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ECONOMIC SPECIES OF *CRYPTOLESTES* (CUCUJIDAE : COLEOPTERA) OCCURRING IN INDIA AND THEIR CONTROL

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ABSTRACT

Taxonomy, biology and control of *Cryptolestes pusillus* (Schonherr) and *Cryptolestes ferrugineus* (Stephens) have been dealt. A key to pest species of *Cryptolestes* is given.

INTRODUCTION

Cryptolestes is a cosmopolitan genus, closely related to the genus *Laemophloeus* Dejean and *Microlaemus* Lefkovitch, differing from the former in having front coxal cavities close behind, intercoxal process of ventrite 1 broad and its apical margin slightly rounded, fronto-clypeal suture absent and apical margin of clypeus never with five apical emarginations. Unlike *Microlaemus*, the head of *Cryptolestes* is devoid of frontoclypeal suture, front coxae globular and its cavities close behind. Grouvelle's species of Indian *Cryptolestes* were so far placed under the genus *Laemophloeus*, moreover, until recently the pest species *Cryptolestes ferrugineus* and *Cryptolestes pusillus* were considered as *Laemophloeus* and this name has been used in several text books.

There are six species of the genus *Cryptolestes* Ganglbauer, namely *ferrugineus* (Stephens), *pusillus* (Schonherr), *turcicus* (Grouvelle), *pusilloides* (Steel & Howe), *ugandae* Steel & Howe and *capensis* (Waltl) recorded as pest of stored products from the world. They generally infest husked rice, wheat and wheat products, sorghum, maize, barley and occasionally on oil seeds. Though the close external similarity of the members of this genus often lead to confusion, considerable differences do exist in the range of geographical distribution, habitat and in sclerites associated with male and female genitalia. Of the six known pest species of *Cryptolestes*, the species *turcicus* (Grouvelle), *pusilloides* (Steel & Howe), *ugandae* Steel & Howe and *capensis* (Waltl) do not occur in India. The most important pest species of this genus are *pusillus* (Schonherr) and

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ferrugineus (Stephens) which are quite common in India and serious pest of stored grain and their products. *Cryptolestes turcicus* (Grouvelle) is more or less confined to the temperate regions of the world and infest wheat, grain residues, maize, dried fruits etc. ; *C. pusilloides* (Steel & Howe) is distributed mainly in Southern hemisphere and recorded from wheat and wheat products, sorghum, rice, barley and occasionally from oil seeds ; *C. ugandae* Steel & Howe is known from Central Africa and associated with stored food ; whereas *C. capensis* (Waltl) has been recorded from Europe, North and South Africa from flour mills. Till to date only two species, *C. pusillus* (Schonherr) and *C. ferrugineus* (Stephens) were known from India. Authors have discovered seven more species of *Cryptolestes* from India including three new to science, which will be dealt elsewhere. Of the two pest species of *Cryptolestes* in India, *pusillus* is more common and causes seriousdamage to unboiled rice, suji and flour. Prior to 1939 *C. pusillus* was

