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THE CHARACTERISTICS OF THE KARYOTYPE AND INVERSION POLYMORPHISM OF *CHIRONOMUS PLUMOSUS* VAR *FLAVEOLUS* MEIG FROM THE EASTERN SIBERIA

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Resumé

In *Chironomus plumosus* L. in the vicinity of Irkutsk, there is development of very high inversion polymorphism. Three sets of paracentric inversions, IL13-19, IIL17-20 and IIIL11-16, two types of terminally divergent homologues IIL17-20 and IIIL, combined with distinct band structures, and a microinversion IR3 were discovered. Autumn and spring populations are characterized by the type of inversion and by their progeny.

There is no doubt that the study of the structure of the polytene chromosomes of Chironomidae larvae is necessary. They are used as subjects (models) in solving many problems in cytogenetics, such as the problem of biosynthesis and its regulation.

One of the most frequently met species of *Chironomus* is *Ch. plumosus* L. The data on its karyological characteristics are limited. The karyotype of *Ch. plumosus* from Central Europe is briefly described by Keyl and Keyl (1959). In this publication the attention is drawn mainly to the structural peculiarities of Chromosome IV. Photographs of 2 variants of polytene chromosomes of the salivary glands of *Ch. plumosus* also appear in this publication. Part of the map of arm R of chromosome III of *Ch. plumosus* was also published by Keyl (1960, 1961). Nesterova (1967a, 1967b) who studied some species of Chironomidae in the vicinity of the city of Novosibirsk and Saratov gives a short description and a map of marker distribution of 3 karyotypes of the larvae belonging to *Chironomus* species, whose larvae were identified as *Ch. plumosus* by the author. Among the published works we could not find the complete karyological characteristics of *Ch. plumosus* L. However, these materials were sufficient for the identification of *Ch. plumosus* from East Siberia, the European part of U.S.S.R. and Western Europe.

The scope of our research work was the study of the karyotype of *Ch. plumosus* L. and of inversion polymorphism of the spring and autumn populations in the vicinity of the city of Irkutsk. The first part of our task was feasible because among the larvae of the autumn population we came across some specimens whose chromosomes did not show any inversions. The mapping of chromosomes was carried out for this case which was taken as a standard (fig. 1 see insert V).

Material and Method

Chromosome polymorphism of *Ch. plumosus* taken from the populations in the vicinity of Irkutsk was examined. It was established that it belonged to this species in accordance with all the developmental stages (Linevich and Erbaeva 1971). The material was collected during spring (May 1970 and 1971) and in autumn (October 1970, 1971). During a period of 15 to 30 days the larvae were kept under laboratory conditions. The larvae of the fourth instar were examined. The growth stages of imaginal discs were recorded according to Kröger (1968). The size, the sex according to gonad structures, the form of mouth parts, the form and composition of salivary glands. The morphology of the latter was specific for each species. (Constantinoff and Luzina, 1961) and serves as an additional criterion for the exactitude of systematic situation. Some of the larvae were kept for adults.

The polytene chromosomes were studied using a common aceto-orcein method. Permanent preparations were prepared using liquid nitrogen and were mounted in balsam. The nucleolus was exposed by means of gallocyanin. During the study of material, attention was drawn to different sizes of polytene chromosomes from the cells of various parts of the gland (Kiknadze and Gruzdev 1970; Miseiko and Popova 1970). The cells with the highest degree of polytenization were used for karyological characterization. 150 larvae were examined. 10-40 cells were examined in each case. Each chromosome was divided into regions according to its length and markers distribution.

Results and Discussion

The shape of the salivary glands of *Ch. plumosus* L. larvae is typical of *Ch.* Meig. The number of giant cells of salivary glands according to our data varies between 42 and 48, which is in agreement with the data obtained by Konstantinoff and Nesterova (1971). The cells of the salivary glands of *Ch. plumosus* contain 4 pairs of chromosomes. Three out of these are long and one short. By analogy with the characteristics of polytene chromosome in Chironomidae and other Diptera (Bauer 1936; Basrur, 1957; Keyl & Keyl, 1959; Miseiko et al., 1971) we took for the centromere section a sharp heterochromatic block, bordering with distinct constrictions of chromosome. Accordingly chromosomes I and III are characterized as submetacentric, chromosome II - nearly metacentric and chromosome IV - acrocentric. The nucleolus is localized in chromosome IV (numbering of chromosomes is according to Keyl and Keyl, 1959).

