XO type of sex mechanism in earwigs (Dermaptera)

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Summary. The diploid chromosome complement in *Allodahlia macropyga* (Westwood) is 14 + XO-♂ and 14 + XX-♀. This is the first record in Dermaptera, of a XO male-determining mechanism.

Whereas a sex-determining mechanism with male heterogamy of the XY[2–10] or XXY[2,5–8,11] type is found to be operating in different species, and sometimes even within 1 species of Dermaptera, there appears to be no published record about the existence of a XO-male type of sex determination in this group. The present report gives information about the occurrence of a XO-male type of sex mechanism in one species, Allodahlia macropyga (Forficulidae).

Materials and methods. Specimens of Allodahlia macropyga (Westwood) were collected during the months of May–August 1973, from Simla Hills, where the animals were feeding on the leaves and flowers of Cannabis indica and Urtica sp. The gonads of the adults were removed in a 0.9% solution of sodium citrate and fixed in acetic alcohol (1:3). The slides were prepared by the air drying method as described by Crozier[12].

Results and discussion. Spermatogonial (figure, a) and oogonial metaphase plates (figure, c) clearly show the diploid number of chromosomes to be 15 in the male and 16 in the female. The chromosomes in the karyotype (figure, b and d) are arranged into 'large' and 'small' categories. The number of large, 6.2 and 5.2 µm long chromosomes is always 4 in both sexes, and they are almost rod-shaped, showing a slight curvature along their length. But the bends are never sharp enough to be taken as the points of localized centromeres. These chromosomes form 2 homologous pairs. Of the small chromosomes, there are 11 in the male and 12 in the female. They are either thick small rods or almost spherical in shape. In the male, 10 of them form 5 homologous pairs, 3.6–2.6 µm long, while the 11th one which is the largest in this category (3.8 µm) remains unpaired and thus is identified as X (figure, b). In the female, the 12 smaller chromosomes form 6 homologous pairs, the largest being the XX (figure, d).

Metaphase-I plates (figure, e and f) of male meiosis invariably reveal 7 bivalents and 1 univalent X-chromosome. The bivalents exhibit 1 or 2 chiasmata each. 2 types of metaphase-II cells have been observed. The cells with 8 elements (figure, g) carry the X-chromosome and those

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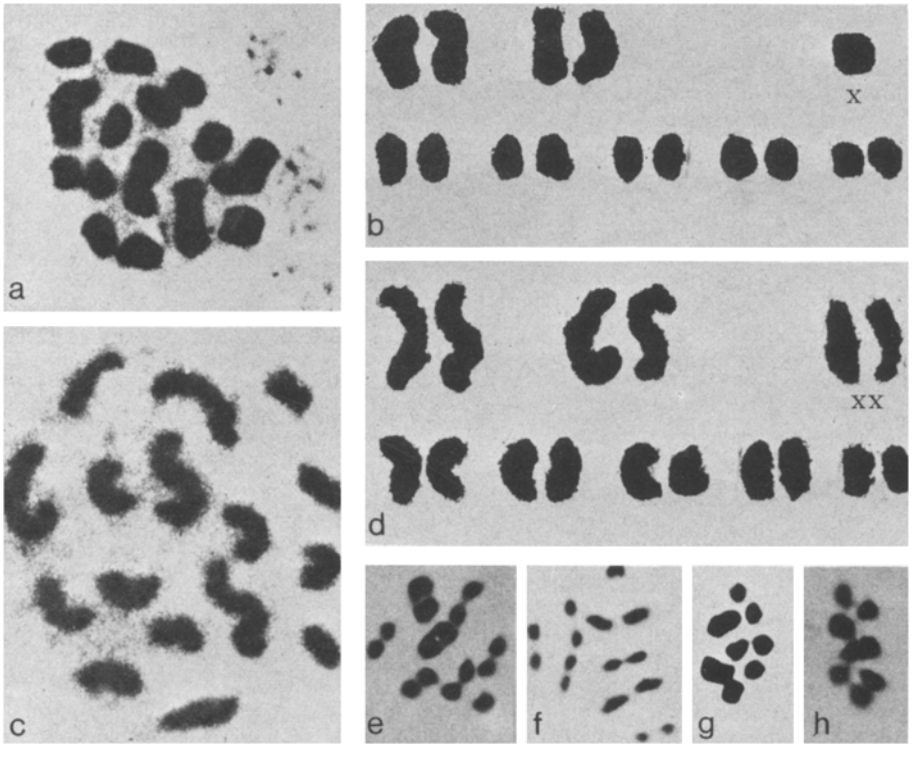

Mitototic and meiotic chromosomes of Allodahlia macropyga. *a* Spermatogonial metaphase with 15 chromosomes. ×1800. *b* Male karyotype 15 (14+X). *c* Oogonial metaphase with 16 chromosomes. ×1800. *d* Female karyotype 16 (14+XX). *e* and *f* First metaphase plates each with 7 bivalents and 1 univalent X-chromosome. ×1270. *g* Second metaphase with 8 chromosomes (7+X). ×1270. *h* Second metaphase with 7 chromosomes. ×1270.

with 7 (figure, h) are without it. While meiosis-I is reductional, meiosis-II is equational both for the autosomes and the sex-chromosomes.

