CYTOTAXONOMICAL STUDIES ON THE SPIDER FAUNA OF NORTH EASTERN REGION OF INDIA

ABSTRACT

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Spiders are the most successful arachnids. They have been reported from varied ecological conditions. Generally they are solitary in habit although a few species are social. Their size varies from pin head to that of a quarter plate. Although jumping spiders do not spin web but hunt for prey in bushes or grasses etc., most of the spiders exhibit unique skill in weaving web to ensnare prey. The food of spider is invariably a living animal. This feeding habit of spiders checks the population of harmful insects to some extent and thus helps man. The phenomenon of cannibalism is also very much pronounced in spiders, extended not only to the male after mating but also to the mother spider in some cases.

The spiders are world wide in distribution. The ballooning spiderlings have been collected at an elevation of 5000 feet from aircraft (Tikader 1977). So far about 30,000 species of spiders have been reported from different parts of the world. India and in particular the North Eastern Region registers a wide distribution of different species.

Cytology as a tool in taxonomy steps in with the advent of the chromosome theory of heredity and ultimately it has been accepted by most of the naturalists. The parameters used by the different workers which have established cytology as a taxonomic tool with phylogenetic approach may be summarised as follows: the analysis of karyotypes, the diploid number, total chromosomal length, metrical data of metaphase chromosomes, N.F. values, centromeric characteristics, pericentric and paracentric inversions, duplications, deletions, all forms of translocations including fusions (evolutionary decrease in chromosome number) and dissociations (increase in chromosome number), polymorphism, monomorphism, pre- and post-reductional meiosis, chiasma frequency and chiasma distribution, achiasmatic meiosis, the various types of supernumerary chromosomes, haplodiploidy, bizarre chromosome cycles, evolution of sex, sex chromosome constitution and sex determination mechaism, effect of total amount of genetic recombinations, heterochromatinization, dosage compensation, different banding patterns etc. However, all the up-to-date, cytologically studied groups of animals do not represent all the cytotaxonomical criteria just mentioned, generally different groups offer different sets of cytotaxonomical criteria.

The study on spider cytology dates back to the years 1885 when Carnoy initiated the study on spider chromosomes, although he did not mention about any sex determination mechanism. Wallace (1909) studied the spider, Agelena naevia cytologically and first of all described the male sex determination mechanism. Following Wallace, classical works on spider cytology was done by Painter (1914) on 13 North American spider species and Hackman (1948) on 68 species of Finish spiders. Suzuki and Okada (1950) and Suzuki (1951, 1952, 1954) also studied spider chromosomes. Suzuki worked out 90 species of spiders cytologically.

Recent investigations with new approach to the study of spider chromosomes was conducted by Brum-Zorilla and Cazenave (1974) who applied C-band techniques to detect heterochromatin localisation in spider chromosomes. Brum-Zorilla and Postiglioni (1980) studied C-, G- and fluorescence-banding pattern in three species of the genus Lycosa. Maddison (1982) studied 13 species of the genus Pellenes and reported for the first time $X_1X_2X_3Y$ mode of male sex determining mechanism in four species.

In India, studies on spider chromosome were initiated in 1950 when Bole-Gowda and Sharma reported the karyotype of single species each, collected from Eastern and Northern India respectively. Subsequently interest on spider chromosomes was shown by a number of workers and as a result about 137 species of Indian spiders have been chromosomally studied.

Review of literature indicates that though there exist about 30,000 described spider species, only about 321 species have been cytologically worked out. Although the spider fauna is very rich in North-Eastern India, not a large number of species is cytologically known from this part in comparison to their counterparts in the rest of India (Datta and Chatterjee 1983a, b, 1984). The present investiagion, therefore, was undertaken to determine the diploid number, chromosome morphology and sex determining mechanism of 58 spider species of North-Eastern India and to analyse the phylogenetic relationship among the various members of the different families. The summary of the work is given in the following table.

Table: Chromosome number and sex determination mechanism in 58 species of spiders.