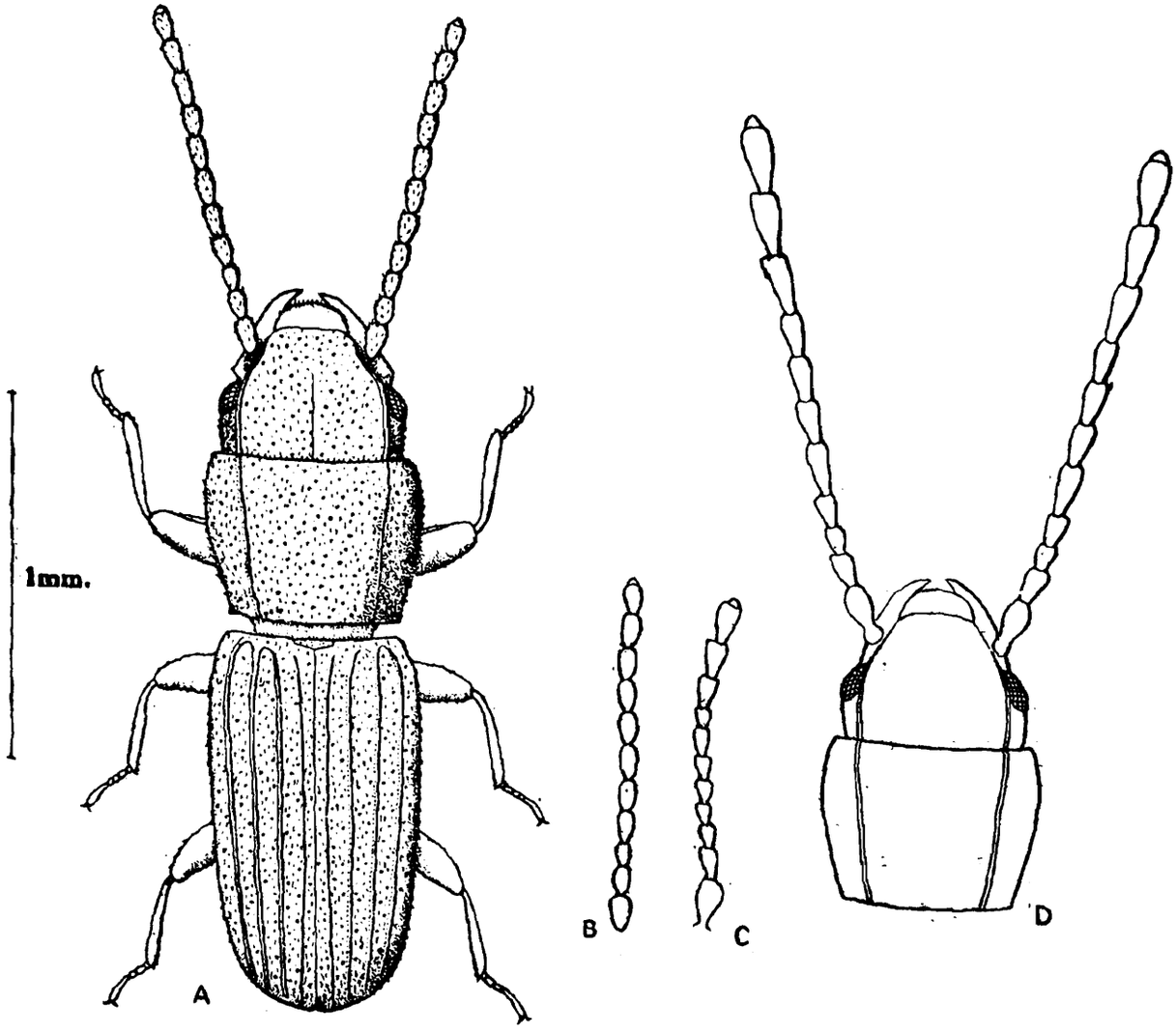

Fig. 1-(A-B) *Cryptolestes ferrugineus* (Stephens) A. Dorsal view. B. antenna of female ; (C-D) *Cryptolestes pusillus* (Schonherr) C. antenna of female, D. head and prothorax of male.

considered to be a secondary pest, but during the second world war it was recorded as a serious, widespread pest of rice.

Key to the stored grain species of **Cryptolestes** Ganglbauer

1.	Length of antennae in male either as long as or longer than body, outer margin of mandible simple and rounded	3
	—Length of antennae never exceed two thirds of the body in both sexes, outer margin of mandible with a distinct tooth like structure near base.	2
2.	Hind angles of pronotum prominent & acute, pronetum slightly narrowed posteriorly, segment 3 of antenna about as long as pedicel.....	*ferrugineus* (Stephens)
	—Hind angles of pronotum obtuse, pronotum markedly narrowed posterio.ly, segment 3 of antenna distinctly longer than pedicel..	*capensis* (Waltl)
3.	Pronotum quadrate	4
	—Pronotum not quadrate and narrowed posteriorly..	5
4.	Apical margin of clypeus straight	*turcicus* (Grouvelle)
	—Apical margin of clypeus distinctly emarginate.....	*ugandae* Steel & Howe
5.	Each cell of elytra with two rows of punctures ; dorsal surface of the body densely pubescent, pronotum 1.4 times as broad as long....	*pusillus* (Schonherr)
	—Each cell of elytra with one row of punctures ; dorsal surface of the body less pubescent, pronotum 1.1—1.2 times as broad as long....	*pusilloides* (Steel & Howe)

