females from Taubaté and 1 female from Pindamonhangaba. For chromosome analysis air-dried preparations of bone marrow, spleen and testis were made after in vivo colchicine treatment; 0,075 M KCl was used as hypotonic solution and 3:1 methanol-acetic acid as fixative. Conventional staining was done with buffered Giemsa 2%, pH 6.8. G-bands were obtained by trypsin treatment[12], and Q-bands according to Caspersson et al.[13].

All specimens had a diploid number of 2n=38. 2 males from Americana and 1 female from Taubaté presented a typical Oceanian karyotype. The G-band patterns were similar to those found in 2n=38 *R. rattus* from Australia and India[14]. The remaining specimens, 3 males (2 from Taubaté and one from Americana) and 2 females (1 from Taubaté and 1 from Pindamonhangaba) also had 38 chromosomes, which included an autosome heteromorphic pair, consisting of an acrocentric and a subtelocentric (figure 1). Q-bands allowed the identification of the heteromorphic pair as No. 8, with a pericentric inversion giving rise to the subtelocentric (figure 2). However, the heterozygote inversion was not detectable by meiotic analysis in male rats.

The diploid number of 2n=38 in our sample is not surprising, since all South American black rats studied so far, including Brazilian specimens from Rio Grande do Sul[7,8], have been found to have this diploid number. However, contrary to the supposed lack of karyotypic variability in the South American populations[9,10], heteromorphism due to a pericentric inversion is seen to occur with a high frequency. Since this rearrangement has never been found in the original populations from abroad, it is most probable that it has recently arisen and spread rapidly.

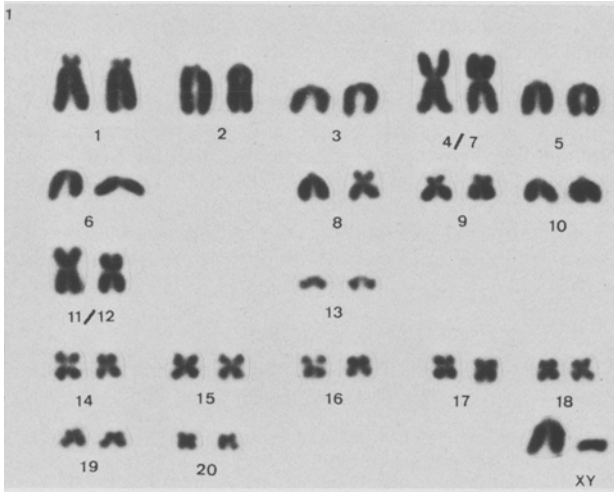

Fig. 1. Karyotype of a male *R. rattus* (2n=38) heterozygote for a pericentric inversion in pair No. 8.

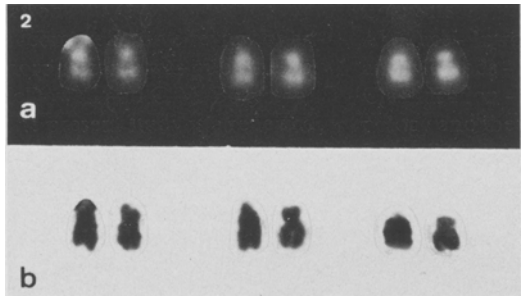

Fig. 2. Chromosome pair No. 8 from 3 metaphases of a male *R. rattus* heterozygote for a pericentric inversion. a) after Q-banding; b) the same chromosome pairs after Giemsa staining.

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Morphogenetic effect of precocene I and II on *Schistocerca gregaria* (Forsk)

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Summary. 4th instar nymphs of *Schistocerca gregaria* exposed to precocene I and II by topical application metamorphosed precociously. The ED_{50} of both compounds were evaluated and, unexpectedly, precocene I was found to be more active than precocene II. All adultiforms were identical and in an advanced form.

Although considerable interest has been devoted to insect juvenile hormones, molting hormones (ecdysones) and synthetic juvenile hormone mimics, there is relatively little work done on inhibitors of hormones regulating metamorphosis in insects[2]. Such inhibitors could be used to disrupt the hormone-regulated processes of insects and lead to new types of chemicals for safe, selective insect control. Precocene I (7-methoxy-2,2-dimethylchromene) and precocene II (6,7-dimethoxy-2,2-dimethylchromene) possess anti-allatotropic properties and induce precocious metamorphosis in several insect orders[3]. These activities have been explored mostly using *Oncopeltus fasciatus*[3-6] and

Locusta migratoria migratorioides[6-9]. We have found that 5,7-dimethoxy-2,2-dimethylchromene, a synthetic analog of precocene, is active on the last species[10]. In 1978, we briefly reported a qualitative evaluation of precocene I on *Schistocerca gregaria* by topical application[11]. More recently, Nair et al.[12] presented the effects of precocene II on this species using the contact method. We wish to report here a quantitative evaluation of both precocenes on *Sch. gregaria* by topical application.

