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QUALITATIVE STUDY OF CYTOGENETIC EXPERIMENTS ON MEMBER OF THE FAMILY COREIDAE

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Abstract

The current investigation of 19 Coreinae species reveals a varied C-banding pattern in terms of location, quantity, and number of C-banded chromosomes. Only terminal/sub-terminal locations or terminal and interstitial places have been reported to feature bands. In various animals, the quantity of constitutive heterochromatin ranges from a very thin array to substantial blocks. In the same way, the number of chromosomes with C-bands varies. C-base heterochromatin's composition ranges from very A-T rich repeats to interspersed A-T and G-C rich repeats with few G-C rich areas. Silver banding of nine Coreinae species reveals one large nucleolar body or two smaller nucleolar bodies. Four nucleolar bodies have been discovered in Anoplocnemis compressa.For four species of Homoeocerus, three species of Anoplocnemis and Cletus, and two species each of Cletomorpha, Acanthocoris, and Anhomoeus, cytogenetic markers have been found.

Keywords: coreidae, cytogenic experiments, c- banding, choromosomes

1. Introduction

Insects are among the most diverse groups of animals on the planet and include more than a million described species which represent more than half of all known living organisms. The number of existing insect species is estimated to be between six and ten million, and potentially represent over 90% of the different metazoan life forms on earth. Class Insecta comprises 30 orders. Order Hemiptera is the largest and by far the most successful order of the hemimetabolous insects. They do not undergo metamorphosis between larval and adult phase. Instead, their young ones, called nymphs, resemble the adults to a large extent.

The final transformation involves development of functional wings and sexual organs with no intervening pupal stage as in holometabolous insects. They are divided into two sub-orders: Heteroptera and Homoptera which can often be distinguished easily. Heteropterans have a large pronotum and a relatively small mesonotum and metonotum whereas most homopterans have a small pronotum and a large mesonotum and slightly smaller metanotum.

Many species are robust and many are ornamented with spines and tubercles which are acute processes of humeral angles of the pronotum. The head is diagnostic for the family with the bucculae extended beyond the antennifers. The hemelytra contain a subcostal vein and the membrane has numerous veins. The legs are relatively thick, often with the metafemora incrassate and sometimes with the tibiae flattened (Schaefer, 1965; Dolling, 1991; Schuh and Slater, 1995).

Coreids are phytophagous and majority of them live on plants above the ground feeding on the plant vascular system. The biology of Coreidae was summarised by Schuh and Slater (1995) and Mitchell (2000). Schaefer and Mitchell (1983) listed the known host plants of the coreids providing host records for over 200 species. They reported that many coreid bugs show definite associations with particular plant groups. Most of the species are polyphagous. Globally, coreids cause significant damage to grains, legumes, cucurbit crops, soft fruits and nuts. In Coreidae, definite feeding preferences are evident with respect to plant parts with some species primarily feeding on vegetative tissue while others preferentially attacking reproductive organs (Kumar, 1966).

Coreidae is divided into 4 subfamilies: Coreinae, Pseudophloeinae, Meropachydinae and Agriopocorinae. Subfamily Coreinae is worldwide in distribution and contains vast majority of coreids. It is divided into 31 tribes. Only Coreini (38 genera) and Hydarini (6 genera) occur worldwide while 19 tribes (Acanthocorini, Amorbini, Anhomoeini, Cloresmini, Colpurini, Cyllarini, Daladerini, Dasynini, Gonocerini, Homoeocerini, Latimbini, Manocoreoini, Mecocnemini, Mictini, Petascelidini, Phyllomorphini, Prionotylini, Procamptini and Sinotagini) occur only in the Eastern Hemisphere and 10 (Acanthocephalini, Acanthocerini, Anisoscelidini, Barreratalpini, Chariesterini, Chelinideini, Discogastrini, Leptoscelidini, Nematopodini and Spartocerini) are found only in the Western Hemisphere. Subfamily Pseudophloeinae comprises

166 species falling in 28 genera and is predominantly Old World in distribution. Subfamily Meropachydinae and Agriopocorinae are rarely found and only a few genera for each are known (Schuh and Slater, 1995).