Cryptolestes puillsus (Schonherr)

This elongated, flattened, parallel-sided, reddish brown, densely and finely pubescent beetle is popularly known as 'flat grain beetle' and mostly common in humid tropical areas, less so in cooler drier climates and unable to survive in temperate regions. They are scavenging by nature, infesting grains which are out of condition and generally follows up the attack of *Silophilus oryzae* (L.) and *Tribolium castaneum* (Herbst). The larvae of the species are particularly fond of germ in wheat. In India, authors have recorded the species infesting biscuits (Calcutta, March), flour (Calcutta, March), unboiled rice (Chaibasa : Bihar, June). Suji (Calcutta, August). Besides this, it is also recorded from under bark of *Iagerstroemia perviflora* (Lythraceae) : Hasimara : West Bengal, *Stereospermum chelonoides* (Bignoniaceae) Dainadubi : Meghalaya, *Bombax malabaricum* (Bombacaceae) : Kaziranga : Assam, *Quercus dilatata* (Fagaceae) : Dehra-Dun : Uttar Pradesh.

Head transverse, frontoclypeal suture and median line on vertex indistinct, lateral line at the inner margin of eyes ridged, vertex densely, finely and closely punctured and pubescent ; eyes small, black and moderately coarsely faceted ; antennae 11—segmented and longer in male than female. External surface of mandible (Fig. 2A) simple and rounded. Prothorax (Fig. 1D) transverse, narrowed at base, front angle obtuse, hind angle not-projected and less acute, lateral line on either side ridged, pubescence and punctures similar to that of on head. Scutellum transverse and finely punctured. Elytra less than two times longer than its width, humeral and apical angles rounded, each elytron with three cells. Sclerites associated with male and female genitalia are as figured (Fig. 2, B,C). Males can be easily distinguishable from females, especially in antennal character. The antenna of male is a long as the body, with segments 9-11 forming an indistinguishable club. In the females the antennae never exceeds two-thirds of its body length and segments 9-11 form rather distinct club (Fig. 1C).

Biological notes : Adults are apparently unable to attack healthy grains but the larvae particularly attack the grain embryos.

The adult female lays 100-140 eggs, the larvae being very active, flat, moderately elongated, slightly narrowed in front and hehind with heavily chitinized urogomphi. The larval stage lasts for 2-4 weeks. Pupation takes place within the cocoon formed by fine silky materials. Under favourable condition species complete its development from egg to adult stage in about 6-9 weeks. Aitken (1975) noted that the lowest temperature limit for development is somewhere between 15°C and 17°C and lowest relative humidity is 50% and shortest life cycle recorded, is 21 days at 37°C and 80% humidity.

Cryptolestes ferrugineus (Stephens)

It is commonly known as 'rusty grain beetle' feeds on whole and processed grains and oilseeds and causes serious infestation in stored grains in absence of any other pest species and is usually found in flour mills. They have been also recorded infesting copra, oilcake. cocoa, beans and dried fruits. In India, we have re-

