Chromosomes of Puerto Rican Hispinae and Cassidinae (Coleoptera: Chrysomelidae)
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CHROMOSOMES OF PUERTO RICAN HISPINAE AND CASSIDINAE (COLEOPTERA: CHRYSOMELIDAE)

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ABSTRACT

Basic chromosomal parameters are first reported for two species of hispines and seven cassidines (Chrysomelidae) from Puerto Rico. *Physonota (Eurypepla) jamaicensis* (Linnaeus) and *Charidotella (s. str.) sexpunctata* (Fabricius) (both Cassidinae), the latter a potential pest of sweet potato (*Ipomoea batatas*), are new records for Puerto Rico. Only *P. jamaicensis* shows the modal (inferred ancestral) meioformula $8 + X_Y$ of the subfamily. All other Puerto Rican species studied show increased autosomal counts apparently due to centric fissions followed by pericentric inversions. The two hispines have meioformula $8 + X_Y$ conforming well with earlier finds. Meiogram, a new term, is defined and used for the first time in this paper.

REsUMEN

Los parámetros cromosomales básicos de dos especies de hispinos y siete cassidinos (Chrysomelidae) de Puerto Rico son informados por primera vez. *Physonota (Eurypepla) jamaicensis* (Linnaeus) y *Charidotella (s. str.) sexpunctata* (Fabricius) (ambos Cassidinae), la última una plaga potencial de la batata (*Ipomoea batatas*), son registros nuevos para Puerto Rico. Sólo *P. jamaicensis* muestra la meiofórmula modal (inferida ancestral) $8 + X_Y$ de la subfamilia. Todas las otras especies puertorriqueñas estudiadas muestran conteos autosomales mayores probablemente debido a fisiones céntricas seguidas por inversiones pericéntricas. Los dos hispinos tienen meiofórmula $8 + X_Y$ y se ajustan bien a hallazgos previos. Meiograma, un nuevo término, es definido y usado por primera vez en este trabajo.

Chromosomal data can contribute significantly to systematics. The chrysomelid subfamilies Hispinae and Cassidinae have always been considered to be closely related (see Seeno and Wilcox 1982 for different classifications of the Chrysomelidae) and, at times, hard to delimit morphologically (Crowson 1967). Their similarities are extended to the chromosome numbers and sex chromosome systems. Both subfamilies tend to have numbers below the modal polyphagan $2n = 20, 9 + X_Y$ (Petitpierre *et al.* 1988). The meiofórmula $7 + X_Y$
prevails among the 20 species of Hispinae studied; 8 + Xy, among over 50 species of Cassidinae known chromosomically. Among the hispines, only Microrhopala vittata (Fabricius) has counts greater than 9 + Xy, (15 + Xy, Smith and Virkki 1978), whereas about a third of Cassidinae have larger counts. The highest chromosome number in the Cassidinae occurs in Botanochara Dejean, a Neotropical genus, usually in combination with very complicated sex chromosome system (Vaio and Postiglioni 1974; Panzera et al. 1983).

We present an account of basic chromosomal characteristics of nine of the 18 (50%) Puerto Rican Hispinae and Cassidinae.

It has become customary to arrange chromosomes in rows where the homologues of mitotic metaphase are side-by-side in decreasing length order ("riconstruzioni del cariotipo," Battaglia 1959, 1963). The sex chromosomes, when present, are depicted slightly separated from the autosomes. These presentations are commonly called karyotypes although such artificial arrangement is not a prerequisite for using the term that has been employed to cover any phase, arrangement or formula from which the precise number and morphology of the chromosomes can be determined. Thus, clarification of several terms is needed to distinguish between unarranged chromosomes, as they appear in preparations, and the artificially ordered ones. Unarranged chromosomes will be presented under the karyokinetic phase they represent (spermatogonial mitosis, or meiotic stages such as pachytene, diakinesis, M I, M II, etc.). For artificially arranged chromosomes, we use terms ending with -gram (< Gr. gramm = line, letter, writing).

KARYOGRAM. Although Battaglia (1952) has defined karyogram as a detailed description of the chromosome set of a single cell, we follow the common practice to apply this term to the arrangement, in rows, of mitotic chromosomes. Chromosomes are either cut off from photographs or traced from them.

IDIogram (< Gr. ideo = form, appearance). This term, originally synonymous with karyogram (Rieger and Michaelis 1958), will be reserved for the presentation of schematically drawn karyotypes. Idiograms are based on chromosome measurements rather than on a single photograph.