Allodahlia macropyga (Westwood) has the lowest number of chromosomes of any species belonging to the family Forficulidae that has been studied cytologically so far. Thus, A. macropyga differs markedly not only from the rest of the forficulids but also from its congeneric forms in having 15 (16) chromosomes while the others have 24^{2-10}, except F. smyrnensis which has only 21 chromosomes in the male[11]. This significant difference in the number of chromosomes further favours the exclusion of A. macropyga from the genus Forficula and its inclusion in Allodahlia, as has been done by Burr[13], Kapoor[14] and many others on taxonomical grounds. However, to establish the modal number of chromosomes for the genus Allodahlia, more species are required to be worked out cytologically.

The unique feature of A. macropyga, is the possession of an XO type of sex-determining mechanism, which has not yet been reported in any of the Dermaptera, except that White[15] made a passing reference to the existence of XO-males in an Australian species of the genus Labidura studied by Webb (unpublished). By contrast, the occurrence of XY/XX$^{2-10}$, XXY/XXX$^{5-8}$ and XYY^{8} has been recorded in a number of species of the earwigs.

Henderson[7] pointed out that sex-determination in earwigs is not of the X : autosomal balance type as found in Drosophila, but of the type found in mammals where the Y-chromosome has male determining activity. His conclusion was based on the maintenance of the male phenotype in the individuals of F. auricularia, which possess XY, X_1, X_2, Y or XYY sex-chromosomes. Since an XO-male mechanism exists in A. macropyga, it seems to be more adequate to suspect determination of the X : autosomal balance type as in Drosophila.

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Tuber formation and protein content in some wild cassava (Mandioca) species native of central Brazil[1]

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Summary. Screening for protein content in some wild species of Manihot showed 2 of them to have a notably high percentage of protein on dry matter basis. Moreover, one of these high-protein wild species was found to be extremely sweet.

Cassava, a staple crop that takes the 7th rank all over the world, represents an inadequately explored source for nutrition. Its ability to grow in sub-optimal conditions offers it a competitive superiority over all other staple food crops in underdeveloped nations. Cassava has various food forms which are well established in the consumption habits of the people but which are unfortunately characterized by their low protein content. If varieties with higher protein content could be developed, this would enhance the value of cassava as a food or/and animal feed. Efforts have been made in the past to increase the protein content of cassava roots by interspecific hybridization with a wild species known for its higher protein content[2]. This raised an increasing interest in looking for wild species, collecting them and screening them for protein content.

Among some wild species collected from Goias state, Brazil, 4 species were shown to form tubers. These species were screened for tuber formation, fibre and protein content. They are: M. oligantha pax emend. Nassar subsp. nesteli, collected from Cristalina (figure 1); M. tripartita Muell., collected from Serra Dourada, municipal Goiania (figure 2); M. zehntneri Ule, collected from Goianesia (figure 3), and M. anomala Pohl, collected from road Goiania–Inhumas (figure 4). These species differed largely in tuber formation pattern and tuber content. M. oligantha subsp. nesteli forms abundant cylindrical tubers, superficial, about 10.0 to 30.0 cm distant from ground surface, external color of tubers is dark brown, surface is rough, cortex is white. M. tripartita forms extremely globosus-shaped tubers, deep in the ground at a distance of more than 50.0 cm from ground surface, external color is light brown, surface is smooth, cortex creamy. M. anomala forms superficial tubers distant about 20.0–30.0 cm from ground surface, oval-shaped, with rough surface and light brown yellow color, cortex is creamy. M. zehntneri forms cylindrical to oval tubers, very deep in the ground, at a distance of about 50.0–70.0 cm from ground surface, external color is dark brown, has white cortex and rough surface.

Protein and fibre were estimated in tubers according to AOAC[3] procedure. Contents were shown as follows.

Average protein and fibre content of wild cassava species on a percent dry matter basis

Species*	Crude protein	Crude fibre
M. oligantha subsp. nesteli	7.10 ± 0.58	26.67 ± 4.86
M. tripartita	6.88 ± 1.48	33.48 ± 6.36
M. anomala	3.74 ± 0.63	23.44 ± 4.82
M. zehntneri	3.06 ± 0.82	21.52 ± 4.84

*20 tubers of each species were analyzed and replicated 4 times.

The composition of cassava as reported in the literature is somewhat variable. This variation comes from the fact that bitter cultivations differ from sweet ones, not only in the amount of HCN they contain, but also in the proportion of nutrients (according to Bolhuis[4], cultivars with roots containing less than 50 mg of HCN per kg are considered sweet). However, many reports state that crude protein dry matter ranges from 2.2 in sweet cassava to