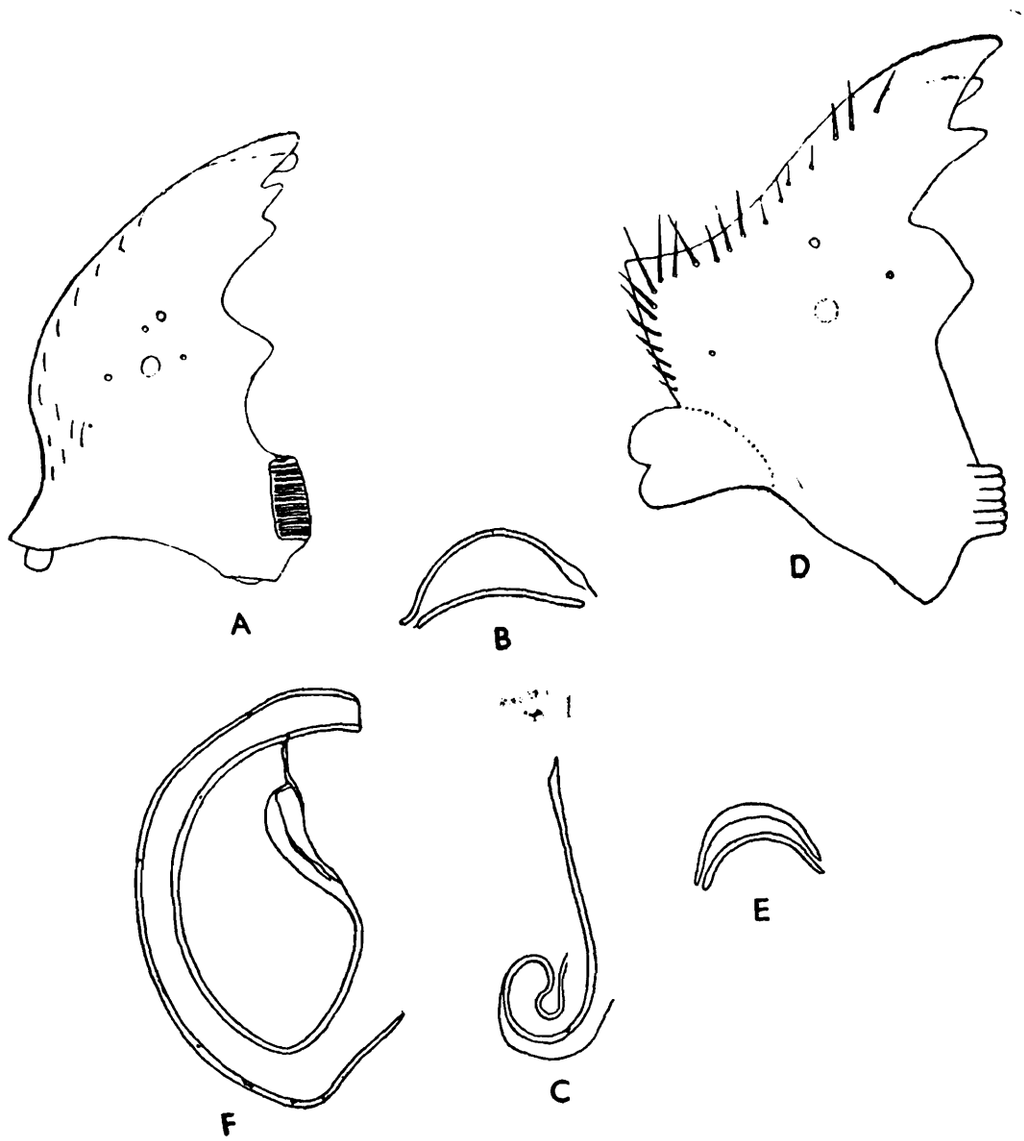

Fig. 2. (A-C) *C. pusillus* (Schonherr) A. mandible. B. sclerite associated with male genitalia, C. sclerite associated with female genitalia ; (D-F) *C. ferrugineus* (Stephens) D. mandible of male, E. sclerite associated with male genitalia, F. sclerite associated with female genitalia.

corded this species from : Calcutta, West Bengal infesting rice and wheat during the month of September and November respectively. This species generally favours dry conditions, coarse food and has low larval density.

Characteristic feature : General appearance (Fig. 1A) elongated, flattened, dorsal surface ferrugineus. Head transverse, fronto-clypeal suture indistinct, median line on vertex distinct, lateral line at the inner margin of eyes ridged, vertex with moderately large, closely arranged punctures and pubescent ; eyes small, black and moderately coarsely faceted. Antennae 11-segmented, somewhat moniliform and its length not extending more than half of its body length in both sexes. Outer margin of mandible (Fig. 2D) of male with a distinct tooth like structure near base. Prothorax transverse, distinctly narrowed at base, front angle obtuse, hind angle projected and distinctly acute, lateral line on either side ridged, puncturation and pubescence similar to that of on head. Scutellum transverse and finely punctured. Elytra less than two times longer than its width, humeral and apical angle rounded, each elytron with three cells, sclerites associated with male and female genitalia as figured (Fig. 2E,F). Unlike as in *C. pusillus*, in this species the sexual dimorphism is confined to the nature of mandible, the outer margin of which in males with a distinct tooth like structure near base (Fig. 2D), while in the female the outer margin is simply rounded.

