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Chromosome Study on Four Species of the Genus *Hypera* (Curculionidae : Coleoptera)

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竹内 恭：タコゾウムシ4種の染色体研究

The literature shows that five species of the genus *Hypera* have previously been studied chromosomally, except for *Hypera punctata* studied by Stevens (1909), the others were exclusively studied by the present author (Takenouchi, 1958a, b, 1963, 1965). Although the investigation of the sectioned slides did not show the details of association of the sex chromosomes (Stevens, 1909; Takenouchi, 1958a, b, 1963) the squash slide clearly showed the details in every case (Takenouchi, 1955, 1965). According to the author's experience, among various kinds of squash methods the Smith's (1943) method is superior to the others and tells the details of chromosome structure very well.

The author have had a chance to study the chromosomes of four species of the genus *Hypera*. This paper reports the details of the investigation. In these four species, three had already been studied using an other method or with Canadian insects in part, the other was studied for the first time.

Materials and Method

Three *Hypera nigrirostris* Fabricius, seven *H. rumicis* Linnaeus, one *H. mongolicus* Motschulsky, and seven *H. viciae* Cyllenhal were available for the study. The last species is the first one recorded in Japan. Testes of adult males were squashed with Smith's (1943) method and then stained with methyl green-basic fuchsin (Smith and Takenouchi, 1969). All drawings were made with the aid of a camera lucida and magnified 3,600 times.

Observations

Hypera nigrirostris Fabricius (Figs. 1–4)

Numerous insects were collected in Hakodate in mid July 1964. In spermatogonial metaphases there are 22 chromosomes of various sizes and most of them are meta- or sub-metacentric (Fig. 1). In reference to the first metaphase it seems probable that the X is one of the smaller metacentric chromosomes, however, in the diploid complex there are always two small chromosomes having nearly the same size and it is impossible to detect the X in each case. On the other hand, the y is very easily detectable. It is the smallest and slenderest

metacentric chromosome. There are 11 bivalents of different sizes in the first metaphase (Fig. 2). One of them, the smallest, is the sex-determining pair having the shape of a parachute. To detect ring bivalents is difficult. As a result of the first division, two sorts of secondary spermatocytes are produced: one contains 10 autosomal univalents plus the X (Fig. 3), and the other contains the same number of univalents plus the tiny y. (Fig. 4).

Figs. 1-4. Chromosomes of *Hypera nigrirostris*. 1. Spermatogonial metaphase. 2. First metaphase. 3. Second metaphase, X-class. 4. The same, y-class.

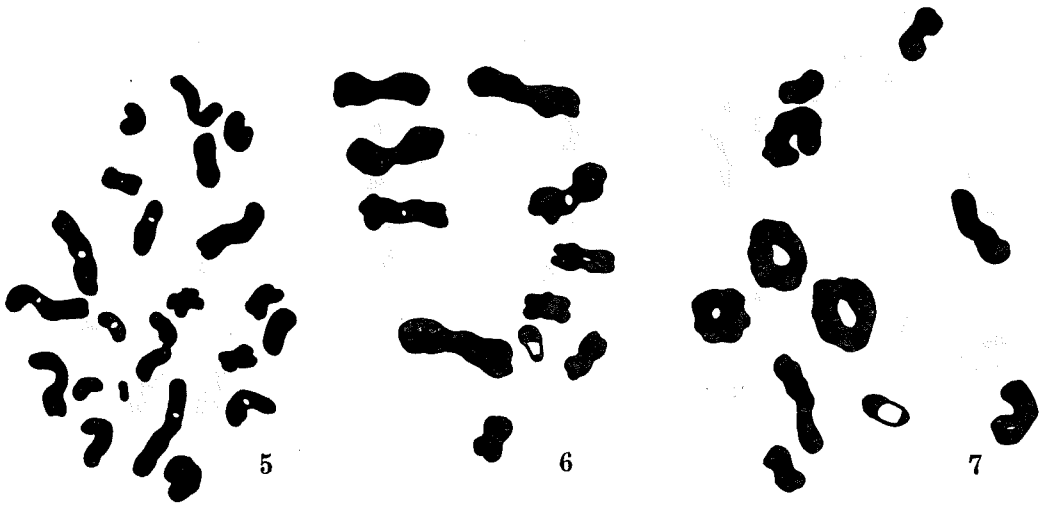
Hypera rumicis Linnaeus (Figs. 5-7)

