THE GENUS PACHNODA IN ETHIOPIA

IDENTIFICATION, PEST STATUS AND CONTROL OF THE SPECIES

BY

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THE GENUS Pachnoda (Coleoptera: Scarabaeidae) IN ETHIOPIA: IDENTIFICATION, PEST STATUS AND CONTROL OF THE SPECIES

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SUMMARY

This bulletin deals with the identification and economic importance in Ethiopia of beetles of the genus *Pachnoda* (Scarabaeidae: Cetoniinae). A general account of their known biology and distribution is given. The pest status of each species is outlined together with a review of possible control measures. Each species is briefly described and a key and 26 figures are provided as an aid to their identification and as a guide to their distribution.

INTRODUCTION

Cetoniid beetles of the African and Arabian genus *Pachnoda* are only occasional pests of fruits and flowers. Reference to the first 65 volumes of the **Review of Applied Entomology** (Series A) produced virtually no information on the biology or control of these beetles. In Ethiopia, however, one species *P. interrupta* (Olivier) is a serious agricultural pest and at least two others cause sporadic damage to grain crops. Being always conspicuous and frequently damaging, their occurence is often reported by Field Officers. This bulletin is intended as a general introduction to the biology and control of these insects and as an aid to the identification of the species known to occur in Ethiopia.

As part of our study, a countrywide survey was carried out, a search through the reference literature made and museum collections likely to contain Ethiopian material were examined. This produced additional material but also a great deal of confusion and doubt about the correct names of the various species. Accordingly, we submitted examples of our *Pachnoda* spp. to Monsieur G. Ruter in Paris for his expert identification. From this material he separated nine species, one represented by two subspecies. In a country as ecologically varied as Ethiopia further species probably remain to be found.

The Ethiopian species vary in size from 12 to 28 mm in length (apex of pronotum to apex of elytra) and, being half as broad as long, they are relatively robust beetles. They vary from black to brightly coloured, often with a distinct pattern (Figs. 1-10). Except for *P. interrupta* (Figs. 10 and 12) these patterns are moderately uniform. All the species have well-developed hind wings and, as with all Cetoniids, these can be extended for flight with very little elevation of the elytra. Males can be distinguished from females by the presence of a shallow groove on the underside of the abdomen (Fig. 11). The abdomen of the female is convex.

BIOLOGY

Little or nothing is known about the life-history of most African Cetoniids, but from the information available the following general account has been compiled. The eggs are laid in a variety of places. According to the species, eggs may be found in rotten wood, forest leaf-litter, ants' nests, cow dung, compost heaps or in the soil. The larvae are more or less covered with rows of close-set setae (Fig. 14). They move on their backs by undulatory movements which pass along the body, purchase being provided by the setae. The clawless legs are small and play no part in locomotion (Balachowsky, 1962). The larval period is from one to three years depending upon the species and the environmental conditions. Pupation takes place within an egg-shaped cocoon made from soil or other substrate particles cemented with larval saliva (Fig. 15). The adults emerge from this cocoon, make their way to the surface and fly off to find food. They become sexually mature after some considerable time, possibly as much as twelve months for *P. interrupta*. Mating, which takes place on the host plant, is soon followed by egg-laying and death. Species which occur in the more arid areas almost certainly have definite times of the year for these various activities timed to coincide with the arrival of the rains and the flowering of wild plants and crops. Species occuring in the highlands are active for most of the year, although there are still certain seasons when more individuals are seen.

Cetoniids are strictly diurnal, requiring warm, sunny conditions for their dispersal and it is during the warmest part of the day that they are most active. Because of their large size and loud buzzing flight they are very noticeable and often mistaken for large bees as they fly around flowers and fruits. They are found most often on yellow blossoms which indicates that sight must play an important part in the selection of individual flowers. But they appear to be attracted to the plant species in the first instance by the flower's scent. When feeding on the petals of flowers or the soft tissue of fruits and seeds they are wary and, under warm conditions, they will immediately fly off if disturbed. Control by hand-picking is, therefore, difficult. Sometimes when they are present in very large numbers and gorged with food they are less likely to fly away. As the day becomes cooler, they find a sheltered spot in which to pass the night, flying the following qay when the temperature again rises.

In Ethiopia, only two species, *P. stadelini* Sch. and *P. abyssinica* Blan., are regularly found at altitudes above 2,000 metres. The other species occur commonly in areas of *Acacia* woodland from 800 to 1800 metres. Temperature and rainfall are probably the main limiting factors in their distribution although yellow-flowering *Acacia* trees appear to be an important food source for adults and their occurence probably plays an important part in the distribution of some species. The maps (Figs. 23-26) show the distribution of all the species in Ethiopia and localities are given below for the less common ones.

CONTROL

The contrasting habits of the larvae and adults of the species of *Pachnoda* give rise to difficulties in the planning of their control. The adults attack tree crops such as citrus, and also Ethiopian sorghums which may be over three metres tall. All these are difficult to spray or dust without special equipment. In these circumstances control measures directed at the larvae ought to be more practicable. The larval habits, however, of most species are not known and have proved very difficult to discover.