MEIOGRAM (abbreviation for meiokaryogram). This new term means the presentation in rows of uni-, bi- or multivalent profiles of late meiotic prophase to metaphase (M I preferred over prophase). The sex chromosomes will be usually depicted to the right of the autosomes. More than one meiogram may be necessary to illustrate M I in chromosomically polymorphous species, but a meiogram based on a typical M I is a fairly reliable expression of chromosome number, sex chromosome system and pairing relations. Other parameters, such as number and distribution of chiasmata, need additional data and nomenclature. As with karyograms, the chromosomal elements are either cut off from a photograph or traced. Meiogram has the advantage over M I photographs in that chromosomal elements moderately clumped or at different depths can be separately picked up and rescued for publication. This form of presentation has been used by many classical cytogeneticists (Darlington 1937; Suomalainen 1946; Smith 1960; White 1973). We follow them and present the meiotic autosomal elements in a liberal order (not according to their valency or size). The apparent size of a chromosome is influenced by variations in natural processes such as terminalization of chiasmata and chromosomal condensation or stretching, and by preparation techniques (pretreatments, fixation, force of squashing, etc.).

MEIOFORMULA (Virkki 1988) is a written form of a meiogram. Typically, the M I condition is given as a formula where the number of autosomal bivalents
is followed by a “+” sign and the sex chromosome symbols. In the case of associated sex chromosomes, their symbols are always written together (for instance: 9 + Xy; 10 + X, X, Y). If the symbols are separated by a “+,” it means that the sex chromosomes are univalents (for example, 10 + X + Y). Similarly, autosomal valency groups can be separated from one another by a “+” among the autosomes (for instance, 7II + 2I + 1IV + XX). This practice has proven very useful because it is more informative than plain bivalent numbers. Therefore, and to avoid confusion when writing 2n numbers, we may specify the sex chromosomes in parentheses following a full 2n number. For example, 2n = 20(X, y) or 2n = 20(2X) instead of 2n = 18 + XX, which is used sometimes. (Details on these practices in Smith and Virkki 1978:102.)

Karyo- and meiograms are complementary methods of describing a karyotype. The former gives mitotic structure, the latter meiotic structure and function in relation to the following generation, such as linkage, recombination and segregation. It would be ideal to illustrate both for each species, but pioneering chromosome studies dealing with wild species are frequently confined to the simplest techniques. In Coleoptera, untreated testes remain the main source of data. Employing rapidly working fixatives and phase contrast microscopy, a beetle testis can be prepared for chromosome scanning in about five minutes. Unfortunately, mitoses are not always present, and if present, may not respond well to monitoring. This leaves the meiogram as the most common, and often unique, chromosomal information source.

The Puerto Rican Hispinae and Cassidinae are karyologically unknown. We considered it desirable to publish all such data accumulated in N.V. laboratory in Puerto Rico during the past 30 years even though data remain far from exhaustive. This paper emphasizes their karyotypes at M I.

Methods

Specimens of two species of hispines and seven of cassidines where collected in Puerto Rico and the adjacent islands of Culebra and Mona (Table 1), and brought to the laboratory alive in an icebox kept at about 20°C. Testes were excised and processed for phase contrast microscopy and microphotography using a rapid fixation and squash technique (Virkki 1983, Schedule 5). From 2-30 males, depending on the species, were studied. Selected slides were stained employing Giemsa and/or AgNOR methods.

A Zeiss Photomicroscope II and Kodak Plus-X Pan 35mm film were used throughout. For karyotype arrangements, the negatives were enlarged up to 3,546 x. For karyograms, the chromosomes were cut out and rearranged in rows or traced in rows, then rephotographed. For meiograms, the bivalents were traced similarly. The final magnification of both karyo- and meiograms was adjusted to 1700 x.