Sl. Nos.	Species	Sex	2n	Metaphase I	Metaphase II	Sex determination
FAMILY ULOBORIDAE						
1.	*Uloborus danolius* Tikader	0	17	8+X	8, 9	XO
2.	*U. khasiensis* Tikader	0	18	$8+X_1X_2$	8,10	X_1X_2O
3.	*U. krishnae* Tikader	0	19	$8+X_1X_2X_3$	8,11	$X_1X_2X_3O$
FAMILY THERIDIIDAE						
4.	*Achaearanea budana* Tikader	0	22	$10+X_1X_2$	10,12	X_1X_2O
5.	*Argyrodes cyrtophore* Tikader	0	22	$10+X_1X_2$	10,12	X_1X_2O
6.	*A. gazedes* Tikader	0	22	$10+X_1X_2$	10,12	X_1X_2O
7.	*A. gazingensis* Tikader	0	24	$11+X_1X_2$	11,13	X_1X_2O
8.	*A. sp₁*	0	22	$10+X_1X_2$	10,12	X_1X_2O
9.	*A. sp₂*	0	22	$10+X_1X_2$	10,12	X_1X_2O
FAMILY LINYPHIIDAE						
10.	*Labulla nepula* Tikader	0	25	$11+X_1X_2X_3$	11,14	$X_1X_2X_3O$
11.	*Lephthyphantes bhudbari* Tikader	0	25	$11+X_1X_2X_3$	11,14	$X_1X_2X_3O$
FAMILY ARANEIDAE						
12.	*Argiope shillongensis* Sinha	0	24	$11+X_1X_2$	11,13	X_1X_2O
	A. shillongensis Sinha	♀	26			

Sl Nos.	Species	Sex	2n	Metaphase I	Metaphase II	Sex determination
13.	Cyrtophora citricola (Forskal)	♀	26			
14.	Cyclosa bifida (Dol)	0	24	$11+X_1X_2$	11, 13	X_1X_2O
15.	C. spirifera Simon	0	24	$11+X_1X_2$	11, 13	X_1X_2O
16.	Gasteracantha hasseltii Koch	0	16	$7+X_1X_2$	7, 9	X_1X_2O
	G. hasseltii Koch	♀	18			
17.	G. leucomelaena (Dol)	0	16	$7+X_1X_2$	7, 9	X_1X_2O
	G. leucomelaena (Dol)	♀	18			
18.	Leucauge celebesiana (Walckenaer)	0	25	$11+X_1X_2X_3$	11, 14	$X_1X_2X_3O$
19.	L. decorata (Blackwell)	0	25	$11+X_1X_2X_3$	11, 14	$X_1X_2X_3O$
20.	L. tessellata (Thorell)	0	25	$11+X_1X_2X_3$	11, 14	$X_1X_2X_3O$
21.	Meta segmentata (Clerck)	0	24	$10+X_1X_2X_3X_4$	10, 14	$X_1X_2X_3X_4O$
22.	Neoscona achine Simon	0	24	$11+X_1X_2$	11, 13	X_1X_2O
23.	N. poonaensis Tikader & Bal	0	24	$11+X_1X_2$	11, 13	X_1X_2O
24.	Nephila clavata Koch	0	24	$11+X_1X_2$	11, 13	X_1X_2O
	FAMILY TETRAGNATHIDAE					
25.	Tetragnatha andamanensis Tikader	0	24	$11+X_1X_2$	11, 13	X_1X_2O
26.	T. mandibulata bidentata Gravely	0	24	$11+X_1X_2$	11, 13	X_1X_2O
27.	T. = (Meta) gracilis Stol	0	24	$11+X_1X_2$	11, 13	X_1X_2O

