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Leptinotarsa decemlineata

Effects of Precocene-I and II on the development of Colorado
potato beetle, *Leptinotarsa decemlineata*

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Leptinotarsa decemlineata

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Leptinotarsa decemlineata Say (Col.: Chrysomelidae)

Koopmanschap)

.(et al., 1989

(IGR)

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- CPB (Colorado Potato Beetle)
 - Solanaceae
 - Insect Growth Regulator

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.(Edwards & Menn, 1981)

.(Yuhás *et al.*, 1983)

.(Hoffmann & Lorenz, 1998)

(Bowers, 1976)

(*Ageratum houstonianum* Mill)

.(Bowers *et al.*, 1976)

P-450

.(Ellis, 1983)

P-450

.(Polivanova, 1984)

Bowers .

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- Juvenile hormone
 - Precocene
 - Floss flower
 - Compositae

.(Ohta *et al.*, 1977)

Thermobia domestica Pack

.(Bitsch & Bitsch, 1984) (Lepismatidae)

.(Staal, 1986)

.(Das & Medda, 1987)

II- .(Bowers, 1976; Miall & Mordue, 1980)

(*Schistocerca gregaria* Forskal)

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.(Eid *et al.*, 1988)

Locusta migratoria

Polivanova & Triseleva, 1989; Triseleva, 2003;)

Heteracris littoralis Rambur

.(Nemec *et al.*, 1978

.(Alrubeai, 1986)

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Nilaparrata lugens Stall

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.(Pradeep & Nair, 1989)

Bowers *et al.*,)

.(1976; Bitsch & Bitsch, 1984

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.(Chorni, 2004)

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.(Darvas *et al.*, 1989)

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.(Mellaert *et al.*, 1983)

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- 7-methoxy-2, 2-dimethyl chromene
 - 6,7-dimethoxy-2, 2-dimethyl-3-chromene

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() % / ((Roskin & Levinoson, 1957) ()

(Roskin & Levinoson, 1957) ()

(PH=7.3) () %

) (% % (Miranov *et al.*, 1994) JEM-100B TEM

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- Osmium tetroxide
 - Epon 812
 - Transmission Electron Microscopy

جدول ۸- تأثیر غلظت‌های مختلف پریکوسن-۱ و II روی فاکتورهای رشد و نموی در شرایط آزمایشگاهی
 Table 1- Effect of different concentrations of Precoene-I & II on CPB developmental factors¹ in vivo.²

Treatment	Larval Period (day)	Pupal Period (day)	Larval Mortality (%)	Pupal Mortality (%)	Pupal Weight (mg)	Adult Emergence (%)
تیمار	دوره لاروی (روز)	دوره شفیری (روز)	تلفات لاروی (%)	تلفات شفیری (%)	وزن شفیره (mg)	ظهور حشرات کامل (%)
Precoene-I (1 µg)	15.7±1.2 cd	6.45±0.4 a	12.5±5.0 e	5.55±7.1 a	100.98±9.2 a	82.50±9.6 a
Precoene-I (10 µg)	16.0±1.8 bc	6.36±0.1 a	27.0±7.2 e	0.00±0.0 a	101.05±7.0 a	72.50±12.2 a
Precoene-I (20 µg)	18.0±2.5 bc	6.36±0.3 a	60.0±8.2 bc	8.50±5.0 a	101.11±4.7 a	35.00±12.9 c
Precoene-I (30 µg)	18.4±3.1 bc	6.20±0.5 a	70.0±8.3 a	0.00±0.0 a	106.34±7.6 a	30.00±18.3 c
Precoene-I (50 µg)	-	-	100±0.0 a	-	-	0.00±0.0 d
Precoene-II (1 µg)	16.3±0.9 cd	6.17±0.2 a	32.5±2.7 de	5.00±6.5 a	105.14±4.4 a	65.00±13.8 ab
Precoene-II (10 µg)	16.8±0.8 cd	6.06±0.4 a	35.0±3.5 cde	3.13±5.6 a	109.02±9.4 a	62.50±11.7 ab
Precoene-II (20 µg)	17.1±1.4 cd	6.28±0.3 a	37.5±6.2 cde	3.13±6.3 a	109.83±6.0 a	62.00±18.3 ab
Precoene-II (30 µg)	20.8±0.4 ab	6.10±0.1 a	57.5±8.6 bcd	0.00±0.0 a	113.38±9.9 a	37.50±9.6 bc
Precoene-II (50 µg)	22.5±0.7 a	6.00±0.0 a	95.0±5.8 a	0.00±0.0 a	107.40±5.8 a	5.00±5.8 d
Control	13.8±1.2 d	6.02±0.5 a	10.0±2.5 e	5.55±6.4 a	113.28±4.8 a	82.50±10.0 a