Control measures which might be used against adult beetles fall under six headings:

1. **Use of dwarf crop varieties.** Dwarf types would facilitate both hand collection and chemical control. This particularly applies to controlling species such as *P. interrupta* which are pests of sorghum. However, the grain of such varieties may not be locally acceptable as food and the tall stems of the standard varieties may be valued for house or fence building and/or fuel.

2. **Hand collection.** This may be adequate when a few ornamentals (Clarke, 1975) or small fruit trees are involved. When field crops are attacked the beetles are usually too numerous and too active to be collected by hand in significant numbers.

3. **Screens.** Netting screens have been used around valuable fruit trees to check the beetles in their flight. This method has only a very limited application for African conditions.

4. **Diversionary crops.** Crops with bright yellow flowers, such as sunflowers, can be planted around more valuable crops to divert the beetles to an area where economic damage is less and/or control measures are more easy to apply.

5. **Non-living attractants.** Since *Pachnoda* spp. appear to be attracted by flower scents and yellow colours it should be possible to devise a cheap, efficient trap. This approach has not yet been studied in much detail and would appear to justify further research.

6. **Chemical control.** Compounds are needed which are fairly persistent and have a low mammalian toxicity but are highly toxic to *Pachnoda* beetles. Preliminary tests suggest that carbaryl may be appropriate for use on sorghums but it is very hazardous for insect-pollinated crops. For these endosulfan or trichlorphon, products with low toxicity to bees (Chandler, 1976), are more suitable. In peasant-grown crops very dilute sprays of pyrethrins might be used to paralyse and knock down the beetles. Then they could be collected from the ground by children and destroyed. Wood smoke can also be used to knock down the beetles from the tops of tall trees.

Aerial spraying is rarely feasible in Ethiopia. Either the sorghum plots are too small and scattered or, if the area is larger, the terrain is too rugged. Dusts can be applied to a small area of sorghum with a loosely woven sack attached to a long, bamboo pole (Fig. 15). The use of dwarf sorghums would of course permit standard spraying machines to be used. Hand-held ULV sprayers would be particularly useful on large areas, especially as sorghum is grown in areas where water is usually in short supply.

When dealing with a major pest like *P. interrupta* it is probably more efficient in the long run to identify larval breeding areas, monitor larval densities and apply control measures before pupation. Three types of control measures have been suggested:

1. **Cultivations.** If the breeding area is ploughed or harrowed, larvae would be exposed to dehydration or predators. Peasants could bring chickens to the area during the process to increase the percentage kill.

2. **Chemical control.** Persistent chemicals could be mixed with the compost, manure, etc., in which the eggs may be laid. DDT is unlikely to be effective (Bohm, 1960) but aldrin is toxic to a wide range of Scarabaeid larvae. Nonpolluting, cheap, organo-phosphates of low mammalian toxicity would, however, be more acceptable than aldrin; diazinon might deserve a trial.

3. **Microbial control.** Certain Scarabaeid larvae are controlled by parasitic fungi (Roberts & Yendol, 1971). This approach may be applicable to *Pachnoda* control but would require detailed research.

KEY TO PACHNODA SPECIES FOUND IN ETHIOPIA

1. Above dark drown and white in colour ...*petersi (p. 5)*
   - Colour other than this 2

2. Above bright green with side edges narrowly yellow ... ...*stehelini (p. 6)*
   - Not bright green above 3

3. Pronotum almost completely pale yellow to orange, elytra black or dark pitchy brown ...*massajae (p. 6)*
   - Not as above 4

4. More or less uniformly reddish-brown, only disc of the pronotum sometimes darker, ...species near *rufa* (*p. 5)*
   - Not as above 5

5. Elytra completely black, sides of pronotum broadly yellow ... ...*crassa crassa (p. 7)*
- Elytra not completely black or if completely black, sides of pronotum not broadly paler 6

6. Large insects, longer than 20 mm. 7
- Smaller insects, shorter than 18 mm. 9

7. *Base of pronotam completely yellow,* pygidium completely black ... ...*peregrina (p. 6)*
- Base of pronotum black, pygidium black with white spots 8

8. Elytra black with four red or orange marks ...*abyssinica (p. 5)*
- Elytra very dark green with sides and apices and a complete transverse band near apex yellow ... ...*flaviventris (p. 7)*

9. Pygidium yellow with at most two small apical marks black ... ...*crassa fairmairei (p. 7)*
- Pygidium black, with or without white spots ... ...*interrupta (p. 7)*

1. **Pachnoda** sp. near **rufa** Degeer

Figs. 7, 19 and 23 (map)

A rounded species 14 to 16 mm long (4 exx); head black with or without white stripes; pronotum and elytra brown, disc of pronotum slightly darker; pygidium black, with or without white markings.

This species, which may be new to science, is only known from a very few examples collected at Alemaya 1950 m (Harer Province) and Nazareth 1600 m (Shewa Province). Nothing is known of its biology.

2. **Pachnoda petersi** Harold

Figs. 4, 20 and 24 (map)

One of the larger species 19 to 24 mm long; above chocolate brown with sides of pronotum and apices of elytra white in the shape of a broad U-shaped mark; pygydium white with edges narrowly brown.

