A Brief Report on the Chromosome Number of Neodiplogaster pinicola and Panagrellus redivivoides (Nematoda: Rhabditida)

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Abstract: Both *Neodiplogaster pinicola* and *Panagrellus redivivoides* reproduce amphimictically, with XO type of sex determination. In *N. pinicola*, primary spermatocytes have six bivalent chromosomes and one univalent; after two meiotic divisions, sperm are produced with either six or seven chromosomes. In primary oocytes, with seven bivalents, meiosis is initiated by entrance of a sperm. After two meiotic divisions, three polar nuclei are produced, and egg and sperm pronuclei fuse. Cleavage begins after the egg is laid. Males have a 2n number of 13 chromosomes; females, 14. In *P. redivivoides*, primary spermatocytes have four bivalents and one univalent. After two meiotic divisions, spermatids are produced with either four or five well separated chromosomes. In primary oocytes, the first maturation division is initiated after penetration of a sperm; after two meiotic divisions, each egg has five chromosomes. Cleavage begins immediately after fusion of egg and sperm pronuclei, and embryonic development and hatching occur within the uterus. Males have a 2n chromosome number of 9; females, 10. *Key Words:* reproduction, gametogenesis.

Gametogenesis and chromosome number in *Neodiplogaster pinicola* Steiner, 1930, and *Panagrellus redivivoides* (Goodey, 1943) Goodey, 1945, are described below. This study showed that reproduction in *N. pinicola* is very similar to that found in *Mononchoides changi*, Goodrich, Hechler and Taylor, 1968, and in *P. redivivoides* it is identical to that of *P. redivivus* (L., 1767) Goodey, 1945. A detailed description of the process has been published for both *M. changi* (1) and *P. redivivus* (2); therefore this report is limited to a brief outline.

MATERIALS AND METHODS

Specimens of *N. pinicola* were acquired and cultured as described previously (3). Oatmeal cultures (2) of *P. redivivoides* were initiated with specimens taken from a rotten apple fruit grown near Washington, D.C. Living nematodes were placed in a solution of 60 parts 100% ethanol, 10 parts concentrated propionic acid, and 30 parts chloroform for 25 min or longer, stained about 60 min in 1% propionic orcein, and mounted in 0.25% propionic orcein.

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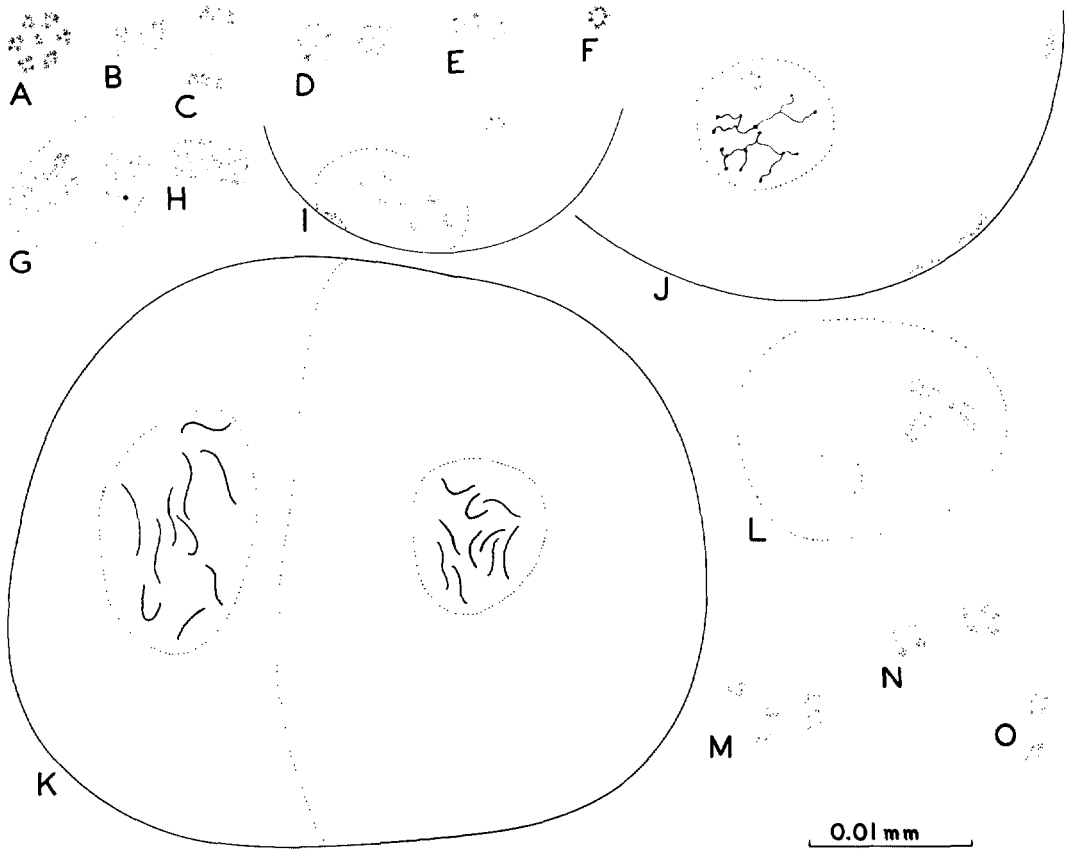