1- Means ± SE

2- Means within column followed by the same letter not found significant (P<0.05, DMRT)

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.(Srivastava & Kumar, 1997)

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Azambuja *et al.*,)

(Chenevert *et al.*, 1980; Islam, 1995)

(Hales & Mittler, 1988)

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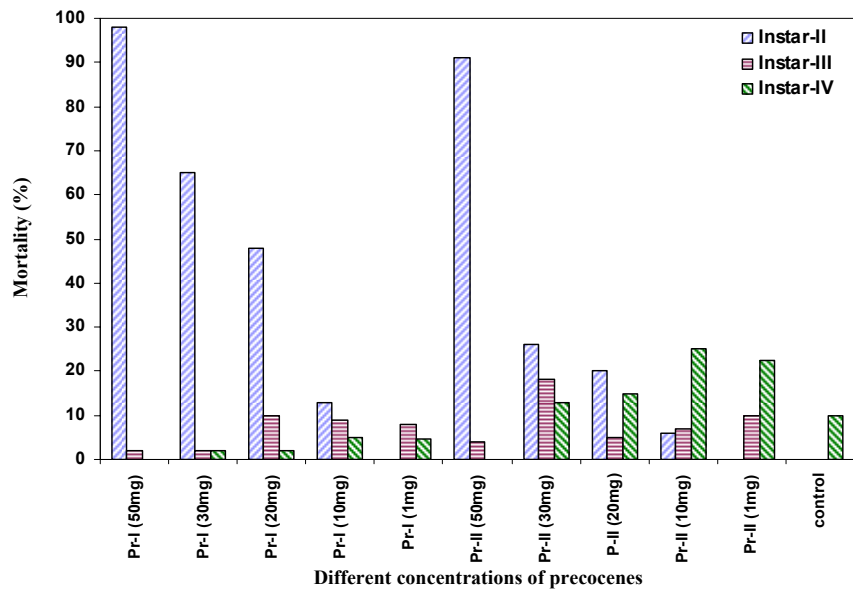
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.(Filipovich *et al.*, 1988)

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Fig. 1- Larval instars mortality of CPB treated with Precocene-I & II