The first data on insect chromosomes was published late in the nineteenth century. Since that time, a number of discoveries of general biological significance have been made in this field. Cytogenetic information has sometimes been used in the taxonomy to break complexes and identification of sibling species, evolution, taxonomy and phylogeny of insects. Although a full-scale use of karyotypic details for constructing phylogenies of large insect taxa is possible only in combination with other features, chromosomal characters are still very important for phylogenetic purposes because their evolution is more or less independent of the environment. The cytological informations have been important in understanding the mechanism governing the transmission of genetic information, hence speciation.

Cytological studies in Heteroptera date back from 1891 with Henking's morphological study on the spermatogenesis of the bug *Pyrrhocoris apterus* (Pyrrhocoridae). He described the presence of a chromatin body (X chromosome) that showed an unusual staining during meiotic prophase and a peculiar behaviour during meiosis. Since then, more than 1,600 Heteropteran species belonging to 46 families have been cytogenetically analysed and the data has been compiled by Papeschi and Bressa (2006). The diploid chromosome number ranges from 4 (*Lethocerus* sp., Belostomatidae) to 80 (4 species of *Lopidea*, Miridae) (Ueshima, 1979; Manna, 1984; Schuh and Slater, 1995; Rebagliati *et al.*, 2005). The genetic system of Heteroptera has many characteristics that make it unique among most insect groups. They are characterized by the presence of holokinetic chromosomes, inverted meiosis for sex chromosomes, a mean chiasma frequency of only one chiasma per autosomal bivalent, presence of "microchromosomes" in some families and presence of multiple sex chromosome mechanisms such as X_n0, X_nY, X_nY_n.

Out of 4 subfamilies of Coreidae, cytogenetic data is available for 2 families, Coreinae and Pseudophloeinae. For Coreinae, cytogenetic data is available for 116 species belonging to 51 genera and referable to 18 tribes. A modal number of 2n=21 is observed in 48 species. The most common sex mechanism in males is X0 present in species followed by X_1X_20 present in 24 species. A multiple system of $X_1X_2X_30$ in males has been ascribed to one population of *Coreus marginatus* Linnaeus (Xavier, 1945). A pair of microchromosomes is present in 92 species.

For subfamily Pseudophloeinae, cytogenetic data is available for 4 species belonging to 3 genera referable to 2 tribes and a complement of 2n=10A+2m+X0 is present in 3 out of 5 species.

In all, 23 species of Coreidae belonging to 2 subfamilies, Coreinae and Pseudophloeinae have been cytogenetically investigated. For subfamily Coreinae, 22species belonging to 11 genera referable to 7 tribes and for subfamily Pseudophloeinae, 1 species has been studied. Amongst 23 species, 15 have been cytogenetically reported for the first time from India while 14 are new to the cytogenetic world. 20 species have been subjected to C-banding, 19 to fluorescent banding and 10 to silver banding.

2. REVIEW OF LITERATURE

On Indian Heteroptera, a lot of cytogenetic study has been done on the diploid chromosomal complement and the progress of meiosis. Manna (1950, 1951, 1956, 1957, 1958, 1962, 1982, 1983, 1984) is an Indian Heteroptera cytogenetics pioneer and key researcher. His collaborators and other investigators continued the study, and Das Gupta (1950), Satapathy et al. explored chromosomal number, sex mechanism, and meiotic activity in a growing number of Indian species (1990). After a 15-year hiatus, Kaur et al. (2006, 2009, 2010), Suman (2010), Kaur and Suman (2009), Kaur and Semahagn (2010b), and Kerisew (2011) expanded heteropteran cytogenetics. B. Chromosome complement and meiosis in Coreidae Coreinae, Pseudophloeinae, Agriopocorinae, and Meropachydinae are the four subfamilies of the Coreidae family (Schuh and Slater, 1995). Only two subfamilies, Coreinae and Pseudophloeinae, have cytogenetic data.