This distinctive species has only been recorded from two localities- Melka Werer 750 m (Harer Province) and Welenchiti 1550 m (Shewa Province). It is usually seen eating wild flowers but has also been found attacking young cotton bolls.

3. **Pachnoda abyssinica** Blanford

Figs. 1, 17 and 25 (map)

The largest species in Ethiopia 22 to 28 mm long; above black with sides of pronotum and four marks on the elytra red or yellow; pygidium black with four to six white spots.

This moderately uncommon species is endemic to Ethiopia and is rare below 1800 m (the records from Tepi and Dorfu are exceptional). It is recorded from the Dorfu valley 1400 m (Eritrea Province); Bahr Dar 1970 m (Gojam Province); Majete 1950 m, Ambo 2140 m, Holetta 2390 m, Sebeta

2400 m and Weliso 2100 m (Shewa Province); Gore 2100 m and Tepi 1250 m (Ilubabor Province).

This species has never yet been recorded from the same localities as *P. massajae*. The structure of the penis of the two species appears to be identical. *P. abyssinica* may represent a highland form of *P. massajae*.

P. abyssinica is most often reported damaging garden flowers especially yellow roses. It has also been recorded on citrus and *Acacia abyssinica*.

4. **Pachnoda massajae** Gestro

Figs. 6 and 25 (map)

A large species 21 to 27 mm long; head and elytra black or dark red, the latter sometimes with an obscure pattern; pronotum, except for the extreme base, orange or yellow; pygidium black, usually with four small white spots; penis identical with *P. abyssinica* (Fig. 17).

This moderately common species has been recorded from Dire Dawa 1200 m, Alemaya 1950 m and Melka Werer 750 m (Harer Province); Lake Langano 1650 m (Shewa Province) and Yabelo 2100 m (Sidamo Province). It is rare above 1800 m. It has been found feeding on flowers of rose, mango, *Acacia* and *Cordia*.

5. **Pachnoda peregrina** Kolbe

Figs. 3, 18, and 23 (map)

A moderately large species 21 to 24 mm long, above black to reddish brown with all four margins of pronotum yellow; elytra with sides, apices and a broad subapical transverse band also yellow; pygidium black.

This uncommon species is only recorded from Melka Werer 750 m and Dire Dawa 1200 m (Harer Province) and Gibe River (0814N/3735E) 1200 m (Shewa Province). It feeds on flowers of mango and *Acacia* spp.

6. **Pachnoda stehelini** Schaum

Figs. 2, 16 and 23 (map)

A medium to large species 15 to 24 mm long; above green with sides of pronotum narrowly (rarely broadly) yellow; the etytra usually with an incomplete transverse yellow band near apex; pygidium white with or without dark brown markings.

A common highland species rare below 1500 m. It is recorded from Eritrea, Tigray, Gonder, Welo, Gojam, Harer, Shewa, Ilubabor, Kefa and Sidamo Provinces.

It is a pest of roses and occurs on other garden flowers. It has also been recorded feeding on flowers of *Schinus, Acacia, Clausena* and *Dregia*. On one occasion in the Abay River valley (1005N/3816E) it was found in very large numbers eating the milky grains of sorghum and other reports of similar damage were received from Lake Hayk in Welo Province and Mekele in Tigray Province. In Mekele it was noted that a tall red-seeded variety with lax panicles, locally known as **lekwa**, was particulary attractive.

A fully mature adult was found in its pupal cell, together with associated larvae in forest leaf litter near Hagere Maryam (Sidamo Province). Newly emerged adults occur in large numbers in Addis Abeba during October and November. Smaller numbers have been recorded in all other months of the year.

7. **Pachnoda flaviventris** (Gory & Perch)

Figs. 5 and 24 (map)

One female 21 mm long; above very dark green, sides of pronotum and elytra very broadly yellow, the latter also with apices and a broad subapical band also yellow. The sides of pronotum shoulders and apices of elytra with a black mark; pygidium dark red with six white spots.

The single record is from Gedo Siro wells 1000 m (Sidamo Province). Paoli (1931-33) records this species as a pest of fruit and flowers in Somalia.

8. **Pachnoda crassa crassa** Schaum

Figs. 8, 21 and 24 (map)

A small species 14 to 17 mm long (4 exx.); above black with front of of head and sides of pronotum broadly yellow to orange; pygidium black.

This uncommon subspecies has only been recorded from Dire Dawa 1200 m and Alemaya 1950 m (Harer Province). It has been found on flowers of the thistle *Echinops spinosus;* otherwise nothing is known of its biology.

9. **Pachnoda crassa fairmairei** Raffray

Figs. 9 and 24 (map)

A small species 12 to 18 mm long; colour pattern variable, usually predominantly yellow with two broad elongate dark marks on pronotum and small scattered dark marks on elytra; pygidium yellow with two small apical black spots.

Recorded from Dibaruba 1970 m and Asmera 2325 m (Eritrea Province); Alemaya 1950 m and Harer 1950 m (Harer Province); Nazret 1600 m (Shewa Province) and Awasa 1700 m (Sidamo Province).