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Oncopeltus fasciatus Dallas

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Heliothis zea Boddie

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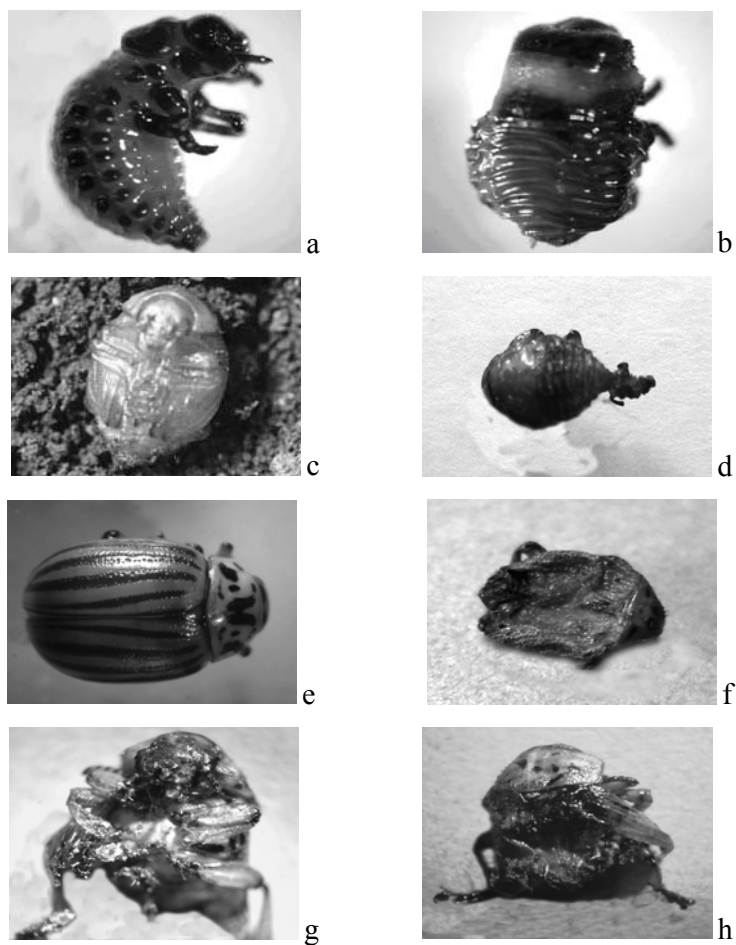
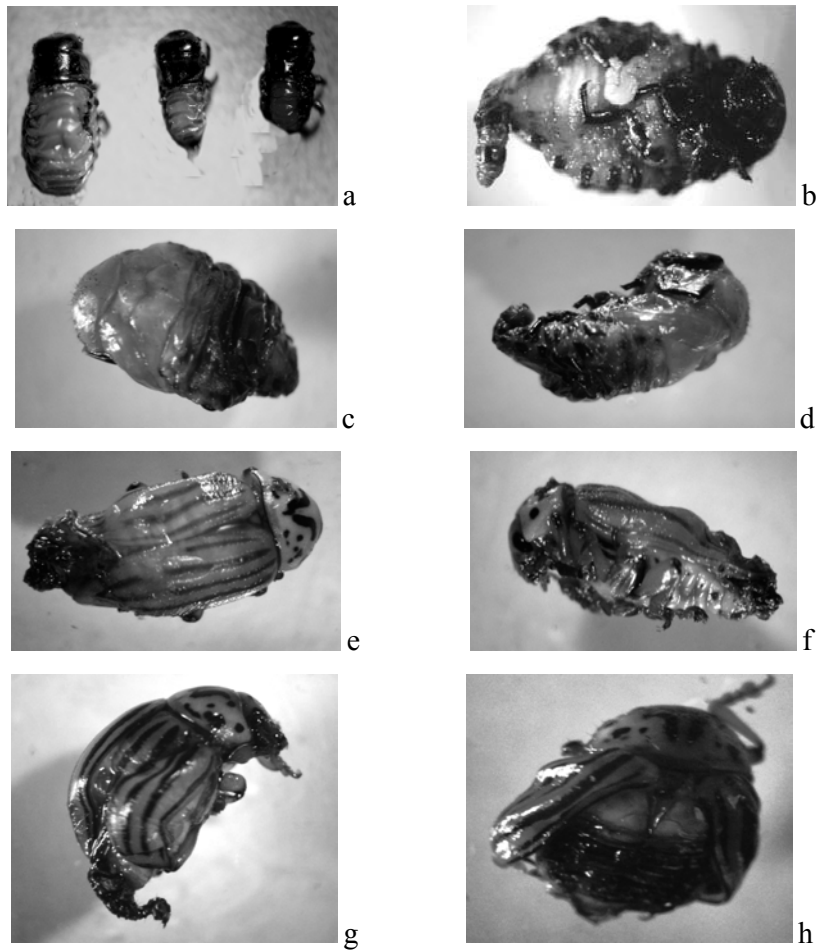


Fig. 2- a) CPB larva (Control); b) CPB larva treated with Precocene-I; c) CPB pupa (control); d) CPB pupa from larvae treated with Precocene-I; g) CPB imago (Control); f-h) CPB imago from larvae treated with Precocene-I .

