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TAXONOMY AND CYTOLOGY OF TAIWAN GRASSHOPPERS (*ACRIDOIDEA*)

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ABSTRACT

K. M. Ho and C. Y. Lee (1971) *Taxonomy and Cytology of Taiwan Grasshoppers* (*Acridoidea*) Bull. Inst. Zool. Academia Sinica **10**(1): 1-5. Twenty five species of grasshoppers (*Acridoidea*) found in Taiwan were collected and identified. They were classified into *Pyrgomorphidae* and *Acrididae* two families. Chromosome numbers of twenty two species were determined and cytological study was carried out. Chromosomal aberrations such as B-chromosomes, tetraploid nuclei, asymmetrical bivalents and chromosome interchanges were observed in some of the species.

Though grasshoppers are a major insect-pest on some economic crops, they provide suitable material for cytological investigations (3). The chromosomes in grasshoppers are individually distinguishable at most of them (3) and chiasma frequency is easy to score (1, 2). Spontaneous changes of chromosome structure in grasshoppers have been reported frequently (see 5). Lewis and John (5) studied behaviour of different chromosomal aberrations in grasshoppers to understand the polymorphism in their natural population. The behaviour and effect of B-chromosomes in grasshoppers have been studied by John and Hewitt (4). Though much work has been carried out on the grasshoppers from different parts of the world, however, little is known about the species of grasshoppers in Taiwan. The present paper reports the preliminary observations on the species of grasshoppers found in Taiwan and their chromosome constitution.

MATERIALS AND METHODS

The materials used in this study were collected in Taiwan mainly from Taichung area (Wang-tien, Hou-li, Nan-tun, and Che-lung-pu), and partly from Siao-ke-tou of Taipei area during the summer of 1967. The specimens collected were sent to the Anti-Locust Research Centre, London, England for identification of their taxonomic groups.

For cytological observations, the testes of male grasshoppers were removed and fixed in a solution of 1:3, glacial acetic acid and ethyl alcohol for 24 hours. The fixed

TABLE 1.

The species and chromosome numbers of grasshoppers (*Acridoidea*) collected in Taiwan.

Species	Chromosome Nos. in male	
	n	2n
Pyrgomorphidae		
Atractomorpha brevicoznis heteroptera Bei-Bienko	9, 10	19*
Acrididae		
Oxyinae		
Oxya intricata Stal	11, 12	23**
Catantopinae		
Stenocatantops mistshenkoi F. Willemse	11, 12	23
Catantops pinguis pinguis Stål	11, 12	23
Cyrtacanthacridinae		
Patanga avis Rehn	11, 12	23
Chondacris rosea De Geer	11, 12	23
Acridinae		
Acrida willemsei Dirsh	11, 12	23
Phlaeoba galeata Walker	11, 12	23***
P. infumata Brunner von Wattenwyl	11, 12	23***
Gastrimargus africanus orientalis Sjostedt	11, 12	23
G. marmoratus transversus Thunberg	11, 12	23
Pternoscirta caliginosa Walker	11, 12	23
P. cinctifemur de Haan	— —	—
Trilophidia annulata Thunberg	11, 12	23
Gelastorrhinus tonkinensis C. Willemse	11, 12	23
Aiolopus tamulus Fabricius	11, 12	23
Heteropternis respondens Walker	11, 12	23
Locusta migratoria manilensis Meyen	— —	—
Hemiacridinae		
Hieroglyphus annulicornis Shiraki	11, 12	23
Coptacridinae		
Eucoptacra praemorsa Stäl	11, 12	23
Eyprepocnemidinae		
Shirakiacris shirakii I. Bolivar	11, 12	23
Eyprepocnemis hokutensis Shiraki	— —	—
Truxalinae		
Aulacobothrus sven-hedini Sjostedt	11, 12	23
A. decisus Walker	11, 12	23
A. luteipes Walker	11, 12	23

* Tetraploid nuclei and asymmetrical bivalent were observed.
** A chain of eight chromosomes was observed in one individual.
*** B-chromosome was observed in these species.

material was squashed in propiono-carmine. A minimum of five individuals were examined from each species.

