ISSN: 2456–5474 RNI No.UPBIL/2016/68367 Vol-2* Issue-12* January- 2018
Innovation The Research Concept

Chromosomal Images of Three Butterflies of the Pieridae Family

Meenu Sadhotra
Assistant Professor,
Deptt.of Zoology,
Govt. College for Women,
Parade, Jammu

Abstract

Mitotic and meiotic chromosomes of *Pieris canidia*, *Pieris brassicae* and *Pontia daplidice* were studied after *in vitro* treatment with 0.1% colchicine. The chromosomes bore typical dot like or elongated structures. Chromosomes structure and size are of great significance in chromosome studies and have relevance to evolution, speciation and chromosome organization.Chromosomal studies in Lepidoptera has been a difficult task due to small dot- like chromosomes of similar sizes. Some interesting aspects of cytology of butterflies and moths are presented in this communication.

Keywords: Mitotic, Meiotic, Colchicine, Lepidoptera.

Introduction

The chromosome cytology of Indian Lepidoptera is very much limited, namely, 16 species described by Srivastava and Gupta (1961) and Gupta (1964); 8 by Gupta and Narang (1980); 30 by Rishi (1973); 45 by Mohanty and Nayak (1983); 31 by Kaur (1988) and 7 by Sharma and Bajwa (1992, 1995a,b). On account of inadequate techniques in early work, sex chromosomes could not be clearly differentiated from the autosomes in a majority of species investigated in this group. The present study pertains to the chromosomal images of three butterflies.

Aim of the Study

It is always interesting to study chromosomes as they convey other aspects of cytology, taxonomy, evolution *etc etc*.

Materials and Methods

Different instar larvae of the three species of butterflies were collected from their respective host plants from different regions of Jammu. Larvae were fed to maturity in the laboratory. Brain ganglia and testes were processed for chromosome analysis following *in vitro* colchicine treatment (Rishi *et al.,* 1997) followed by a pretreatment in 0.7% NaCl for 15-20 minutes, the tissues were transferred to 1% sodium citrate for 15 minutes and then fixed in methonal- acetic acid (3:1) for 30 minutes and further processed according to air drying Giemsa technique for slide preparation.

Results

Although chromosomes of Lepidoptera are holocentric but Chromosomes of *Pontia daplidice* bore a typical dot like structure whereas chromosomes of that of *Pieris brassicae* and *Pieris canidia* were elongated. Somatic metaphases and meiotic stages of three butterflies are shown from Fig. 1 – 15. The change in length of chromosome contributes to the change in karotype which signifies towards evolution.

Discussion

Pierid family of butterflies ranks second in the list of cytologically exploited families. 205 species of Pierid butterflies are investigated so far. Lepidopteran chromosomes are interesting to study because of the nature of centromere; Lepidopteran chromosomes are holocentric, meaning that their centromeres are spread over at least 70% of their length. In addition, they generally have a relatively small size and do not depict any clear morphological features. This makes it difficult to distinguish the different chromosomes. The most important work, which gave credense to holocentric nature, was that of Bauer (1967). He found that the chromosomes of *Pieris brassicae* on being broken by ionizing radiations, travelled to the poles in the normal way due to the presence of diffused centromere.

Secondly, the mechanism of sex determination. The sex chromosomes in butterflies and moths have not been found clearly differentiated from the autosomes. The genetical studies showed that Lepidoptera have female heterogamety (Doncaster and Rayoner, 1906). The mechanism of sex determination is yet to be confirmed in many species of butterflies and moths on cytological basis.

Thirdly, chromosomal behaviour during meiosis, these chromosomes generally have a marked tendency to contract extremely and assume the form of small spherical bodies at metaphase. In the diakinetic bivalents the presence of one or two completely terminalized chiasmata can be justified. There are a few instances, however, where certain bivalents are precociously resolved into univalents disclosing most probably a failure of chiasma formation. The question, therefore, whether definite chiasmata are formed in Lepidoptera cannot be answered with absolute certainity.

The oogenesis in Lepidoptera has been described as achiasmatic but only a few studies have been made on this aspect (Bauer, 1939).