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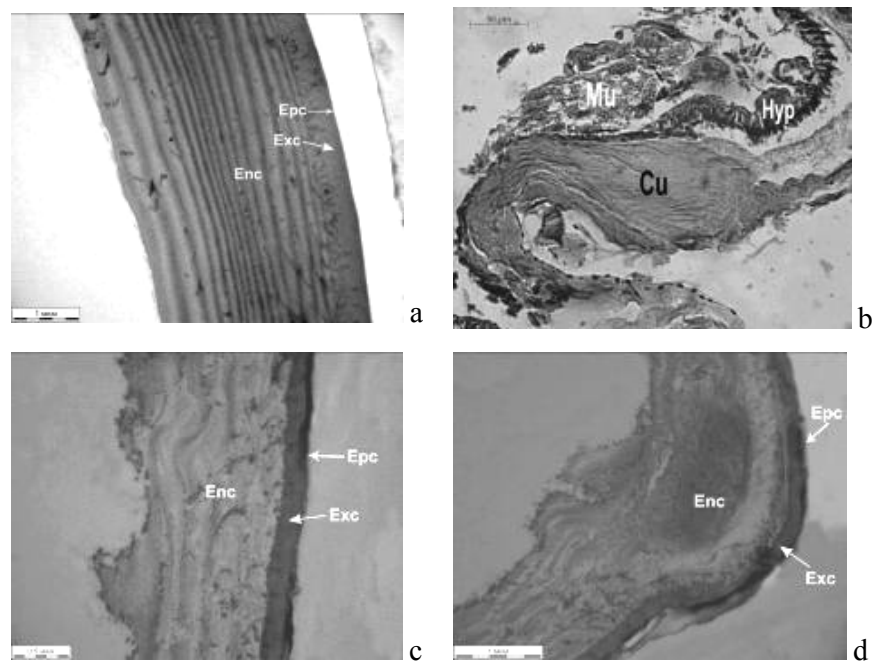
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Fig. 3- a-b) CPB larva treated with Precocene-II; c-d) CPB pupae from larvae treated with Precocene-II; e-h) CPB imagoes from larvae treated with Precocene-II .



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Fig. 4- a: TEM cross-section of CPB larval cuticle (control); b: Cross-section of CPB larval cuticle treated with Precocene-I; c-d: TEM cross-section of CPB Larval cuticle treated with Precocene-II. (*Cu*: Cuticle, *Enc*: Endocuticle, *Epu*: Epicuticle, *Exo*: Exocuticle, *Hyp*: Hypoderm, *Mu*: Muscle).

Oncopeltus fasciatus Dallas

Heliothis zea Boddie

.(Bradley & Bowers, 1992; Binder & Bowers, 1992; Bowers, 1983)

.(Hodkova & Socha, 1982)

.(Samaranayaka-Ramasamy & Chaudhury, 1982)

.(Bowers *et al.*, 1976; Dorn, 1982; Polivanova, 1982)

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Effects of Precocene-I and II on the development of Colorado potato beetle, *Leptinotarsa decemlineata* (Col.: Chrysomelidae)

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ABSTRACT

The Colorado potato beetle, *Leptinotarsa decemlineata* Say (Col.: Chrysomelidae), is the most harmful insect pest in potato fields. Precocene, a juvenile hormone inhibitor, has cytotoxic effects on insect's corpora allata. The effects of precocene-I and precocene-II were tested on the 2nd larval instar of *L. decemlineata* by topical application in laboratory. The results showed that precocene-I and precocene-II increased larval mortality and developmental period, but had effect on pupal period. Both larval mortality and developmental period were directly correlated with precocene concentration. The most effective concentration of precocene was 50 mg/larva, which caused 95% (precocene-II) and 100% (precocene-I) mortality during larval period. Precocene did not influence number of larval instars and molting, but it led to early formation of pupal characteristic on larvae and formation of adultoids. *Leptinotarsa decemlineata* treated with precocene were also showed other severe morphological abnormalities, such as size reduction, body segmentation disturbance, strong deformation or complete reduction of wings and elytra, and persistence of old cuticle.

