Chromosome numbers of some Indian moths

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Abstract

Cytological investigations in forty-five species of Indian moths belonging to ten families (Tinaeidae, Limacodidae, Thyrididae, Pyralididae, Lasiocampidae, Saturnidae, Sphingidae, Noctuidae, Lymantriidae, Hypsidae) of Lepidoptera revealed haploid chromosome numbers varying from 12 to 31, the latter number being predominant (in 26 species). Their haploid chromosome numbers at metaphase I and II are stated in a table.

Introduction

Chromosomal studies in Indian Lepidoptera have made very little headway although some attention has been paid to this branch in recent years (Gupta, 1964; Rishi, 1973, 1975; Nayak, 1975; Narang & Gupta, 1979a; Rao & Murty, 1976). The present work pertains to the male meiotic chromosomes of 45 species of moths belonging to ten different families.

Material and methods

Larvae of the different species of moths were collected from their respective host plants and were reared in cages under laboratory conditions. Testes of fifth-instar larvae and early pupae were dissected out in physiological saline, fixed in aceto-alcohol (1:3), squashed and stained with Heidenhains iron haematoxylin and were made permanent. The slides were examined under a Meopta binocular research microscope and good metaphase-I and -II stages were scored to determine the haploid chromosome number. Spermatogonial metaphase counts confirmed the diploid number.

Results

The 45 species investigated and their haploid chromosome numbers (n) as determined in spermatocytic division I and II are given in Table 1.

Table 1.

SUPERFAMILY, family and *species*	n (Division I & II)
TINAEOIDEA	
Tinaeidae	
Nephantis serinopa Meyr.	30
PSYCHOIDEA	
Limacodidae	
Parasa lepida Cram.	19
Parasa gentilis Suell.	24
PYRALIDOIDEA	
Thyrididae	
Rhodoneura myrtaea Drury	31
Pyralididae	
Antigastra catalaunalis Dup.	31
Chilotraea infuscatellus Sn. (Sugarcane stem-borer)	29
Chilo suppressalis Walk. (Striped borer)	12
Cnaphalocrocis medinalis Guen.	29
Corcyra cephalonica Staint. (Rice moth)	27

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Table 1. (continued)

SUPERFAMILY, family and *species*	n (Division I & II)
Crocidolomia binotalis Zell.	31
Dichocrocis nilusallis Walk.	30
Dichocrocis punctiferalis Guen.	31
Galleria mellonella Linn. (Wax moth)	30
Lamprosema indicata Fabr.	31
Lepyrodes neptis Cram.	31
Margorina indica Saund. (Pumpkin caterpillar)	31
Maruca testulalis Gey.	31
Orthaga exvinacea Hmps. (Mango shoot-webber)	29
Pyrausta sanguinalis Linn.	31
Tryporyza incertulas Walk. (Rice stem-borer)	22
BOMBYCOIDEA	
Lasiocampidae	
Crinocraspida torrida Moore	26
Dendrolinus hyrtaca Cramer	31
Saturnidae	
Antheraea mylitta Dr.	31
Antheraea paphia Linn.	31
SPHINGOIDEA	
Sphingidae	
Acherontia styx Westw. (Deaths' head moth)	29
Cephonodes hylas Linn. (Humming bird halk moth)	29
Deilephila (Daphnis) nerii (Dark olivegreen pink-moth)	29
Macroglossum bombylans Bois.	29
Macroglossum gyrans Walk. (Dark coloured humming bird halk moth)	29
Rhyncholaba acteus Cram.	28
Theretra oldenlandiae Fabr.	29
NOCTUOIDEA	
Noctuidae	
Achaea janata Linn.	31
Acontia intersepta Guen.	31
Anomis sabulifera Guen. (Jute looper)	31
Cosmophila erosa Hubn. (Green semi-looping larva)	31
Earias fabia Stoll.	31
Heliothis armigera Hubn.	31
Hyblaea puera Cram.	31
Plusia orichalcea Fabr.	31
Plusia signata Fabr.	31
Sesamia inferens Walk. (Pink borers)	31
Tarache tropica Guen.	31
Lymantriidae	
Euproctis virguncula	31
Hypsidae	
Hypsa alciphron Cram.	31