The phylogeny of Lepidoptera has presented many problems which the taxonomists have faced from time to time. The lepidopteran modal, n=29-31 represents clearly the ancestral condition among the Nymphalidae, from which taxa with various chromosome numbers have differentiated. The overall results show that Neotropical taxa have a tendency to evolve karyotype instability, which is in dark contrast to the otherwise stable chromosome numbers that characterize both Lepidoptera and Trichoptera. The whole issue demands verification on cytological basis.

Another problem is about the inclusion of micropterygidae under Lepidoptera. This can be resolved by comparing the cytological features of these two groups.

The phylogeny of lepidopteran species finds its relevance in morphological features which is re-evaluated on the basis of the molecular phylogeny. Phylogenetic or biogeographical patterns describe the chromosome number variation. Chromosomal evolution is a directional process towards increasing number caused by fission or decreasing number caused by fusion events. Chromosomal changes occur as byproduct of speciation or cause of it. The mechanism which leads to the change in chromosome number is unknown, but it seems probable that low chromosome numbers are caused by fusion and high numbers by fission of chromosomes (Lorkovic, 1990). This is also indicated by the striking reciprocal correlation between the number of chromosomes and their size.

The analysis of morphological and anatomical characters is still the most widely used method for taxonomic and systematic studies in insects. The identification of many groups of insects is problematic because of their small size, morphological attributes that change as a function of environment and the prevalence of biotypes and sibling species which cannot be easily differentiated from one another based on morphological characters. Moreover, it is very difficult to differentiate between the immature stages of insect groups on morphological basis. These problems have necessitated the need of molecular techniques for accurate identification.

Conclusion

Chromosomal studies provide important information on the genetic structure, life cycles and ecological characteristics, evolution, taxonomy and phylogeny of insects. Chromosomal rearrangements can be used for the ecological monitoring of various insect populations and for pest control. Chromosomal analysis can be used to reveal and identify sibling species. Chromosomal polymorphism may be due to geographical variation.

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Pieris canidia **(2n = 50)**