Materials and methods. Crowded locusts were kept in a regime of 12 h light and 12 h darkness at 28 °C. Relative humidity was maintained at 45%. Precocenes were purchased from Aldrich Chemical Co., Milwaukee, Wisc. and stored at 0 °C under a nitrogen atmosphere. The compound to be tested was dissolved at different concentrations in spectral grade acetone so that each insect received 10 µl of the solution. Fresh stock solutions were prepared before each experiment. The solution was applied topically on the ventral part of the abdomen of 4th instar nymphs 1-24 h old. Effects were recorded every day. Tests were performed on groups of 20 locust nymphs and repeated twice.

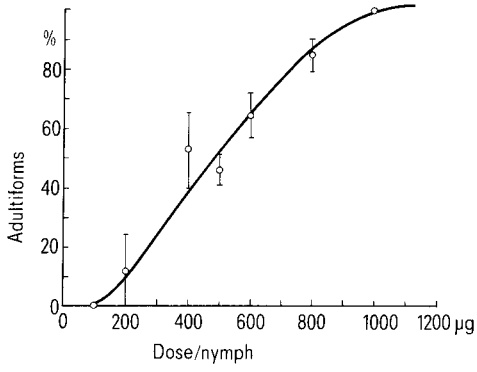

Fig. 1. Dosage, adultiform production curve for *Schistocerca gregaria* exposed to precocene I.

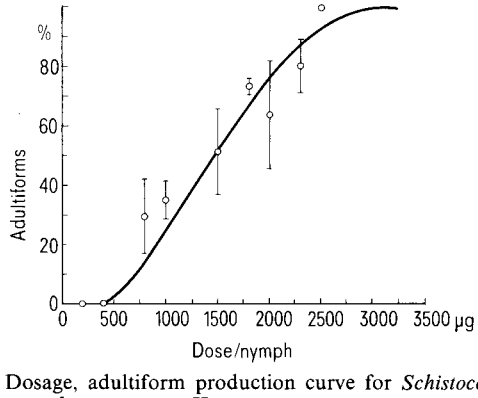

Fig. 2. Dosage, adultiform production curve for *Schistocerca gregaria* exposed to precocene II.

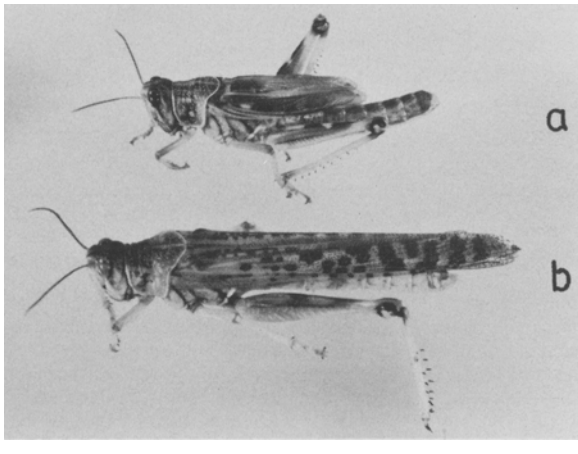

Fig. 3. *a* Precocious adult after the 5th moult, produced by treatment of 4th instar nymph with precocene. *b* Normal adult.

Results and discussion. The morphogenetic effects of precocenes are illustrated in figures 1 and 2; brackets represent SEM, and where no bracket is shown, SEM was smaller than the symbol used. The curves show the percentage of adultiforms among the survivors vs the dose. The mortality rate was always under 20%, even at the higher doses. The mortality rate among control insects receiving only acetone was less than 5%. The effective dose (ED_{50}) evaluated graphically was 480 µg for precocene I, and 1470 µg for precocene II. These effective doses are undoubtedly high even for insects averaging 350 mg in weight. The activity of precocene II in particular is very low by topical application. Nair et al.[12] reported that precocene II was ineffective in introducing precocious metamorphosis in *Sch. gregaria* by topical application and effective by a contact method. To the best of our knowledge, this is the first time that precocene I has been found to be more active than precocene II. For instance, Bowers et al.[3] reported that precocene II is 5 times more active than precocene I on *O. fasciatus* and we have found that precocene II is almost 3 times more active than precocene I on *L. migratoria*[9]. Besides the results illustrated in figure 1 and 2, we have also noted the following effects:

- The precocenes greatly delayed the molt and this delay increased with higher doses.
- The morphology of adultiforms is the same from one specimen to another. Such an adultiform is represented in figure 3. This constant morphology contrasts with that seen in *L. migratoria*, where the morphology of adultiforms varied from moderate adult characteristics to advanced adult characteristics[7].
- The adultiforms are viable and survive at least 1 month after the molt.
- The deaths occurred mostly within 24 h after the application. Only a few died during the molt.
- The normal-looking female adults obtained from precocene I or II treated 4th instar nymphs were not sterile and they laid eggs.

The fecundity of these females was not measured.

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