It is an occasional pest of sorghum, feeding on the milky grains. It is also common on sunflower and has been recorded on *Echinops, Acacia* and maize. Schmutterer (1969) records it as a pest of pearl millet in the Sudan.

10. **Pachnoda interrupta** (Olivier)

Figs. 10, 12, 13, 22 and 26 (map)

The smallest species occuring in Ethiopia 12 to 16 mm long; very variable in colour (Fig. 12) from completely black to almost completely pale yellow but usually with a distinct colour pattern as shown in Fig. 10; pygidium black, usually with four small white spots.

This species is widely distributed across Africa. In Ethiopia, it is common along the eastern scarp slopes below 2000 m and north of latitude 8°N. In several parts of Ethiopia, especially in Eritrea, it is a major agricultural pest. During bad outbreaks whole fields of sorghum are completely destroyed, the adult beetles eating out the contents of the grain in the milky stage. This species will also attack pearl millet heads and maize cobs, in the latter case first removing the silk and then chewing out the contents of the distal ker-

nels. It is also recorded on flowers of cotton, citrus, *Cordia, Acacia* and *Dichrostachys*.

Outbreaks usually occur when newly-emergent populations appear in September and October. Such adults are sexually immature and, under laboratory conditions, do not lay eggs till the following September. The almost spherical eggs are straw coloured and measure 1.6 to 1.7 mm in diameter. Five pupal cells (Fig. 13) containing fully mature adults were discovered beneath dung of an old cattle kraal in Eritrea (1435N/3845E) in July 1973. It is probable that, in the arid areas where *P. interrupta* lives, cattle dung is the most important larval food but the possibility that there are other breeding grounds cannot be excluded.