Sl Nos.	Species	Sex	2n	Metaphase I	Metaphase II	Sex determination
FAMILY AGELENIDAE						
28.	Agelena auclandi Burman	0	42	$20+X_1X_2$	20,22	X_1X_2O
	A. auclandi Burman	♀	44			
29.	A. gautami Tikader	0	43	$20+X_1X_2X_3$	20,23	$X_1X_2X_3O$
FAMILY ZODARIIDAE						
30.	Storena indica Tikader	0	22	$10+X_1X_2$	10,12	X_1X_2O
FAMILY LYCOSIDAE						
31.	Pardosa birmanica Simon	0	28	$13+X_1X_2$	13,15	X_1X_2O
FAMILY OXYOPIDAE						
32.	Oxyopes ratnae Tikader	0	21	$10+X$	10,11	$X\ O$
FAMILY GNAPHOSIDAE						
33.	Gnaphosa sp.	0	22	$10+X_1X_2$	10,12	X_1X_2O
FAMILY CLUBIONIDAE						
34.	Chiracanthium himalayensis Gravely	0	26	$12+X_1X_2$	12,14	X_1X_2O
35.	C. insigne Cambridge	0	26	$12+X_1X_2$	12,14	X_1X_2O
36.	C. melanostoma Gravely	0	43	$20+X_1X_2X_3$	20,23	$X_1X_2X_3O$
37.	C. murina Thorell	0	23	$10+X_1X_2X_3$	10,13	$X_1X_2X_3O$
	C. murina Thorell	♀	26			
38.	Clubiona ludhianaensis Tikader	0	26	$12+X_1X_2$	12,14	X_1X_2O
39.	Trachelas sp.	0	24	$11+X_1X_2$	11,13	X_1X_2O

Sl Nos.	Species	Sex	2n	Metaphase I	Metaphase II	Sex determination
FAMILY SPARASSIDAE						
40.	*Sparassus sp*$_1$	0	42	$20+X_1X_2$	20,22	X_1X_20
41.	*Sparassus sp*$_2$	0	42	$20+X_1X_2$	20,22	X_1X_20
42.	*Sparassus sp*$_3$	0	44	$20+X_1X_2X_3X_4$	20,24	$X_1X_2X_3X_40$
FAMILY HETEROPODIDAE						
43.	*Heteropoda leprosa* Simon	0	41	$19+X_1X_2X_3$	19,22	$X_1X_2X_30$
44.	*H. sikkimensis* Gravely	0	42	$19+X_1X_2X_3X_4$	19,23	$X_1X_2X_3X_40$
FAMILY THOMISIDAE						
45.	*Pistius sreepanchamii* Tikader	0	23	11+X	11,12	XO
46.	*Thomisus beautifularis* Basu	0	23	11+X	11,12	XO
47.	*Xysticus minutas* Tikader	♀	24			
48.	*X. sujatai* Tikader	0	23	11+X	11,12	X 0
49.	*X. sp.*	0	23	11+X	11,12	X 0
FAMILY SALTICIDAE						
50.	*Marpissa sp*$_1$	0	28	$13+X_1X_2$	13,15	X_1X_20
51.	*Marpissa sp*$_2$	0	28	$13+X_1X_2$	13,15	X_1X_20
52.	*Myrmarachne bengalensis* Tikader	0	25	12+X	12,13	X 0
53.	*Phidippus indicus* Tikader	0	29	$13+X_1X_2X_3$	13,16	$X_1X_2X_30$

Sl Nos.	Species	Sex	2n	Metaphase I	Metaphase II	Sex determination
54.	P. sp_1	0	26	$12+X_1X_2$	12, 14	X_1X_2O
55.	P. sp_2	0	28	$13+X_1X_2$	13, 15	X_1X_2O
56.	Plexippus paykulli (Aud)	0	28	$13+X_1X_2$	13, 15	X_1X_2O
57.	Rhene indicus Tikader	0	23	11+X	11, 12	X O
58.	Salticus ranjitus Tikader	0	28	$13+X_1X_2$	13, 15	X_1X_2O

Including the present report, 375 species of spiders are now chromosomally known. However, it has to be admitted that we do not have at present chromosomally known representative species of a number of families and accordingly only a preliminary statement may be presently given. The following points seem worthy of mention.

Though there is a wide variation of haploid chromosome number, the majority of the spiders have the number restricted between 12 to 15. Presence of single-armed chromosomes seems to be the characteristic of the spider karyotype. While a general trend in the reduction of chromosome number is discernible from primitive to modern spiders, the X_1X_2O - $X_1X_1X_2X_2$ sex determination mechanism seems to be well established as it is found in equal abundance in primitive, intermediate and modern spiders. Karyotypic interrelationship within family members can be easily construed clearly demonstrating the operation of orthoselection in spiders.

Our data has been useful in establishing the independent entity of a large number of closely related species and in particular the remarkable differentiation between the yet unnamed congeneric species. We are hopeful that our studies will provide chromosomal information of value in unravelling the problems of taxonomy and evolution of spiders.