Key words: Colorado potato beetle, Precocene-I, precocene-II, juvenile hormone inhibitor

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References

- ALRUBEAI, H. F. 1986. Effects of precocenes I and II on the grasshopper *Heteracris littoralis* (Orthoptera: Acrididae). Ann. Entomol. Soc. Amer. 79(2): 341-343.
- AZAMBUJA, P. D., S. E. GARCIA and J. M. C. RIBEIRO, 1981. Effects of ecdysone on the metamorphosis and ecdysis prevention induced by precocene I in *Rhodnius prolixus*. Gen. and Comp. Endocrinol. 45(1): 100-104.
- BINDER, B. F. and W. S. BOWERS, 1992. Effects of precocene II on the nutritional physiology of last instar, *Heliothis zea* larvae. Arch. Insect Biochem. and Physiol. 19(4): 237-246.
- BITSEH, C. and D. BITSEH, 1984. Antigonadotropic, antiallatae effects of precocene II in the fire bat *Zhermobia domesticue* (Zhysamera: Lepismaidae). J. Insect Physiol. 30(6): 463-470.
- BOWERS, W. S. 1976. Discovery of insect antiallatotopins. The juvenile hormones. N.Y.: Plenum Press, P. 737-742.
- BOWERS, W. S. 1983. The search for 4-th generation pesticides. Natur. Prod. Innovative Pest. Manag. Oxford. P. 47-58.
- BOWERS, W. C., T. OCHTA, G. S. CLEERE and P. A. MARSELLA, 1976. Discovery of insect anti-juvenile hormones in plants. Science. 193 (4253): 542-547.
- BRADLEY, F. B. and W. S. BOWERS, 1992. Effects of Precocene II on the nutritional physiology of last instar *Heliothis zea* larvae. Archives of Insect Biochemistry and Physiology. 19: 237-246.
- CHENEVERT, R., J. M. PERRON, R. RAQUIN, M. ROBITALLIE and Y. K. WANG, 1980. Activity of precocene analogs on *Locusta migratoria migratoriodes* (R and F). Experientia. 36(4): 379-380.
- CHORNI, A. M. 2004. Biologically active substances for control of Colorado potato beetle. Thesis abstract. Kiev. Ukraine. 43 pp.
- DARVAS, B., L. TIMAR, L. VARJAS and P. KULSCAR, 1989. Synthesis of novel 2, 2-dimethylchromene derivatives then toxic activity a larvae of *Pieris brassicae* (Lep.: Pieridae), *Leptinotarsa decemlineata* (Col.: Chrysomelidae). Acta phytopathol. Acad. sci. hung. 24: 455-472.
- DAS, S. and A. K. MEDDA, 1987. Effects of precocene II on the mortality, body

weight and duration of larval and pupal instars and the protein and nucleic acid contents of fat body and ovary of silkworm *Bombyx mori* L. Zool. Jahrb. Abt. allg. Zool. und Physiol. Tiere. 91(1): 27-38.

DORN, A. 1982. Precocene-unduced effects and possible role of juvenile hormone during embryogenesis of milkweed bug *Oncopeltus fasciatus*. Gen. and Comp. Endocrinol. 46(1): 42-52.

EDWARDS, J. P. and J. J. MENN, 1981. The use of juvenoids in insect pest management. Chem. Pflanzenschutz. und Schadlings-bekampfungs. Berlin e.a. P. 185-215.

EID, M. A. A., M. S. SALEM and G. Z. TAHA, 1988. Effects of precocene II on morphogenesis of the desert locust *Schistocerca gregaria*. Biochem. Syst. and Ecol. 16(5): 515-520.

ELLIS, P. G. 1983. The mode of action of pro-allatocidins. Natur. Prod. Innovative Pest Manag. Oxford e.a. P. 323-353.

FILIPOVICH, Yu. B., S. A. ROSLAVTSEVA, N. M. KUTUZOVA, M. N. BARIBKINA, T. A. PERIGUDA and G. B. IVANOVA, 1988. Physiologic-biochemistry fundamentals effects of control methods for harmful arthropods. Science & Technology, Series Entomology. Vol. 8: 193 pp.

HALES, D. F. and MITTLER, T. E. 1988. Male production by aphids prenatally treated with precocene: prevention by short-term kinoprene treatment. Arch. Insect Biochem. and Physiol. 7(1): 29-36.

HOFFMANN, K. H. and M. W. LORENZ, 1998. Recent advances in hormones in insect pest control. Phytoparasitica. 26(4): 1-8.