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Fig. 1 *P. abyssinica*

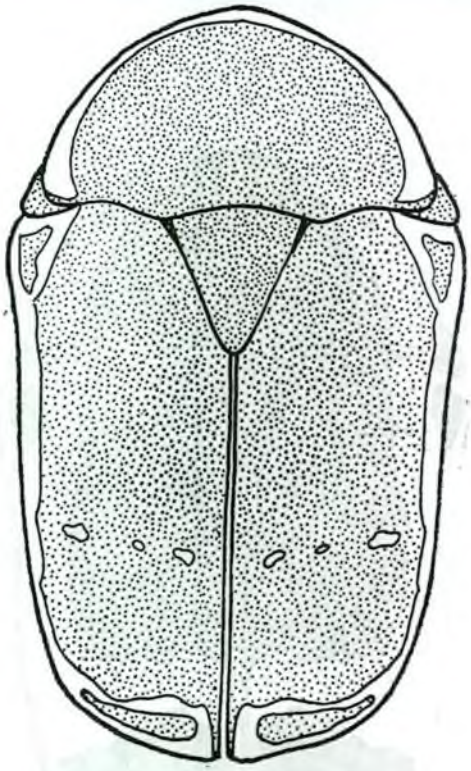

Fig. 2 *P. stehelini*

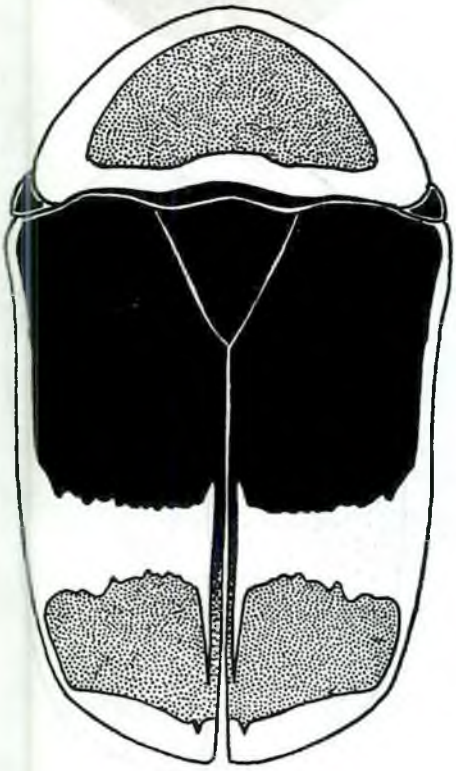

Fig. 3 *P. peregrina*

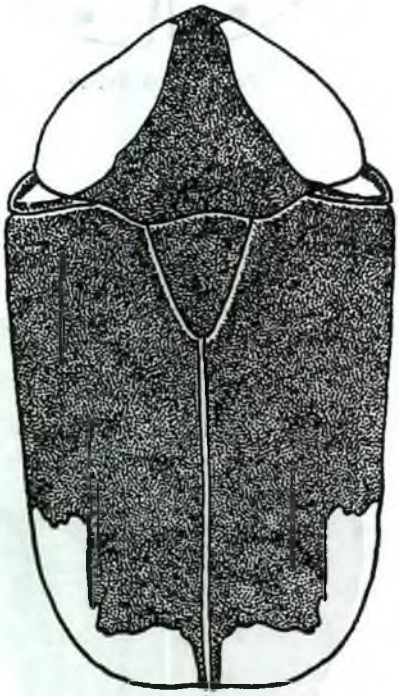

Fig. 4 *P. petersi*

Fig. 5 *P. flaviventris*

Fig. 6 *P. massajae*

Fig. 7 *P.* sp. nr. *rufa*

Fig. 8 *P. crassa crassa*

Fig. 9 *P. crassa fairmairei*

Fig. 10 *P. interrupta*

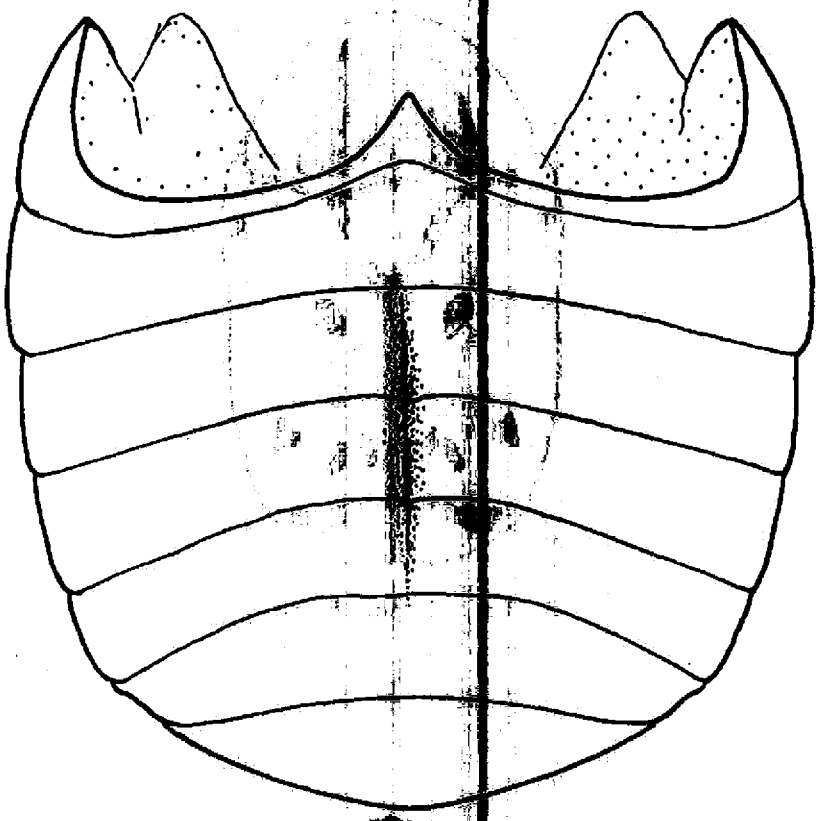

Fig. 11 Abdomen of a male *Pachnoda* showing the shallow mid-ventral groove.

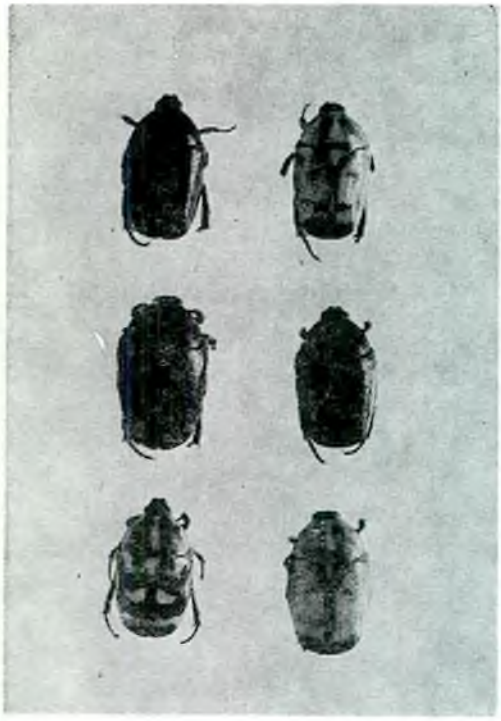

Fig. 12 Six *P. interrupta* showing the very variable colour pattern.

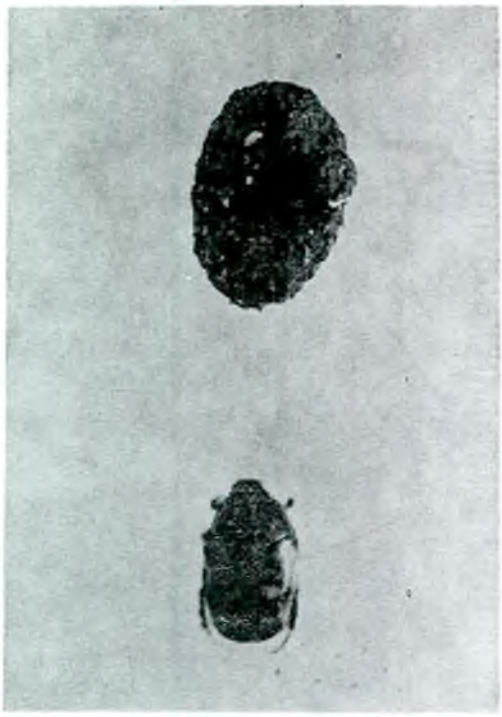

Fig. 13 *P. interrupta* and its pupal cell. The scale is in millimetres.