Discussion

An examination of the chromosome numbers in different species of Lepidoptera shows the most common haploid number to be n = 31 (Makino, 1951; Saitoh, 1959; Maeki, 1961; Suomalainen, 1969; Robinson, 1971; White, 1973; Rishi, 1973; Werner, 1974; Nayak, 1975; Ennis, 1976). The majority of species investigated here also have the standard lepidopteran karyotype. Out of 45 taxa studied, as many as twenty-six have 31 chromosomes in their haploid set; three have 30; nine have 29; one has 28; one has 27; one has 26; one has 24; one has 22; one has 19 and one has 12. On the whole the haploid chromosome number (n) varies between 12 to 31. White (1954) in his compilation 'Animal Cytology and Evolution' writes, 'In point of fact, 31 is the most frequent number...; but 29, 30 and 31 are so nearly equally common that it does not seem legitimate to consider any one of them as the type number in preference to the others'. (see White, 1954 page 176). Beliajeff (1930), on the other hand, considered the haploid number 30 as the ancestral number common to both Lepidoptera and Trichoptera. We agree with White (1954, 1973) as well as with Suomalainen (1969) that the commonest haploid number (n) in Lepidoptera is 31 and that they show a marked mode at 29–31. Nevertheless it is difficult to establish an ancestral number. There are families or sub-families where almost all members have n = 31, as in Nymphalinae or n = 30 as in Limenitini and Papilionidae (White, 1973 page 413). In our study also all species of Noctuidae have the haploid number 31. Ennis (1976) reported the most encountered haploid numbers as 30 and 31 in the 53 species studied by him. Remarkable stability is thus noticed in the chromosome numbers of Lepidoptera, yet in many genera and groups variations occur, the lowest haploid number being 7 and the highest 223. The increase or decrease of chromosome numbers may either be due to chromosomal fission or fusion as pointed out by White (1973). Lepidopteran chromosomes are suitable for the operation of such a process due to their holocentric organization leaving all fragmented chromosomes viable. Further variation in chromosome counts may be noted even in the cells of the same species. This is either due to occurrence of supernumerary chromosomes in addition to the normal set, or to the presence of unpaired univalent chromosomes in the karyotypes of natural interspecific hybrids. On no account can the variation in chromosome number be attributed to polyploidy as put forth by Lorkovic (1941), since the higher chromosome numbers established were no multiples of the chromosome numbers of any low-numbered species. Suomalainen (1969) has furnished evidence against this polyploidy hypothesis by comparing the DNA contents of nuclei of different *Cidaria* species determined by photometry. Moreover, the increase in chromosome number as observed in related species is accompanied by a decrease in chromosome size; had there been polyploidy, then the size would remain unaltered in spite of the numerical change. The diffuse nature of lepidopteran chromosomes favours fragmentation and fusion as the means of evolution of the chromosome number in Lepidoptera.

There are fewer species with higher than with lower numbers if 31 is taken as the ancestral number. Thus the trend of evolution is more towards the lower side of the scale than towards the higher number.

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References

Beliajeff, N. K., 1930. Die Chromosomenkomplexe und ihre Beziehung zur Phylogenie bei den Lepidopteren Z. ind. Abst. VererbLehre 54: 369-399.

Ennis, T. J., 1976. Sex chromatin and chromosome numbers in Lepidoptera. Can. J. Genet. Cytol. 18: 119–130.

Gupta, Y., 1964. Chromosomal studies in some Indian Lepidoptera. Chromosoma 15: 540–561.

Lorkovic, Z., 1941. Die Chromosomenzahlen in der Spermatogenese der Tagfalter. Chromosoma 2: 155-191.

Maeki, K., 1961. Chromosome numbers of butterflies from North America. Zool. Mag. (Tokyo). 70: 165-169. (In Japanese with English resumé).

Makino, S., 1951. An atlas of the chromosome numbers in animals. Ames, Iowa State College Press.

Narang, R. C. & Gupta, M. L., 1979a. Chromosomal studies in Eri silk moth Philosamia ricini Hutt. (Lepidoptera:Saturnidae). Entomon 4(3): 217–221.

Nayak, B., 1975. Studies on the male germinal chromosomes of thirty-one species of moths and butterflies (Lepidoptera). Prakruti 12(1 & 2): 141–150.

Rao, N. N. & Murty, A. S., 1976. Chromosome numbers in two species of Ergolis (Lepidoptera:Nymphalidae). J. Res. Lepid. 19(1): 23-26.

Rishi, S., 1973. Chromosome numbers of thirty species of Indian Lepidoptera. Genen Phaenen 16(3): 119–122.

Rishi, S., 1975. Chromosome studies in Indian Lepidoptera. Nucleus 18: 65–70.

Robinson, R., 1971. Lepidoptera genetics. Pergamon Press, Oxford.

Saitoh, K., 1959. The chromosome numbers of some species of moths. Jap. J. genet. 34: 84–87.

Suomalainen, E., 1969. Chromosome evolution in the Lepidoptera. Chromosomes Today 2: 131–138.

Werner, L., 1975. Zur Evolution des Karyotyps bei den Lepidopteren. Die Chromosomenzahlen der Noctuiden. Genetica 45: 377–395.

White, M. J. D., 1954. Animal cytology and evolution. 2nd Ed. Cambridge University Press, London.

White, M. J. D., 1973. Animal cytology and evolution, 3rd Ed. Cambridge University Press, London.

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