Chromosome biology of the scorpion *Palamnaeus* sp.

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Abstract. The chromosomes of the male scorpion *Palamnaeus* sp. has been analysed making use of the Colchicine-hypotonic-suspension technique. The diploid number has been found to be 62. The presence of clear constrictions on the spermatogonial metaphase chromosomes is noticed. The occurrence of diplotene-diakinesis, chiasmata and translocations have been encountered. The nature of the kinetochore is discussed. It is opined that the chromosomes of this scorpion are apparently monocentric (represented by constrictions on chromosomes) but behaving as holocentric.

Keywords. *Palamnaeus* sp.; constrictions; holocentric; scorpion.

1. Introduction

Even though the cytology of scorpions is well documented, the architecture of the chromosomes, especially the nature of the kinetochore, has been highly controversial (Piza 1943, 1947, 1948, 1950, 1957; Brieger and Graner 1943; Brieger and Kerr 1949; Sharma and Joneja 1959; Sharma *et al* 1959; Srivastava and Agarwal 1961; Guenin 1957, 1961; Venkatnarasimhaiah and Rajasekarasetty 1964, 1965; Venkatanarasimhaiah 1965). All the previous workers studied the chromosomes in sectioned and squash materials. This study is an attempt to re-examine the issue using a different technique.

2. Material and methods

The males of the scorpion *Palamnaeus* sp. collected from the environs of Manasa Gangotri, Mysore, formed the material for the present investigations. They were injected abdominally with 0·2 ml of 0·05% colchicine and sacrificed after 2 hr. The testes were dissected out and treated with 0·9% sodium citrate solution for 30 min and fixed in freshly prepared 1 : 3 acetic acid/methanol. The chromosome preparations were made by the suspension technique, flame-dried and stained with Giemsa.
3. Observations

The genome of this scorpion is characterised by the presence of a diploid number of 62 chromosomes as scored from many spermatogonial metaphases (figure 1). The chromosomes fall into large, medium and small sizes and possess one distinct constriction in each of the two chromatids of metaphase chromosomes at the median, submedian and subterminal positions (figure 2). Not more than one clear constriction representing very likely the primary one has been seen in a chromosome. The two chromatids of each chromosome lie parallel to each other except at the primary constriction region. The occurrence of one chiasma per bivalent in the diplotene stage is mostly clear (figure 3). Further tightening of the coils, increase in the girth, terminalisation of chiasmata and parallel disposition of the homologues result in diakinesis (figure 4). It is very interesting to note that translocation crosses and open-chains have been encountered during the cytological analysis. The interchanges involved 6 or 8 chromosomes (figures 5 and 6). The occurrence of interchanges in this population is being reported for the first time. The anaphases are characterised by the presence of V-shaped and rod-shaped configurations which lie parallel to the main spindle axis (exhibiting axial orientation) (figures 7 and 8).

4. Discussion

There are many divergent views with regard to the presence of diplotene-diakinesis, the formation of chiasmata and whether the chromosomes are holokinetic or monocentric. In Tityus bahiensis (Piza 1943), Tityus matto grosensis (Piza 1947), Rhopalurus (Piza 1957), and in three Indian Buthids (Sharma et al 1959) the absence of the formation of chiasma and diplotene-diakinesis were reported. On the other hand, in Palamnaeus longimanus (Srivastava and Agarwal 1961) the existence of diplotene-diakinesis stage, with no chiasma formation, was claimed. The occurrence of diplotene-diakinesis and chiasma formation was noticed in Buthus occitanus (Guenin 1961). It was claimed by Brieger and Graner (1943) that they have seen some configurations suggestive of chiasma formation in Tityus sp. But Piza (1943) has pointed out that the homologues simply remain paired throughout their length from pachytene upto the beginning of anaphase-I. Venkatanarasimhaiah and Rajasekarasetty (1964) working on the chromosomes of Palamnaeus gravimanus reported the presence of diplotene-diakinesis stage and chiasma formation. In the present studies also on Palamnaeus sp. the authors have clearly seen the occurrence of diplotene-diakinesis and chiasma formation. The configurations of diplotene bivalents are characteristic and reminiscent of the configurations noticed in grasshopper meiosis.

The translocations reported by Piza (1943, 1947, 1948, 1950) in various Brazilian species such as Tityus and Isometrus are very interesting, since certain individuals are heterozygous for several translocations, leading to the formation of multiple rings at meiosis, similar to those of the plant Oenothera (White 1973). Piza has also shown the occurrence of single, two or multiple cross-shaped configurations at meiosis involving 4, 5, 7 and 8 chromosomes and thereby indicating the presence of multiple translocations. Sharma et al (1959) have also reported the occurrence of translocation heterozygosity in two species of Indian