Fig. 14 Larva of *Pachnoda* sp.

Fig. 15 Dusting tall sorghum with a small sack on a bamboo pole.

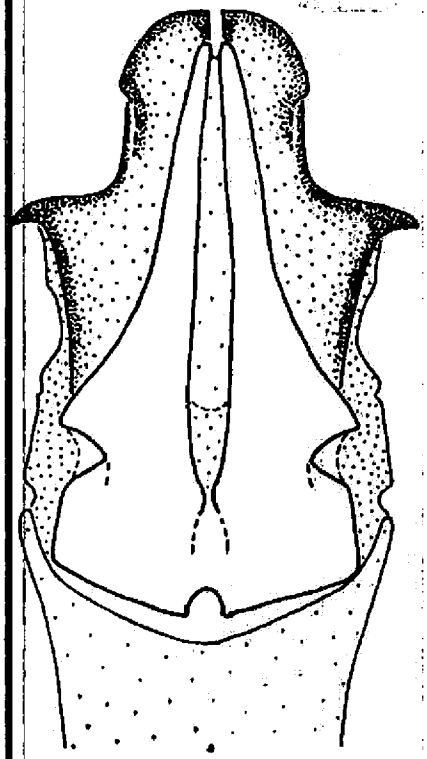

Fig. 16 *P. stehelini*

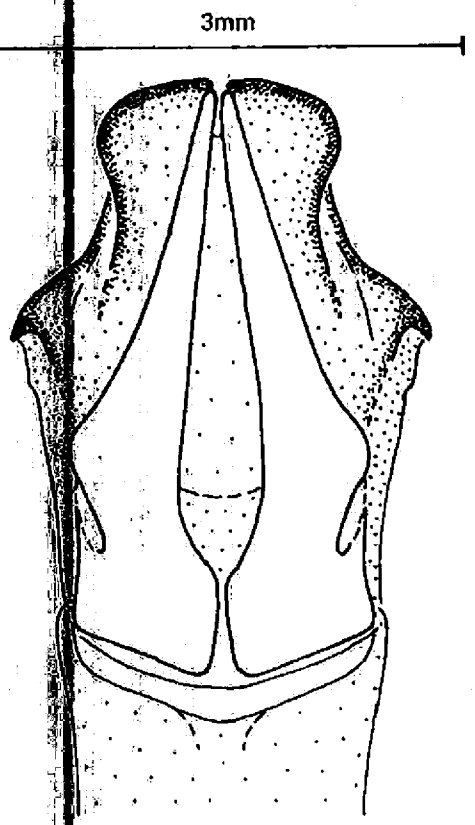

Fig. 17 *P. abyssinca*

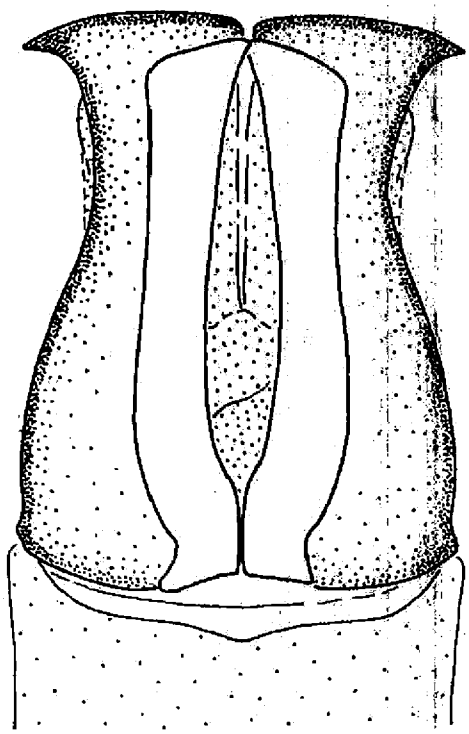

Fig. 18 *P. peregrina*

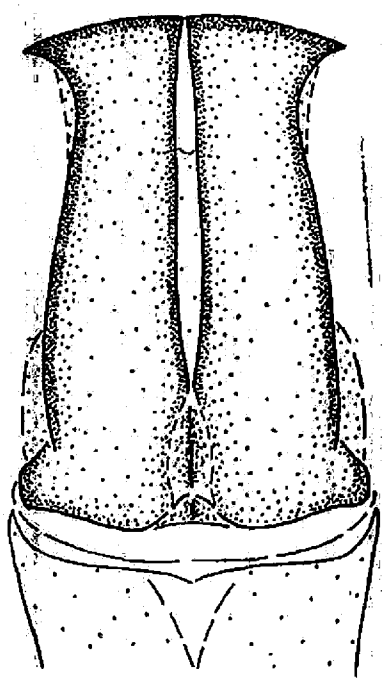

Fig. 19 *P.* sp. nr. *rufa*

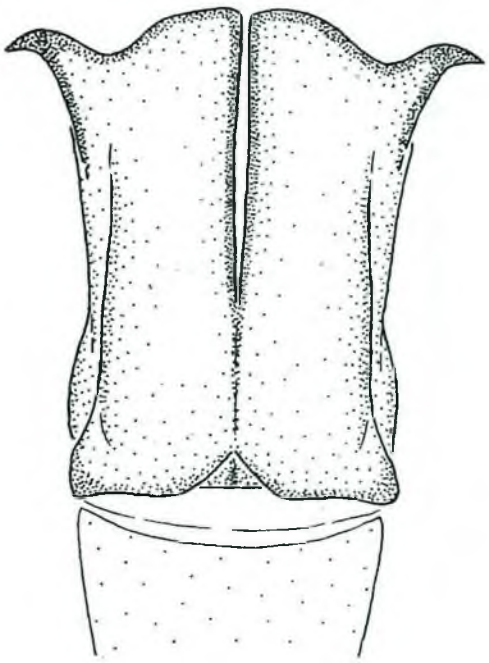