Chromosome I (length 145.6 ± 4.7 mkm) in the majority of cases shows a close pairing of homologues along the length and has a number of characteristics which help their identification. These are first of all two thick dark staining bands, located in the region IL11. The Region IL8 ends with one single thick band. A microinversion is detected in the IR3 region. Sharp, distinct bands are situated in IL13 region and are bound by light spaces between the bands; there is also a section with indistinct band structure (fig. 1,2a; see insert V). A substantial inversion IL13-19 was formed in chromosome I (fig. 3; see insert V) which is met only in autumn populations (19%). The simple loop takes the greater part of the arm L. at the end. The homologues are not paired and the band structure does not correspond. Homologue A ends by a sharp distinct band, homologue B is diffused. There are 2 well defined bands at the base of the inversion, which are bound by eight spaces between the bands. A section with sharply defined bands follows. This type of inversion has much in common with the inversions described by Doubinin and co-authors (1937) for the larvae close to unidentified type of *Chironomus*. The widened section, located between the microinversion and centromere has a distinct band structure.

Chromosome II (length 124.4 ± 3.4 mkm) is easily detected by its well presented centromere section with diffused bands in the IIL10 region. In the region IIL5-6 there is a section with large band structures, turned towards each other at their convex part, a light area with very thin band is situated between the band structures. A small terminally situated inversion IIL18-20 was found in arm L. One homologue has a distinct band structure. A well defined band is absent in the other. This type of inversion is met only among spring populations and represents 13%. In the same chromosome one can often observe a significant disturbance in pairing of homologue terminal sections. The chromosome section before dichotomy has sharp well defined bands with wide spaces between the bands (IIL17). The absence of pairing in the arm is observed both in autumn and spring populations (fig. 2,c).

Chromosome III (length 107.0 ± 4.3 mkm) is characterized by a section with sharp, well defined bands in the arm R (IIIR3-7). The arm bears the inversion IIIL11-16 (fig. 2a) which occurs only in spring populations (13%). In the section IIIR7 a light area is adjacent to the thick band. The band structure of the IIIR3-7 wholly coincides with the band structure of the R of *Ch. plumosus* from Central Europe (Keyl, 1961). In this chromosome one comes across disparity of homologues along the distal third of the arm which explains the absence of pairing.

Chromosome IV (length 54.0 ± 1.9 mkm) carries the nucleolus and one or 2 Balbiani rings. The degree of homologue pairing in Chromosome IV is variable. In the majority of cases only the homologues of the short arm are paired, the location of homologue divergence is marked by a large heterochromatic bloc, which is followed by a light zone and ends with 2 well defined bands. The unpaired sections of homologue carry 2 Balbiani rings. Heterozygosity in the 2nd Balbiani ring occurs in rare cases; there is no evidence of it if the unpaired homologues are connected with a nucleolus. In some cells of the same gland Balbiani rings are absent and the nucleolus is not well defined. In these cases one can observe a more marked closeness of homologues which spreads half way along one of the long arms. Both variants of chromosome IV are met within

the limits of the same gland both in spring and autumn populations. Unfortunately we were not able to establish the relationship of different types of chromosome IV to the cells of one or another part of the salivary glands.

We also could not detect the inversions which characterize the sex. The difference in the inversion between autumn and spring populations was well defined. The IIL18-20 and IIIL11-16 inversions were detected only in spring populations, they can occur jointly and represent 13% of the total number of cases.

The IL13-19 inversion was detected only in autumn populations in 19% of cases. It is met either separately or in conjunction with the divergence of homologue IIIL.

Microinversion IR3 was met in all cases. In 16% of cases in autumn populations it represents the only sign of heterozygotism, whereas in spring populations it combines in all cases with other changes of homologue band structures.

Terminal divergence of homologues in autumn populations was found in 71% of cases and in spring populations in 87%.

Summary

The karyotype of *Chironomus plumosus* was first examined from natural populations of Eastern Siberia. A high rate of inversion polymorphism was found. Four types of inversion were established in chromosomes I, II and III.