FIG. 1. *Neodiplogaster pinicola:* **A.** Nucleus of primary spermatocyte, polar view, Metaphase I. **B.** Nucleus of primary spermatocyte, equatorial view, Metaphase I, showing univalent and two of six bivalents. **C.** Chromosomes of primary spermatocyte, equatorial view, Anaphase I, showing lagging chromosome. **D.** Nuclei of two secondary spermatocytes, Metaphase II, with seven and six univalents, respectively. **E.** Nuclei of two spermatids, with seven and six chromosomes, respectively. **F.** Nucleus of spermatozoan with seven chromosomes. **G.** Nucleus of oocyte in late prophase, showing seven bivalents and nucleolus. **H.** Chromosomes of oocyte at Metaphase I, equatorial view. **I.** Secondary oocyte showing nucleus with seven univalents, one polar nucleus, and sperm. **J.** Fusion nucleus, chromosomes from egg pronucleus uncoiled, chromosomes from sperm condensed, three polar nuclei present. *Panagrellus redivivoides.* **K.** Egg just after first cleavage, showing ten chromosomes in each blastomere. **L.** Nucleus of oocyte just before entering oviduct, with five bivalents. **M.** Nucleus of primary spermatocyte, with four bivalents, one univalent. **N.** Nuclei of secondary spermatocyte, with four and five univalents, respectively. **O.** Chromosomes of two spermatozoa, with four and five chromosomes, respectively.

Camera lucida drawings were prepared from selected nuclei.

RESULTS

Neodiplogaster pinicola. Meiosis in the testis of *N. pinicola* was limited to a short section of three or four layers of cells. At the first metaphase, six bivalent chromosomes and one univalent were present (Figs. 1A, B). At Anaphase I, a lagging chromosome was often seen (Fig. 1C). Secondary spermatocytes were seen with either six or seven univalents, but none with a single chromosome, indicating that the first division was usually disjunctional for the heterochromosome (Fig. 1D). Spermatids with either six or seven chromosomes were produced (Fig. 1E). In mature spermatozoa, the chromosomes appeared as a dark staining ring with an unstained center, usually so close together that they could not be accurately counted (Fig. 1F). Sperm appeared the same in both the proximal part of the testis and after transfer to the female.

Nuclei of oocytes in late prophase, located

in the proximal end of the ovary near the gonad flexure, were often stained enough to show the chromosomes, but staining was not satisfactory in younger oocytes. Seven bivalent chromosomes were seen at late prophase, and the nucleolus was visible until just before the oocyte entered the oviduct (Fig. 1G). When the oocyte passed into the spermatheca, a sperm entered it and the first maturation division began, with seven bivalents at Metaphase I (Fig. 1H), and seven univalents at Metaphase II (Fig. 1I). The first polar nucleus divided, so that after the second division the egg contained three polar nuclei, the sperm with six or seven chromosomes, and the egg pronucleus with seven chromosomes. Fusion of the sperm and egg pronuclei was seen (Fig. 1J). The first cleavage usually did not occur until after oviposition, except in aged specimens, and was not studied.

Females isolated from males before their final molt did not produce progeny, and reproduction is bisexual. The 2n chromosome number of males is 13; of females, 14; with the XO type of sex determination.

Panagrellus redivivoides. Primary spermatocytes of *P. redivivoides* had one univalent and four bivalent chromosomes (Fig. 1M). Lagging chromosomes were often seen at the first meiotic division, after which the two resulting nuclei usually had four and five univalents, respectively (Fig. 1N). Cytokinesis was delayed until after the second division, which resulted in four spermatids, two with four chromosomes and two with five. Some dark staining anucleate material was lost from the spermatids during maturation of the spermatozoa. Chromosomes in the sperm were well separated and easily counted, both in the male and after transfer to the female (Fig. 1O).

Five bivalents were easily seen in older oocytes just before they entered the oviduct (Fig. 1L), although staining was poor in younger ones. After the egg emerged from the oviduct it was entered by a sperm, and the first maturation division began. Two meiotic divisions resulted in the formation of two polar nuclei; and the egg pronucleus, with five chromosomes. After fusion of the egg and sperm, pronuclei cleavage began. Grouping of chromosomes according to origin from egg or sperm was not evident at the first cleavage metaphase. An egg was found with 10 easily counted chromosomes in the first two blastomeres. In the blastomere on the right in Fig. 1K, the chromosomes were all lying on the same plane throughout their lengths, and no noticeable differences could be seen in the length of individual chromosomes. Eggs were retained and hatched within the ovary.

Females isolated from males before their final molt failed to reproduce. The 2n chromosome number in *P. redivivoides* is identical to that of *P. redivivus*, with nine in the male and ten in the female. Sex determination is of the XO type.

LITERATURE CITED

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