Fig. 20 *P. petersi*

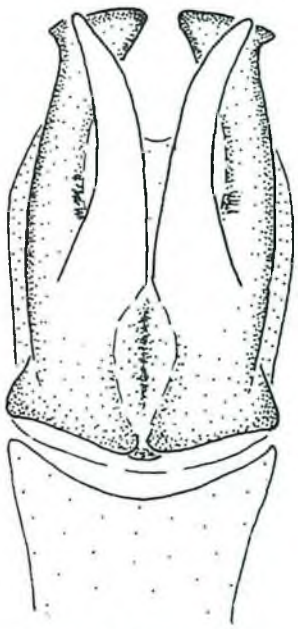

Fig. 21 *P. crassa crassa*

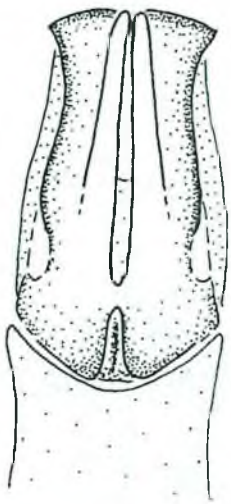

Fig. 22 *P. interrupta*

Fig. 23 Map showing distributions of *P. pergerina, P. stehelini* and *P.* sp. nr. *rufa*

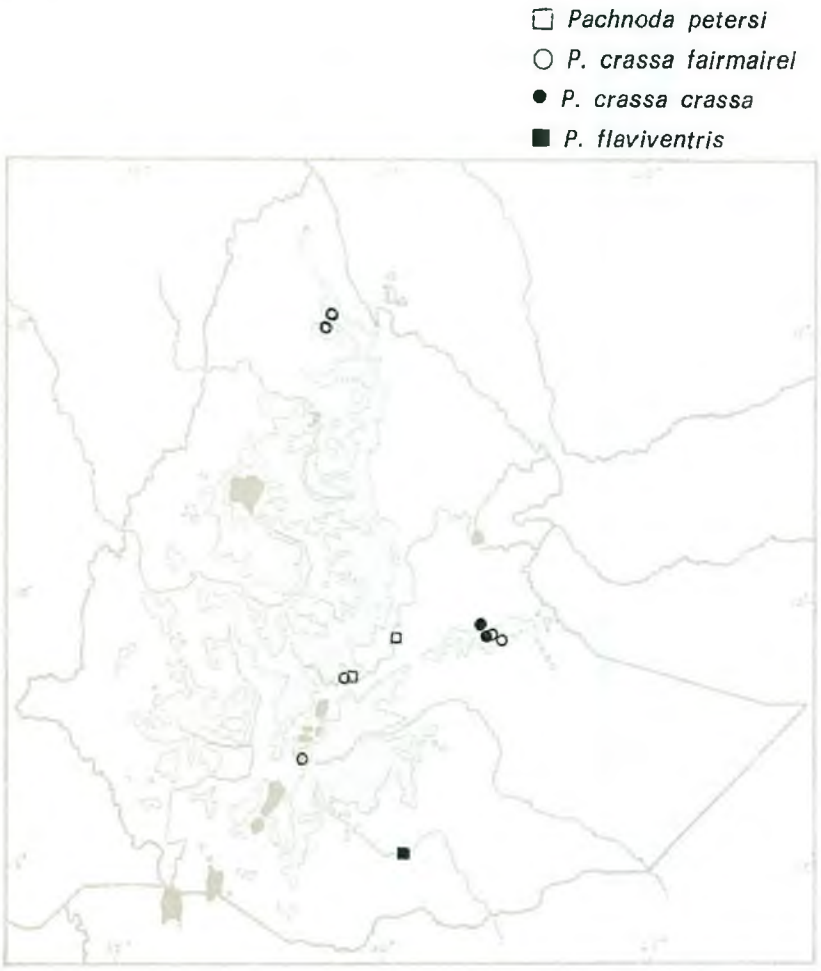

Fig. 24 Map showing distributions of *P. petersi, P. crassa fairmairei, P. crassa crassa* and *P. flaviventris.*