RESULTS AND DISCUSSION

The grasshoppers collected in this study were classified into two families, *Pyrgomorphidae* and *Acrididae* (Table 1). The former included only one species, *Atractomorpha brevicoznis heteroptera*, and the latter twenty four species, which were further classified into eight subfamilies and nineteen genera.

Of the twenty five species collected, all species except three (*Pternoscirta cinctifemur*, *Locusta migratoria manilensis* and *Eyprepocnemis hokutensis*) were successfully examined cytologically. Their chromosome numbers are listed in Table 1. The male species of *Atractomorpha brevicoznis heteroptera* of the family *Pyrgomorphidae* had nine pairs of autosomes and one sex-chromosome (Fig. 3). All twenty one species of the family *Acrididae* examined had eleven pairs of autosomes and one sex-chromosome in male (Fig. 1, 2).

Deviations from normal chromosome complements were also observed in some species. One B-chromosome was found in the species *Phlaeoba galeata* and *P. infumata* collected from Taichung area (Fig. 6). The species *P. infumata* from Taipei area did not have any B-chromosome. The species *P. galeata* was not found in Taipei area. Univalent B-chromosome did not pair with any of the normal chromosomes of the complements (Fig. 6); but frequently moved to one pole at telophase I (Fig. 7). Divided B-chromosome (Fig. 8), and lagging B-chromosome were also observed occasionally. Observation similar to this about B-chromosome of grasshoppers collected from Britain has also been made by John and Hewitt (4). Tetraploid nuclei were observed in the primary spermatocytes of two individuals of the species *Atractomorpha brevicoznis heteroptera*. Within one individual, tetraploid nuclei were found in some follicles of the testes but normal in others indicating that chromosome restitution might have occured in the early development of some germ lines or even earlier in development. In tetraploid nuclei, the two sex-chromosomes lying close together and two or three quadrivalents were frequently observed. Absence of polyploid individuals in this group may suggest that diploid sperms fail at fertilization in competition with haploid sperms. An asymmetrical bivalent was also observed in the species *Atractomorpha brevicoznis heteroptera* (Fig. 4). In the species *Oxya intricata*, a chain of eight chromosomes was observed in one individual (Fig. 5), indicating that interchanges might have occured in the chromosomes.

Grasshoppers appear to be excellent materials for cytological observations; and chromsome structural variation in different species of grasshoppers may provide opportunities for cytological studies. So far as the authors are aware of, this is the first time the grasshoppers of Taiwan were extensively collected and taxonomically reported. Further collections are underway (Li, personal communication). More species are expected in the southern and eastern parts of Taiwan which were not covered in this collection.

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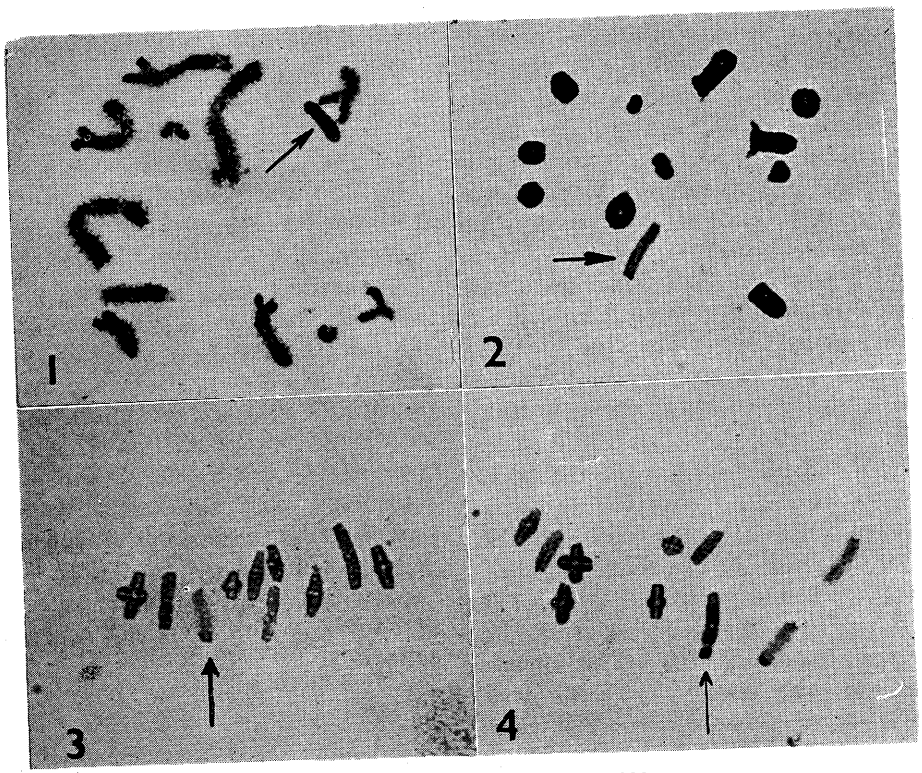