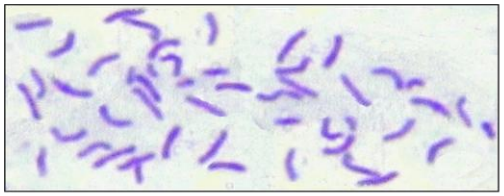

Fig.1 Somatic metaphase ♂

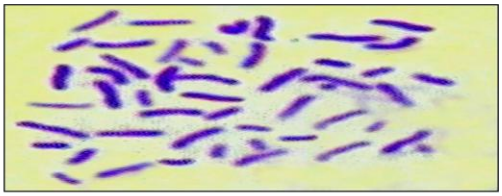

Fig.2 Somatic metaphase ♀

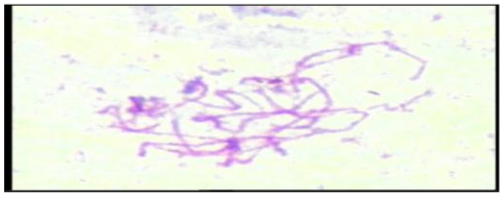

Fig.3 Zygotene

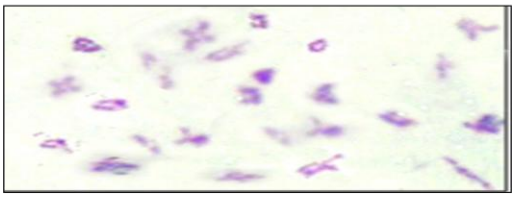

Fig.4 Diakinesis

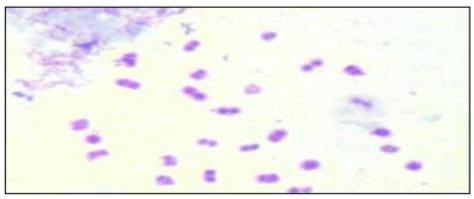

Fig.5 Metaphase I

Pieris brassicae **(2n = 30)**

Fig.6 Somatic metaphase ♂

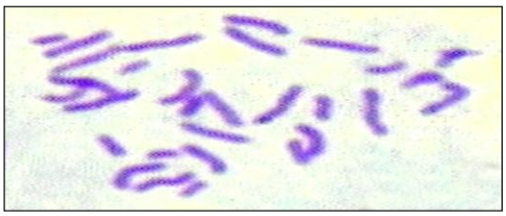

Fig.7 Somatic metaphase ♀

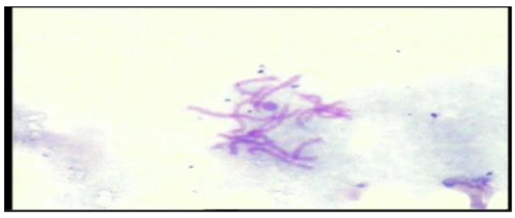

Fig.8 Leptotene

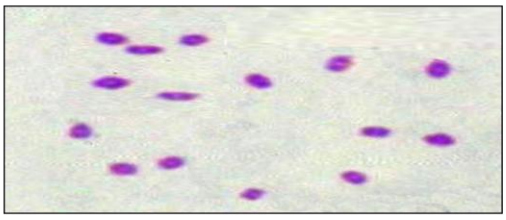

Fig.9 Diakinesis

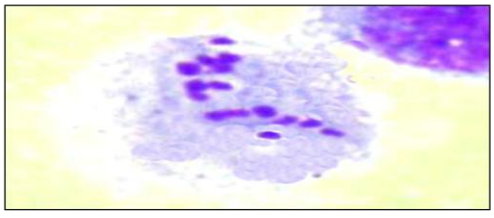

Fig.10 Metaphase I

Pontia daplidice **(2n = 52)**

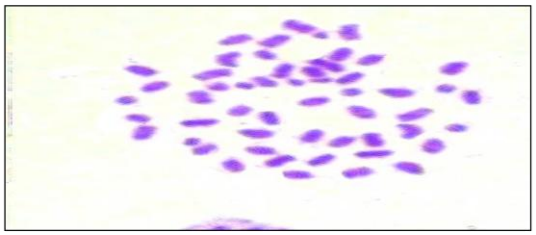

Fig. 11 Somatic metaphase ♂

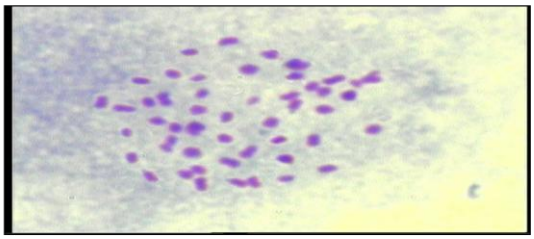

Fig.12 Somatic metaphase ♀

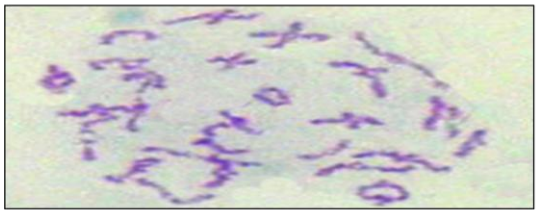

Fig.13 Diplotene

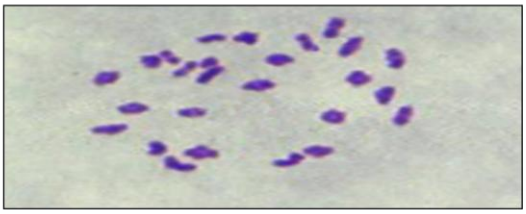

Fig.14 Diakinesis

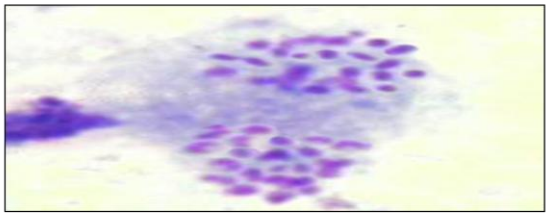

Fig.15 Anaphase