Results

Sceloenopla mantecada Sanderson (Hispinae, Sceloenoplini). This species is known only from Puerto Rico. We have found it feeding on tender leaves of Rapanrea sp. (Myrsinaceae), possibly R. coriacea (Sw.) Mez., trees in April to June in the central mountains of Puerto Rico, from Jajome (Cayey) to Monte Guilarte (Adjuntas). The specimens from Jajome have a slight greenish tint not seen in westerly samples. This is the first member of the Sceloenoplini examined for karyotype determination. Thirty males were studied.
Table 1. Species, plant association and collection data for specimens examined.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Plant association</th>
<th># Examined</th>
<th>Collection data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispinae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sceloenoplini</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sanderson</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Chalepini</td>
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<td></td>
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<tr>
<td>(Linnaeus)</td>
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<td></td>
</tr>
<tr>
<td>Cassidinae</td>
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<tr>
<td>Stolaini</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(Linnaeus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physonotini</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physonota jamaicensis</td>
<td>Cordia sp. (Boraginaceae)</td>
<td>15</td>
<td>Culebra Is., 20 Jun. 85.</td>
</tr>
<tr>
<td>(Linnaeus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassidini</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agroiconota propinqua</td>
<td>Ipomoea sp. (Convolvulaceae)</td>
<td>6</td>
<td>Fajardo, 4 Oct. 74. Dorado, 6 Jan. 86. Vega Baja, Central San Vicente, 5 May 85. Vega Baja, Laguna Tortuguero, 14 Dec. 88.</td>
</tr>
<tr>
<td>(Boheman)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Deloyala guttata (Olivier)</td>
<td>Ipomoea batatas (L.) Lam. (Convolvulaceae)</td>
<td>12</td>
<td>Isabel, Agric. Exp. Substation, 25 Nov. 87, 29 Dec. 87, 17 Feb. 88.</td>
</tr>
<tr>
<td>(Boheman)</td>
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Table 1. Continued.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Plant association</th>
<th># Examined</th>
<th>Collection data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charidotella sexpunctata</td>
<td>Ipomoea sp. (Convolvulaceae)</td>
<td>12</td>
<td>Vega Baja, Laguna Tortuguero, 28 Sept. 87, 26 Sept. 88, 3 Oct. 88, 12 Dec. 88.</td>
</tr>
</tbody>
</table>

Meiogram (Fig. 1A) and M I (Fig. 4A): $8 + X_Y_p$. Despite the relatively large size of the autosomes, their bivalents depend typically on a single chiasma. The nonchiasmate arms condensate, in the common coleopteran fashion, to a dense knob laterally from the centromere. Thus, all autosomes look metacentric. Karyogram: $2n = 18(X, Y)$ (Fig. 6A). All autosomes are metacentric.

Chalepus sanguinicollis (Linnaeus) (Hispinae, Chalepini). This species has been reported from North America (Florida), the West Indies and South America (Wilcox 1975), and was noted from Puerto Rico by Sanderson (1967). Apparently, it occurs at all elevations and is more common than S. mantecada. Martorell (1976) mentions Crotalaria spp. (Fabaceae) and Terminalia catappa L. (Combretaceae) as probable host plants; however, similar species in the genus are known to breed in grasses (Poaceae). Sanderson (1967) associated adults with Sorghastrum setosum (Griseb.) Hitchc. and Trichachne insularis (L.) Nees [= Digitaria insularis (L.) Mez et Ekman] (both grasses) on Jamaica and Haiti, respectively. Our cytological observations are based on six males collected on unidentified low vegetation near Tortuguero lagoon, Vega Baja, and in Yabucoa.

Meiogram (Fig. 1B) and M I (Fig. 4B): $8 + X_Y_p$. Similar to that of S. mantecada, but with as many as three bichiasmate ring bivalents observed. One tetraploid spermatocyte was encountered at PM I (Fig. 4C). As expected, the low chiasma frequency has prevented autosomal multivalents. The state of the sex chromosomes is of special interest. We interpret it as $XX_p + Y_Y_p$. Both X chromosomes show an undercondensed arm (Virkki et al. 1990) and are associated in the parachute fashion and not as a regular bivalent.

Hilarocassis exclamationis (Linnaeus) (Cassidinae, Stolaini). This species is known from North America (Arizona), the West Indies, Central and South America (Werner 1960). Hilarocassis exclamationis is included in the chromosome lists of Dey (1986, as Mesomphalia) and Petitpierre et al. (1988, as Stolas). These preliminary records give meioformula $16 + X_Y_p$ for the species. Martorell (1976) mentions unidentified bushes and trees as possible host plants, but this species probably restricts its feeding to the Convolvulaceae. Hilarocassis exclamationis was found feeding on an unidentified convolvulacean (probably Jacquemontia sp.) at Vega Baja. It is a widely distributed species in Puerto Rico. Our karyotyped material consists of eight males collected from unidentified low vegetation both in mountains and dry lowlands and on Mona.