Heterochromatin has been defined by Heitz (1928) as the nuclear material that remains condensed throughout the cell cycle. It is characterized by high proportion of repetitive sequences, late S-phase replication and lack of recombination. It has been argued that heterochromatin is a dynamic component of the chromosome and is liable to both qualitative and quantitative variations. Furthermore, the assortment of heterochromatin and euchromatin into different chromosomal domains appears to play an important role in chromosomal structure (Wallrath, 1998). C-banding technique has made it easier to assess the changes in constitutive heterochromatin and has revealed the prevalance of remarkable degree of variations in C-banding pattern in different species (King and John, 1980; Lopez-Fernandez and Gosalvez, 1981).

3. RESEARCH METHODOLOGY

The work was carried out along the following lines:

1. Collection of specimens
2. Identification
3. Preparation of slides
4. Study of slides

1. COLLECTION OF SPECIMENS

Coreids are phytophagus, feeding on both cultivated and wild plants. So, for collection of bugs, collection tours will be conducted during the period extending from March to May and August to October and vegetative areas, both cultivated and wild falling in the states of Haryana, Punjab, and Himachal Pradesh will be surveyed. Collection will be done by hand picking and light trap methods.

2. Identification

Information about place of collection, collection date and host plant, if any, of each species will be specified. Specimens will be identified with the help of relevant literature.

3. Preparation of Slides:

The fixed material will be tapped on clean slides with the help of fine forceps. The tapped slides will be allowed to air dry and stored in refrigerator at 4°C. They would used for different parameters as and when required. The various parameters for which the slides will processed are as follows:

i. Conventional Staining
ii. C-banding
iii. Sequence-specific staining
iv. Silver nitrate (AgNO3) staining

4. Study of Slides

The prepared slides will be scanned under the Nikon microscope. Initial scanning will be done under 40X and the readings of the selected stages will noted down. The selected stages will be re-observed under the immersion oil (100X) to study the details of chromosomal behavior during division.

4. Result and Findings

Coreids, like other heteropterans, have holokinetic chromosomes (chromosomes without a localized centromere), a pair of microchromosomes, and sex chromosomes that undergo post-reductional meiosis. They also have a pair of microchromosomes but no Y chromosome. Because chromosomes are holokinetic, they have no fundamental constriction and look rounded or rod-shaped during mitotic metaphase. Chromatids stay parallel to the axis of division and at right angles to the spindle fibres during anaphase. Kinetic activity is limited to the telomeric areas in a few heteropterans, and chromatids look V-shaped during anaphase. During early meiosis I, microchromosomes are frequently unpaired and consequently achiasmatic. They form a pseudobivalent (m-pseudobivalent) during metaphase I, which segregates reductionally during anaphase I, as they move closer and associate end to end during late diakinesis. For them, the second meiotic division is equational.

5. CONCLUSION

Previously, cytological data on 120 Coreidae species was available. During the current study, 23 species were cytologically investigated, 14 of which were new to the area of cytogenetics. With this research, the overall number of cytologically recognized species has increased to 134. The whole Coreidae data set has been reviewed, and some patterns have emerged. The most frequent complement in Coreidae is the diploid number of 21, which consists of 9 pairs of autosomes, 1 pair of microchromosomes, and the X0 sex determination mechanism. It is found in 55 out of 134 species and may therefore be considered the basic complement. When the data was analyzed, it was discovered that some tribes exclusively retained this complement (Acanthocerini, Anhomoeini, Chelinidini, Cloresmini, and Daladerini), some tribes retained this complement as the dominant complement with a few deviations (Mictini, Homoeocerini, and Anisoscelini), and some tribes showed intensive karyotypic alterations leading to complements with either increased diploid number (Coreini, Gonocerini, Acanthocorini, Colpurini and Acanthocephalini).

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