Biological notes : The life cycle of this species has been studied by Rilett (1949). Young larvae enter into the seed coat through hole made by them. Unlike *C. turcicus* (Grouv.). This species is generally unable to produce a tough silken cocoon, but whenever one is produced it is very fragile and contains very little silk. At 75% relative humidity, the life cycle varies from 69-103 days at 21°C to 17-26 days at 38°C. Above 75%, relative humidity has no effect on the length of life cycle, but below this level, development is retarded.

CONTROL OF STORED GRAIN BEETLES

Effective control measures mean the working together of good husbandry and chemical control. This includes adequate preparation and maintenance of clean building structures coupled with well planned chemical treatment of uninfested and infested grains.

1. *Building structures* : Prior to bringing in of fresh, uninfested grains in storage, the building, silos, bins etc. should be thoroughly cleaned. Any remains on which insects might feed and breed or prevent them from a contact with insecticides should be removed. After the cleaning operations are completed the building structures should be treated with insecticides. In western countries the two recommended compounds are fenitrothion and primiphos methyl, both of which are organophosphates. On porous surfaces wettable powder formulations are suitable as they give a good deposit. For metal surfaces e. g. grain bins, emulsifiable concentrates are recommended. In places where sprays do not gain access insecticide smokes are suggested e. g. γ - HCH or lindane (Old abbreviation γ - BHC). Chemical treatment should be coupled with careful inspection of all material when brought in for storage. Some additional helpful steps include constructing the building such as to keep stored products dry, constructions should also be sufficiently tight to aid efficient fumigation.

2. *Infested grains* : In general the insecticides (fumigants) that are used to control stored grain pests have a non-specific mode of action. Thus most of them do not combine with specific targets at the molecular level yet achieve high activity with a relatively low concentration. As such compounds used against the grain weevil can also be used to control these beetles.

In Western countries the most commonly used fumigant mixture is ethylene dichloride +carbon tetrachloride either in 3 : 1 combination or 1 : 1 combination. Ethylene chloride is mixed with carbon tetrachloride to reduce fire hazard, however, ethylene chloride is toxic to warm blooded animals and should be handled with care. Operators should not inhale the vapour, should keep the liquid off skin and clothes, and should not use naked lights or smoke, as on exposure to heat the gas produce the highly toxic phosgine. In our country the fumigants widely used are phospine, ethylene dibromide and methyl bromide. Phosphine is easily available and easy to handle. It is normally generated from tablets of aluminium phosphate and ammonium carbamate which in presence of moisture produces phosphine. Recommended dose under atmospheric pressure is 45 tablets or 165 pellets per 30 m^3 (=1000 ft^3 approx.). Fumigation should be carried out for 5 days at 12 to 15°C, 4 days at 16 to 20°C and 3 days at 21°C or above. It is very toxic to higher animals and thus a controlled release is recommended. Ethylene dibromide is an important fumigant and has a comparatively longer effect than methyl bromide or phosphine. It is however very toxic to higher animals and must be handled with care. Methyl bromide has proved of great value in fumigation of stored products, but is an insidious poison, rendering it quite unsafe for use by untrained persons. For preventing reinfestation or cross-infestation grain bag stacks are treated with dust or wettable powder formulations of DDT and HCH. Other insecticides used include aldrin, dieldrin and endrin.

3. *Uninfested grains* : A very useful protective measure particularly in buildings with previous history of infestation, is to treat the grains with a mixture of malathion plus lindane. The insecticide mixture can be either mixed into the grains as a dust, or sprayed as an emulsion. The recommended dose is a mixture not exceeding 500 gm/tonne (20% malathion + 0.5% lindane). When spray is used malathion should not exceed 1 litre/tonne (1.2% emulsion). The choice of correct applicatons also has profound influence on the efficiency of the chemical control measures.

In recent years resistance to insecticides in stored product pests has created an additional problem in the way of effective control measures. Cross resistance and multiple resistance together with the limited choice of alternative chemicals creates further complications. It is therefore valuable to know the mechanism of resistance. This information can be used to try either alternative insecticides or synergists. The practical importance of resistance detected in the laboratory differs with the residual life of a chemical. Thus in case of compounds like malathion or fenitrothion resistance will mean that only the effective life of treatment will be reduced. With fumigants no residual life is involved and thus the practical consequences of resistance will be felt immediately.

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