HODKOVA, M. and R. SOCHA, 1982. Comparison of effects of starvation and precocene II on the function for denervated corpus allatum in *Dysdercus cingulatus* females. Entomol. Acta entomol. bohemoslov. 79. (2): 108-111.

ISLAM, M. S. 1995. Endocrine manipulations in crowd-reared desert locust *Schistocerca gregaria* (Forsk.). II. Effects of precocene on mortality and reproductive parameters. Bangladesh J. Zool. 23(2): 199-208.

KOOPMANSCHAP, A. B., H. OOUCHI and C. A. D. DE KORT, 1989. Effects of a juvenile hormone analogue on the eggs, post-embryonic development, metamorphosis and diapause induction of the Colorado potato beetle, Entomol. Exp. Appl. 50: 255-263.

MATHAI, S. and V. S. K. NAIR, 1984. Treatment of larvae with repeated doses of

precocene II induces precocious metamorphic changes in *Spodoptera mauritia* (Lepidoptera: Noctuidae). Arch. Insect Biochem. and Physiol. 1(2): 199-203.

MELLAERT, H. VAN., A. DE. LOOF and L. JURD, 1983. Insecticidal effects of a benzyl-1, 3-benzodioxole chemosterilant with anti-juvenile hormone activity on the colorado potato beetle. Meded. Fac. landbouwwetensch. Rijksuniv. Gent. 48(2) 303-307.

MIALL, R. C. and W. MORDUE, 1980. Precocene II has juvenile-hormone effect in fifth instar of locusta migratoria. J. Insect Physiol. 26: 361-364.

MIRANOV, A. A., Y. Y. KOMISSARCHIK and V. A. MIRANOV, 1994. Electron microscopical methods in biology and medicine. Nauk Pub. Moscow. 399 p.

NEMEC, V., T. T. CHEN and G. R. WYATT, 1978. Precocious adult locust, *Locusta migratoria migratoriodes* induced by precocene. Acta entomol. bohemoslov. 75(4): 285-286.

OHTA, T., R. J. KUHR and W. S. BOWERS, 1977. Radiosynthesis and metabolism of the insect anti-juvenile hormone, precocene II. J. Agric. Food Chem. 25: 478-481.

POLIVANOVA, E. N. 1982. The influence of precocene on embryonic development in *Eurygaster integriceps*. Dokl. Akad. Nauk SSSR. 263(2): 501-503.

POLIVANOVA, E. N. 1984. Physiologically active substances affecting the hormonal balance in insects. Journal of General Biology. 45(1): 36-48.

POLIVANOVA, E. N. and T. A. TRISELEVA, 1989. Inhibited development of *Locusta migratoria* feeding on precocene-containing plants and outlooks for their application to biological control. Dokl. Akad. Nauk SSSR. 306(2): 755-758.

PRADEEP, A. R. and V. S. K. NAIR, 1989. Morphogenetic effects of precocene II in the brown planthopper *Nilaparvata lugens* Stal. (Homoptera: Delphacidae). Proc. Indian Nat. Sci. Acad. 55(5 & 6): 381-386.

ROSKIN, G. I. and L. B. LEVINSON, 1957. Microscopical technic. Soviet Science Pub. Moscow. 467 p.

SAMARANAYAKA-RAMASAMY, M. and M. F. B. CHAUDHURY, 1982. Precocene-induced sterility in F₁ generation of *Glossina morsitans morsitans*. J. Insect Physiol. 28(6): 559-569.

SRIVASTAVA, U. S. and K. KUMAR, 1997. Precocene I and II induced metamorphosis in a noctuid moth, *Spodoptera litura* Fabr. Proc. Nat. Acad. Sci. India. 67 (3 & 4): 213-226.

STAAL, G. B. 1986. Anti juvenile hormone agents. Ann. Rev. Entomol. 31: 391-429.

TRISELEVA, T. A. 2003. Effect of Plant Synthesizing Biologically Active Substances-

Precocenes-on Insects. Biology Bulletin. 30(3): 275-280.

YUHAS, D. A., R. M. ROE, T. C. SPARKS and A. M. JR. HAMMOND, 1983.
Purification and kinetics of juvenile hormone esterase from the cabbage looper, *Trichoplusia ni* (Hubner). Insect Biochem. 13(2): 129-136.

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