Meiogram (Fig. 2A) and M I (Fig. 4D): $16 + X_Y_c$. The high autosomal number and the rare central association mode of the sex chromosomes ($X_Y_c$; Smith and Virkki 1978) are most noteworthy features. A careful study of the prophase might reveal just an $X_Y_p$ where the y chromosome is unusually large.

Figs. 5–6. 5, Chromosomes of Agroiconota propinqua. Phase contrast; arrow shows Xy, bivalent, arrowhead the y chromosome. 1,860×. A, Spermatogonial prometaphase, 2n = 38(X, y) (Fajardo, 4 Nov. 74). B, M I, 18 + Xy, (Dorado, 6 Jan. 86). 6, Karyograms of three species. A. Scloenopla mantecada, 2n = 18(X, y) (Jajome, 7 May 90). B, Agroiconota propinqua, 2n = 38(X, y) (Fajardo, 4 Oct. 74). C, Deloyala guttata, 2n = 20(X, y) (Isabela, 29 Dec. 87).

The terminalization of the only chiasma is somewhat retarded because cross bivalents can still be encountered at PM I and M I.

Chelymorpha multipunctata (Olivier) (Cassidinae, Stolaini). This species is distributed through the West Indies, but is not very common in Puerto Rico.

Its host plants in Puerto Rico are *Ipomoea* spp. (Convolvulaceae). Sporadic associations with other plants, probably not hosts, have been recorded (Martorell 1976). Our study material consists of two males swept from *Ipomoea* sp. near Tortuguero lagoon, Vega Baja.

Meiogram (Fig. 2B) and MI (Fig. 4E): 10 + Xyp. At least, six or seven autosomes are metacentric and up to three ring bivalents may occur.

**Physonota (Eurypepla) jamaicensis (Linnaeus)** (Cassidinae, Physonotini). This species is listed as *Eurypepla jamaicensis* from Jamaica (Wilcox 1975). *Physonota jamaicensis* is included in Dey (1986) and in the chromosome list of Petitpierre et al. (1988). In June 1985, *Cordia* sp. (Boraginaceae) trees were encountered heavily infested by this large and beautiful cassidine in southern Culebra. This is the first member of the Physonotini examined for karyotype determination, and its discovery in Puerto Rico constitutes a new record of chrysomelid for that island. Fifteen males were examined for karyotype study.

Meiogram (Fig. 3) and MI (Fig. 4F): 8 + Xyp. This is the lowest chromosome number among Puerto Rican Cassidinae. No prominent metacentry could be detected in the autosomes.

**Agroiconota propinqua (Boheman)** (Cassidinae, Cassidini). Recorded for Central America, Hispaniola and South America as *Metriona propinqua* Boheman (Wilcox 1975). This beetle feeds on *Ipomoea* spp., including sweet potato. Six males were studied.

Meiogram (Fig. 7A) and MI (Fig. 5B): 18 + Xyp. This is the largest chromosome number among Puerto Rican Cassidinae. At least, the four largest chromosomes are metacentric and potential ring bivalent formers. Karyogram (Fig. 6B) and spermatogonial prophase (Fig. 5A): 2n = 38(X, y). Metacentry is feasible in most chromosomes.

**Deloyala guttata** (Olivier) (Cassidinae, Cassidini). This species is widely distributed in the Americas and occurs principally on *Ipomoea* spp., including sweet potato (Martorell 1976). Twelve males were examined.

Meiogram (Fig. 7B) and MI (Fig. 8A): 9 + Xyp. All autosomes look about the same relatively large size and metacentric. Karyogram (Fig. 6C) and spermatogonial mitosis (Fig. 8B) show 2n = 20(X, y). A Canadian population of putatively the same species has one less autosomal pair (Smith and Virkki 1978).

**Charidotella (s. str.) quadrisignata** (Boheman) (Cassidinae, Cassidini). Wilcox (1975) lists this species in *Metriona* and gives Cuba and Puerto Rico as the distribution. Wolcott (1948) also mentions it from Puerto Rico. This species is probably monophagous, feeding on *Jacquemontia pentandra* (Jacq.) G. Don. (Convolvulaceae). Fifteen males were studied.

Meiogram (Fig. 7C) and diakinesis (Fig. 8C): 11 + Xyp. At least, the five largest autosomes are potential ring bivalent formers.

