hyacinth leaves and the females deposit their eggs below the epidermis of the petioles and laminae. The larvae which hatch out after 7 – 14 days tunnel inside the petioles and the crown of the plant and after attaining full growth emerge and pupate under water attached to living roots of water hyacinth. Larval and pupal periods last 75 – 90 and 14 – 20 days respectively[6].

Establishment of *N. eichhorniae* was observed in Bellandur tank by October 1984, about 4 months after the initial release. The insects were restricted to the release area of about 500 m^2 and the population of adults per plant was found to be 1.05. By March 1985 the insect population had increased to 3.26 per plant in about 5 ha area and large-scale dispersal was noticed from June 1985. By September 1985 *N. eichhorniae* could be located throughout the tank. Observations in December 1985 revealed that the insect population had increased to about 5.4 adults per plant.

The increase in the population of *N. eichhorniae* was accompanied by a reduction in the petiole length of water hyacinth plants. At the start of the experiment the length of the petioles varied between 59 and 65 cm which declined to 32 and 43 cm in December 1985. Around this time water hyacinth leaves started browning and by March 1986 extensive browning could be noticed. There was progressive reduction in the area covered by water hyacinth and by June 1986 this had reduced by about 50%.

Surveys carried out in nearby tanks showed that *N. eichhorniae* is capable of migration to other tanks when the water bodies are connected. Thus in January 1986 the insect was found to have migrated to a 25 ha tank at Varthur located about 7 km away from Bellandur tank and fed by the latter. The population of *N. eichhorniae* has been building up in this tank also and by September 1986 all the plants were found to be infested by the insect and up to 25 adults could be collected per plant.

The results obtained so far indicate that *N. eichhorniae* is capable of bringing about biological control of water hyacinth thereby opening up water bodies for economic uses like fisheries, irrigation, navigation etc. Distribution of this insect to other parts of the country therefore holds out promise of control of this noxious weed.

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HEART BEAT RATE OF INTERMEDIATE FORMS PRODUCED AFTER JUVENOIDS AND ANTIALLATOTROPIN TREATMENTS ON DIAPAUSING LARVAE OF *SCIRPOPHAGA INCERTULAS* (WALKER) (LEPIDOPTERA: PYRALIDAE)

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EARLY work[1] reveals limited knowledge on the effects of juvenoid and anti-juvenilizing compounds on the rate of heart beat during metamorphosis of insects. In the present communication an attempt has been made to study the rate of heart beat of intermediate forms obtained after juvenoids and antiallatotropin precocene-II treatments on diapausing rice stem borer larvae of *Scirpophaga incertulas* (Walker) (Lepidoptera: Pyralidae).

The method of collection of diapausing larvae of *S. incertulas*, its rearing in the laboratory, applica-

Table 1 *Chemical name of tested compounds*

Common code name	Chemical name
Hydroprene or Altozar or ZR-0512	Ethyl 3,7,11-trimethyl-2, 4-dodecadienoate
Methoprene or Altosid or ZR-0515	Isopropyl 11-methoxy-3,7, 11-trimethyldodeca-2,4-dienoate
$R = CH_3$; $R' = C_2H_5$	*Trans*-3,4-methylenedioxy-phenoxy-6,7-epoxy-3,7-diemthyl-2-nonene
Antiallatotropin or Precocene-II	6,7-dimethoxy-2, 2-dimethyl-2H-1-benzopyran

tion of chemicals (table 1) and control treatments were the same as described earlier[2]. The resultant forms, developed in the experimental categories and from which heart beats were counted, were adultoid larvae and extralarval instars[3]. Since the effects of chemicals were evaluated after the moult, the rate of heart beat of 0–12 hr old pupa in the control series was taken as the comparable data. Heart beats were counted under stereobinocular microscope with a hand-counter and stop-watch[1]. Counts from a minimum of 10 or more specimens, 0–12 hr old, were recorded with five replications per specimen for statistical *t* tests.

Heart beat during development in control specimens:

Heart beats of control specimens were counted in three developmental stages: firstly 2–3 days after the onset of diapause (early phase of diapause) when the rate was 34.28–42.85/min (average 37.83/min); secondly 2–3 days prior to pupation (late phase of diapause) when the rate was 35.50–44.15/min (average 38.80/min) and thirdly just after pupation when the rate was 44.44–47.39/min (average 45.48/min). The rate of heart beat remained non-significantly different ($P > 0.05$) during diapausing larval life and then increased significantly ($P < 0.01$) in early pupa (table 2).

