — 2)
		m	50 00		
10	30	DP	23.33		
		A	33.33	11.40 ± 1.35 (9 — 13)	2. 00 ± 0.63 (1 — 3)
		m	43.34		
1	30	NA	73.34	12.00 ± 1 41 (10 — 14)	4 00 ± 0 82 (3 — 5)
		m	26 66		
Control	20	NA	85 00	11.63 ± 1.26 (9 — 14)	4. 20 ± 0.97 (3 — 6)
		m	15 00		
C. D. at 1%				NS	2 213
at 5%				NS	1.605
M					
100	30	DP	33.33		
		A	30.00	12.20 ± 1.32 (10 — 14)	1. 80 ± 0.40 (1 — 2)
		m	36.67		
10	30	DP	26.67		
		A	40.00	11.20 ± 1.46 (9 — 13)	2. 20 ± 0 40 (2 — 3)
		m	33.33		
1	30	NA	76 67	11.80 ± 1.72 (9 — 14)	4. 40 ± 1.00 (3 — 6)
		m	23 33		
Control	20	NA	85.00	11.63 ± 1.26 (9 — 14)	4. 20 ± 0 97 (3 — 6)
		m	15.00		
C D at 1%				NS	1.990
at 5%				NS	1.444

* Individuals died after undergoing very little or no morphogenetic change.
C. D. = Critical difference
NS = Non-significant.

Juvenoids hydroprene and methoprene were applied topically in acetone solution on 0–24–hr–old pupae at the rates of 100 μg, 10 μg and 1 μg per individual. Each individual received 1 μl solution containing the required amount of the compounds and 1 μl of pure acetone Per individual served as control treatment. Effects caused by the juvenoids were evaluated from the eclosed and non–eclosed forms. The morphs of the non–eclosed forms were identified after removing the pupal exuviae on the 13th day of treatments covering the whole period of emergence of the control moths. Emerged moths were provided with 5 % sucrose water as food.

OBSERVATIONS

Effect on the development and metamorphosis

The resultant forms developed after the application of both the juvenoids, were : defective pupae or non-emerged adultoids (Figs. 1 & 2 DP) and adultoids (Fig. 3, A) (wings twisted or curly, short, pigmentation less; mouth parts and antennae attained imaginal status but were defective).

Intermediate forms of 50 % (DP–30 % and A–20 %) and 57 % (DP–24 % and A–33 %) respectively were produced due to hydroprene 100 μg and 10 μg treatments. Similarly, intermediate forms of 63 % (DP–33 % and A–30 %) and 67 % (DP–27 % and A–40 %) respectively were developed after 100 μg and 10 μg methoprene treatments. There was no significant difference in the duration of pupal life between treated and control specimens $F=0.312$, $P>0.05$; d.f. 3, 16 and $F=0.268$, $P>0.05$; d f. 3, 16 for hydroprene and methoprene treatments respectively). But there occurred a significant percentage of pupal death which was always higher in case of hydroprene treatment (50 % by 100 μg) than in methoprene treatment (37 % by 100 μg). Moreover, the death rate was always higher at higher dosage. There was no effect in 1 μg treatments of both hydroprene and methoprene and moths were externally normal (Fig. 4, NA) (Table I).

Effect on the life span (days between first moult and death)

The life span of emerged adultoids (highest 2 days by 100 μg of hydroprene and methoprene) showed significant reduction from that of normal moths in controls (lowest 3 days) ($F=6.912$, $P<0.01$; d. f 3, 16 for hydroprene and $F=7.730$, $P<0.01$; d f, 3, 16 for methoprene). Differences in dosage effects due to 100 μg and 10 μg treatments of both the compounds were non-significant ($P>0.05$). Further, treatments of 1 μg was not significantly effective ($P>0.05$). The defective pupae had a very short life (<1 day) (Table I).

DISCUSSION

Topical treatments with juvenoids hydroprene and methoprene on pupae of *S. incertulas* produce striking disorders in the differentiation of external morphology of the insect.

The occurrence of intermediate forms in the experimental series of present investigation can explain the hormonal imbalance due to the exogenous treatment of juvenoids (Slama *et al.*, 1974; Novak, 1975; Wigglesworth, 1977). The production of adultoids after the early pupal treatments in the present investigation conforms with the findings, on other insects, of Srivastava (1981) who also recorded that the pupal life is of prime importance to produce different degrees of morphogenetic differentiation. Results similar to the present findings have also been observed after juvenoid treatments in the pupae of some other insects (Tan, 1975 in *Ephestia kuhniella* and *E cautella*; Sehnal *et al.*, 1976 in *Spodoptera littoralis, Mamestra brassicae* and *Autographa gamma*; Orphanidis, 1977 in *Ceratitis capitata*; Ciemior *et al* , 1979 in *Galleria mellonella*; Shaheen & Osmani, 1980 in *Achoea janata*; Robertson & Kimball, 1981 in *Choristoneura occidentalis;* Deb & Chakravorty, 1985 in *Corcyra cephalonica*). The duration of sensitive period and the extent of possible morphological effects have, however, been found to be species specific (Sehnal, 1983). The failure of emergence may be due to the ill development of the structures which are necessary for the eclosinon process Non-emergence has also been observed after pupal treatment with juvenoid (Bagley & Bauernfeind, 1972 in *Plodia interpunctella;* Tan, 1975 in *E. kuhniella*).

The high percentage of pupal death in both the treatments may be due to disturbed ecological niches, damage in the internal organs (Sehnal & Skuhravy, 1976) or due to lethal effect of juvenoids (Robertson & Kimball, 1979; Kim *et al* , 1981).

The juvenoids have no effect of the duration of pupae which could escape the lethal effect of the chemicals. Similar results have been reported by Shaheen & Osmani (1980), Sehnal (1983) and Deb & Chakravorty (1985).

The reduction in the span of life of adultoids may be due to disfunction or disturbed co-ordination of body organs which has also been suggested for the early death of intermediate forms developed due to juvenoid treatment in *Galleria mellonella* (Ciemior *et al* , 1979). The reduced life span of malformed adults has also been observed in *Spodoptera litura* after JH treatment (Morallo-Rajesus & Martinez-Aguda, 1980).

The present investigation, thus, shows that development of post-diapause pupae of *S. incertulas* is very much affected due to juvenoid treatment.

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