Figs. 1-8 Meiosis in the male of Taiwan grasshoppers. × 800

Fig. 1. Pachytene stage in *Patanga avis;* note 11 pairs of autosomes and one sex-chromosome (arrow).

Fig. 2. Metaphase I in *Phlaeoba galeata;* note 11 pairs of autosomes and one sex-chromosome (arrow).

Fig. 3. Metaphase I in *Atractomorpha brevicoznis heteroptera;* note 9 pairs of autosomes and one sex-chromosome (arrow).

Fig. 4. Asymmetrical bivalent (arrow) at metaphase I in *Atractomorpha brevicoznis heteroptera*.

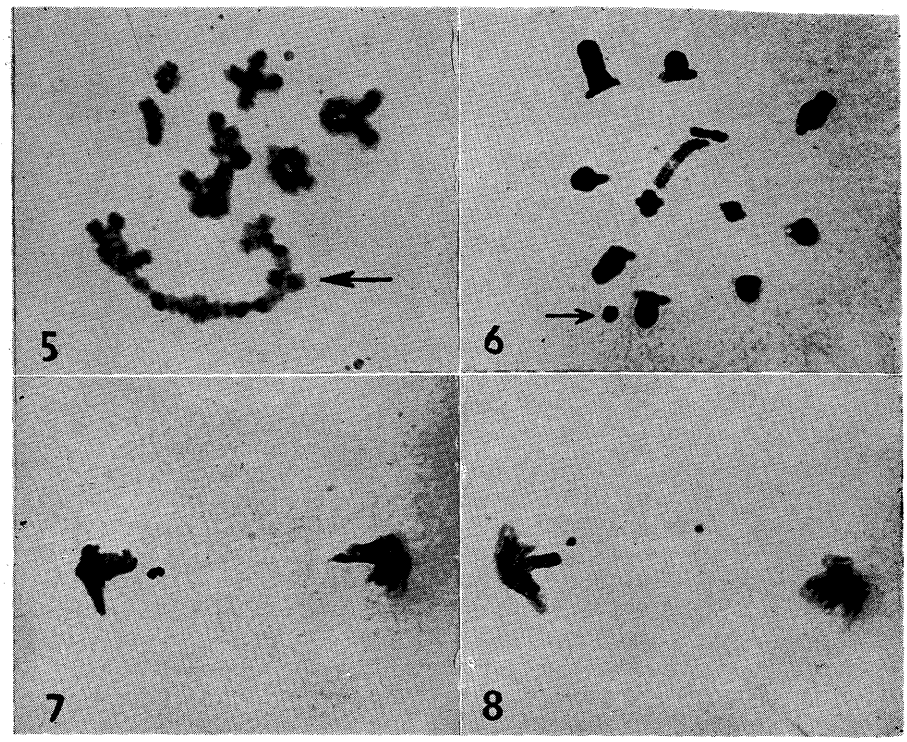

Fig. 5. Chain of eight (arrow) at late diplotene stage in *Oxya intricata*.
Fig. 6. Morphology of unpaired B-chromosome (arrow at metaphase I in *Phlaeoba infumata*.
Fig. 7. Movement of undivided B-chromosome at telophase I in *Phlaeba infumata*.
Fig. 8. Late division of the univalent B-chromosome at telophase I in *Phlaeba infumata*.