Many specimens were obtained from Higashi-Shizunai in early June 1964. The slides provided several spermatogonia and many first spermatocytes at metaphase. Every spermatogonial metaphase shows 22 chromosomes of various sizes (Fig. 5). With the exception of a pair of middle sized elements they are surely metacentric elements with a clear constriction near their middle portion. The smallest element is outstanding in the complex, the element is supposed to be the y. In reference to the first metaphase, the X is one of the smaller chromosomes in the complex, however, there are seven smaller chromosomes so at this stage the X is indistinguishable in the complex. Every first metaphase shows that there are ten autosomal bivalents plus the Xy_p sex-determining pair. A careful examination shows that three or four kinds are found in the first metaphases regarding the autosomal ring bivalent; from no ring (Fig. 6) to three or four rings (Fig. 7).

Hypera mongolicus Motschulsky (Fig. 8)

This is a very rare species in Hokkaido. Since 1963 only a single male was collected in Hakodate in mid-August 1965. The material provided eight excellent spermatogonia only. No first or second metaphases were obtained. Every spermatogonial metaphase shows 22 chromosomes of different sizes as seen in Fig. 8. The differences in size are relatively small

but a careful examination distinguishes 4 large, 8 medium and 10 small sized chromosomes. The majority of them are metacentric in nature. The y is the smallest body and the X is again indistinguishable at this stage.



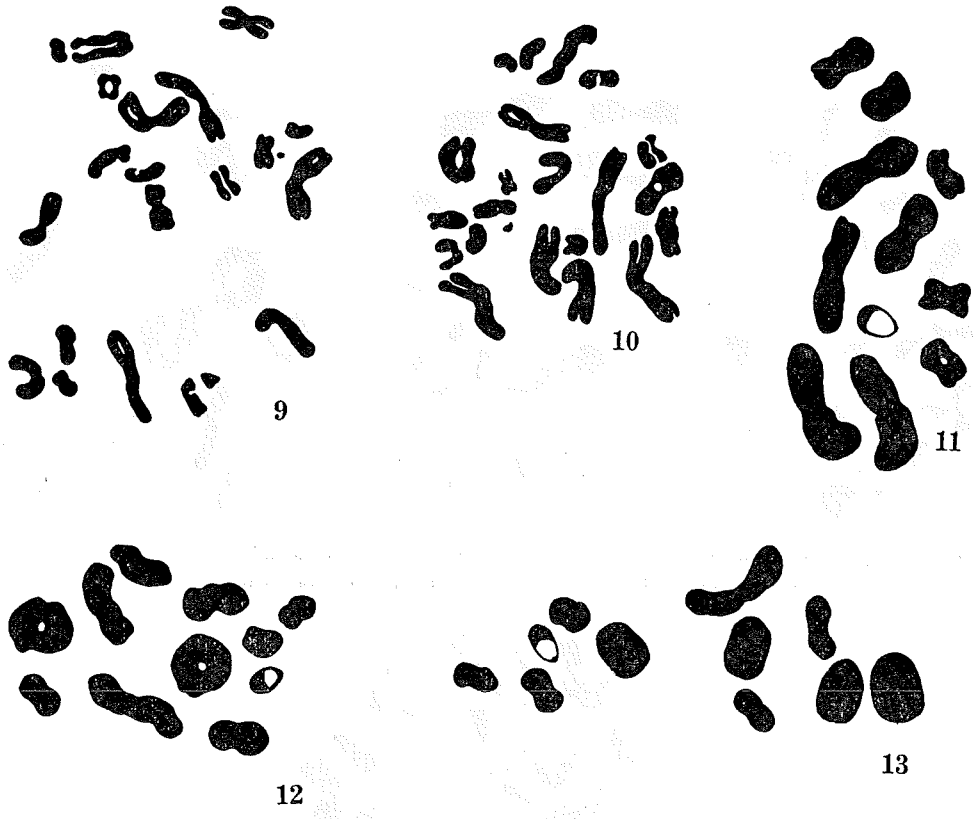
Figs. 5–7. Chromosomes of *Hypera rumicis*. 5. Spermatogonial metaphase. 6. First metaphase with no ring bivalents. 7. The same, with three or four ring bivalents.