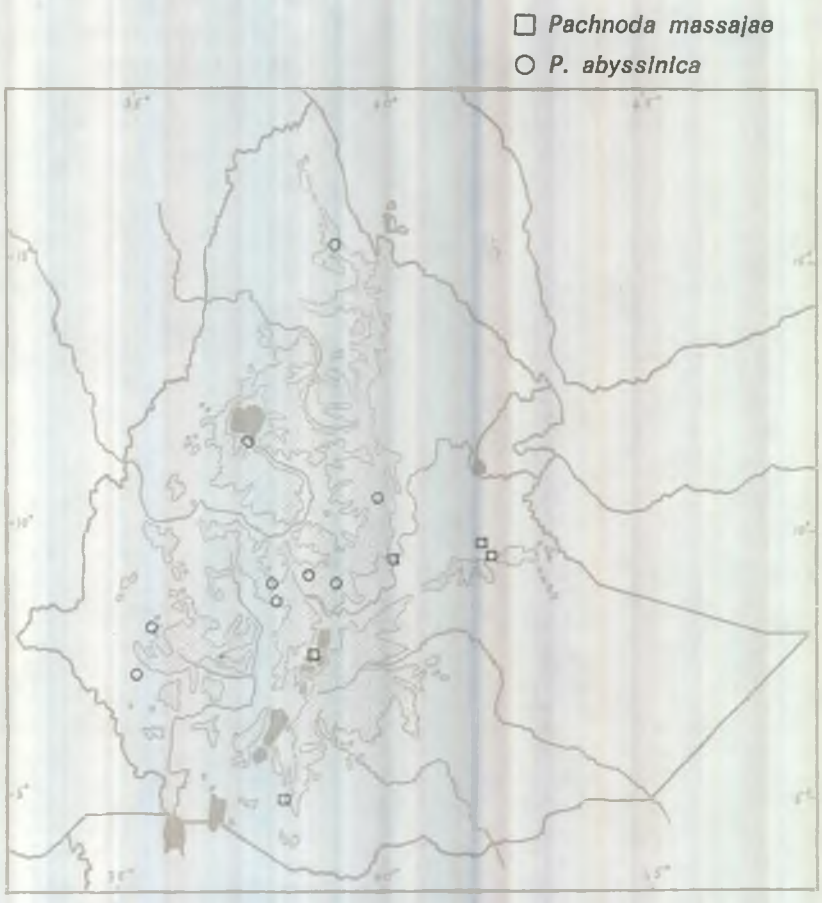

Fig. 25 Map showing the distributions of *P. massajae* and *P. abyssinica*.

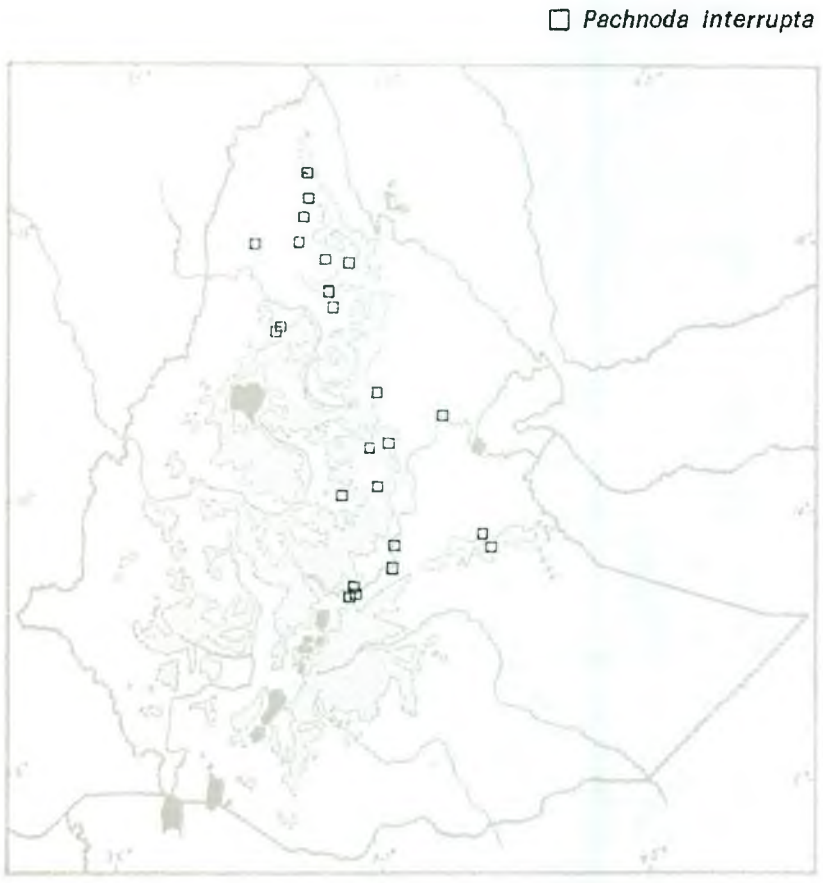

Fig. 26 Map showing the distribution of *P. interrupta.*