Table 2 *Heart beat per minute of control diapausing larva and pupa of S. incertuals*

Stage and phase of diapause	Mean ± S. E. (range)
Last-instar diapausing larva	
Early phase	37.83 ± 3.16 (34.28 – 42.85)
Late phase	38.80 ± 3.32 (35.50 – 44.15)
Pupa	
Post-diapause	45.48 ± 1.13 (44.44 – 47.39)

Heart beat in intermediate forms:

In adultoid larvae, obtained after application of 10 μg of hydroprene and methoprene, the rate of heart beat reduced significantly ($P < 0.001$) from control. Maximum reduction was found in adultoid larvae produced after methoprene treatment (table 3).

In extralarval instars, produced due to the treatment of juvenoids, hydroprene, methoprene, $R = CH_3$; $R' = C_2H_5$ and antiallatotropin precocene-II significant ($P < 0.001$) reduction of the rate of heart beat was recorded. Maximum reduction was observed in the case of 100 μg of $R = CH_3$; $R' = C_2H_5$ treatment and minimum reduction in 50 μg of precocene-II treatment (table 3).

In the present investigation, the rate of heart beat of control series shows non-significant difference during early—and late—diapausing larval life but shows significant increase in pupa. In *Chilo auricilius* the rate of heart beat remains non-significantly different during diapausing larval life and follows a declining trend at diapause breaking in pupal stage[1]. The difference in the mode and intensity of diapause in the two pyralid species is evident in the kinds of intermediate form, duration of diapause and temporal span of diapause breaking in the treated specimens[3]. The reduced heart beat in diapausing *S. incertulas* larvae is possibly due to less physiological activity and retardation of development[4] and the increased heart beat in pupa may be due to diapause breaking. It has been recorded in the active feeding larva of some other insects that the rate of heart beat is greater in larva from that of the pupa, which has been attributed to increased metabolic rate[5]. Influence of ventral glands, in the presence of corpora allata (CA), on the heart beat in *Locusta migratoria* has been emphasized[6]. CA influence the basal metabolism either directly or indirectly[7]. Therefore, the cause of reduction of the rate of heart beat in different developmentally moribund intermediate forms may be the decreased metabolic rate. The reduction in the rate of heart beat in different intermediate forms of *S. incertulas* from control individuals shows parallelism with that recorded earlier in the intermediate forms of *C. auricilius*[1].

Table 3 *Heart beat per minute of the adultoid larva and extra larval instar produced after juvenoids and precocene-II treatments in the diapausing larvae of S. incertulas*

Chemical	Dose (μg/ individual)	No. of Individuals studied	Mean ± S. E. (range)
Adultoid larva			
Hydroprene	10	10	12.44 ± 1.28 (10.00 – 13.63)
Significance			$P < 0.001$
Methoprene	10	10	10.15 ± 1.37 (9.00 – 12.76)
Significance			$P < 0.001$
Extralarval instar			
Hydroprene	100	15	19.90 ± 4.66 (16.21 – 27.77)
Significance			$P < 0.001$
Methoprene	100	15	18.77 ± 3.62 (14.28 – 23.07)
Significance			$P < 0.001$
R = CH_3; R′ = C_2H_5	100	14	13.18 ± 1.98 (10.00 – 16.21)
Significance			$P < 0.001$
	50	15	16.15 ± 2.19 (13.33 – 20.00)
Significance			$P < 0.001$
Precocene-II	150	10	14.26 ± 1.41 (12.50 – 16.48)
Significance			$P < 0.001$
	100	10	24.72 ± 2.17 (22.00 – 27.27)
Significance			$P < 0.001$
	50	15	33.13 ± 1.67 (30.00 – 35.00)
Significance			$P < 0.001$

The juvenilizing property of precocene-II in differentiation and morphogenesis has earlier been found in *Corcyra cephalonica*[8]. Further, methoprene is more effective than hydroprene in reducing the rate of heart beat in adultoid larvae and extralarval instars of *S. incertulas*. This is possible because hydroprene degrades more rapidly than methoprene[9]. On the whole, the rate of heart beat shows drastic reduction in developmentally intermediate forms formed after early diapause breaking due to the application of juvenoids and antiallatotropin precocene-II in diapausing larvae of *S. incertulas*.

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RELATIVE IMPORTANCE OF TEMPERATURE AND PHOTOPERIOD IN THE PHYSIOLOGY OF INDIAN GARDEN LIZARD, *CALOTES VERSICOLOR*

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The literature on environmental control of molting and O_2 consumption in reptiles are scanty[1,2]. Particularly studies on effect of photoperiod on the physiology of reptiles are almost lacking. In the present study an attempt has been made to study the