Fig. 8. Spermatogonial metaphase of *Hypera mongolicus*.

Hypera viciae Gyllenhal (Figs. 9–13)

This species is the first one on record in Japan as mentioned above. Seven specimens were collected in Hakodate between late June and mid-August 1964 and a few were from Mt. Haruka, Otaru, in late June 1967. Both spermatogonia and first spermatocytes were available in several specimens. The spermatogonial cell contains 22 chromosomes of various sizes which consist of twenty elements in ten pairs and an unequal pair made up of an X and y (Fig. 9 and 10). The majority of the autosomes and the X are metacentric in nature, while the y is identified as a minute spherical element. The X is the smallest element with the exception of the y. In the first metaphase there are 11 bivalents of different sizes, which are composed of ten autosomal bivalents with the smallest Xy sex-determining complex forming a

characteristic parachute. There are from one to four ring bivalents in the first meiotic metaphase and the last one is the most numerous (Figs. 11–13).



Figs. 9–18. Chromosomes of *Hypera viciae*. 9 and 10. Spermatogonial metaphases. 11. First metaphase with no or one ring bivalent. 12. The same, with two ring bivalents. 13. The same, with four ring bivalents.

Discussion

Among the four *Hypera* species studied here, three species, *H. nigrirostris*, *H. rumicis*, and *H. mongolicus* were formerly studied by the author (Takenouchi, 1955, 1958a, b, 1963, 1965). *H. rumicis* is the only species studied by a squash method and it is revealed that the species has 2n=22, and MI=10 AA+Xy_p. *H. nigrirostris* was also studied in both Canadian and Japanese race using the squash method: the former race with 2n=22 and MI=10 AA+Xy_p, and the latter, MI=10 AA+Xy_p. On the other hand, the author obtained the result of the species with 2n=22 by using a classical paraffin method. Another species, *H. mongolicus*, has 2n=22 in both spermatogonial and oogonial metaphase. The results were obtained with the paraffin method.

The present investigation was intended to ascertain the former results mentioned above and furthermore to study for the first time a new species, *H. viciae* Cyllenhal. The results of the revised study are completely in agreement with the former results. However, as to the

ring bivalent, in *H. nigrirostris* to detect ring bivalents is difficult; therefore the Japanese specimen is something different from those of the Canadian specimens. Besides, it is revealed that *H. rumicis* has three or four kinds of first metaphases: from no ring bivalent to three or four rings. *H. viciae* has similar chromosome formulae as the other species: 2n=22 and MI= 10 AA+Xy_p. This species has also from one to four ring bivalents in the first meiotic metaphases as found in *H. rumicis*.

Four *Hypera* species, here under study, uniformly show the male heterogamety with an Xy sex-determining mechanism. Excluding of *H. mongolicus* the other three species have Xy_p sex complex without exception. The first meiotic metaphase of *H. mongolicus* was not obtained, so its association with the X- and y-chromosomes is not ascertained.

Table 1. *Hypera* species observed in this study and the data comprising their chromosome numbers and the sex-determining mechanism were established

Species	Chromosome number		Author
	2n	MI	
Curculionidae			
Hyperinae			
Hyperini			
Hypera punctata		Xy	Stevens '69
H. rumicis	22	10AA+Xy_p	Takenouchi '55, Herein
H. nigrirostris	22	10AA+Xy_p	Takenouchi '58a, '63, '65, Herein
H. mongolicus	22	Xy	Takenouchi '58b, Herein
〃	22	XX	Takenouchi '58b
H. viciae	22	10AA+Xy_p	Takenouchi Herein

Summary

Four weevil species belonging to the genus *Hypera* were studied chromosomally according to a modern squash method. The data are summarized in Table 1.

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