**Charidotella (s. str.) sexpunctata** (Fabricius) (Cassidinae, Cassidini). This species ranges from Canada to Argentina and, until recently, was known in North America as *Metriona bicolor* (Fabricius) and in Central America as *M. trisignata* (Boheman). It has a long list of synonyms (see Borowiec 1989). This is the first record of this species for the West Indies. Smith (1960) and Nowlin (1906) reported, under synonyms, 2n = 22, 10 + Xy, and 2n = 22, 10 + Xy, respectively. This species is a potential pest of sweet potato in Puerto Rico. We have collected it on wild *Ipomoea* sp. near Tortuguero lagoon. Twelve males were studied.

Meiogram (Fig. 7D) and MI (Fig. 8C): 10 + Xyp. Except for their number, the autosomal bivalents look similar as in *C. quadrisignata*. 
Meioformulas $7 + X_{yp}$ and $8 + X_{yp}$, corresponding to $2n = 16(X, y)$ and $2n = 18(X, y)$, respectively, occur in such high frequency in the Hispinae and the Cassidinae that they have been inferred relatively ancestral for these subfamilies and perhaps for their common ancestors (Stevens 1980; Petitpierre et al. 1988). The presence of both meioformulas in the Old and the New World genera is congruent with this view. One or two centric fusions of acrocentrics (= Robertson’s Law), or more likely, of diphasic metacentrics (Smith and Virkki 1978; Virkki 1984) may have brought the basic Polyphagan number (nine pairs) down to eight or seven pairs.

The cytological results with the two hispine species fit well with the current knowledge for the subfamily. On the other hand, the cassidine modal meioformula $8 + X_{yp}$ occurs only in *P. jamaicensis*, thus reinforcing to the general impression that cassidines are chromosomically more variable than hispines (Alegre and Petitpierre 1984).

**Evidence for autosomal fission.** Although seven or eight autosomal pairs seem to be a conservative and ancestral karyotypic character for these two families, there is a tendency for increased numbers, a maximum of 24 autosomal pairs in *Botanochara angulata* (Vaio and Postiglioni 1974). The few species with meioformula $9 + X_{yp}$ may represent a step towards an increase in chromosome number rather than the basic Polyphagan condition. Two Australian hispines [*Uroplata girardi* Pic and *Octotoma scabripennis* Guérin-Méneville] (Yadav and Pillai 1974) and five cassidines [three Old World *Cassida*, *C. vibex* Linnaeus (Petitpierre 1977), *C. vittata* Villers (Petitpierre 1985), *Cassida* sp. (Sharma and Sood 1978) and two New World ones, *Eurypedus oblonga* (Sturm) (Vidal 1984) and *Deloyala guttata* (this study)] show that condition.

Several cassidine cytologists (Vaio and Postiglioni 1974; Yadav and Pillai 1975; Petitpierre 1977; Mazzella and Panzera 1983; Panzera et al. 1983) refer to the problem of prevailing metacentry in the supposed fission karyotypes. The problem is common in Coleoptera (Smith and Virkki 1978) and the Puerto Rican cassidines with unusually large autosome numbers are no exception to it. There is evidence showing that among the chromosomes containing pericentric inversions, the most metacentric ones are favored in segregation (G. Foster, in Borstel 1988) but it is unknown whether similar causes function and are sufficient to turn the centric fission products to metacentrics in beetles. Such secondary metacentrics may undergo a new fission-inversion history, further increasing the number and decreasing the size of the autosomes. Such secondary fission series is suspected for *Botanochara* (Mazzella and Panzera 1983).

The Cassidini, with modal meioformula $8 + X_{yp}$, is the best karyotypically studied group of the Cassidinae. The highest counts have been obtained in three noncongeneric species: $18 + X_{yp}$ in *Agroiconota propinquia* (this study) and *Oecassida pudibunda* (Boheman) (Sharma and Sood 1978) and $18 + neoXY$ in *Cassida subferruginea* Schrank (Petitpierre 1985). In the latter, the preceding meioformula has almost certainly been $19 + X_{yp}$. Thus fission, and perhaps secondary fission series, has advanced almost as far as in the Stolaini, where $9 + X_{yp}$ or lower meioformulas have not been reported yet.

Wide discrepancies within inferred ancestral cassidine taxa suggest rapid successions of fissions, not only in *Botanochara* spp. (Stolaini), but also in *Chirida* spp. (Cassidini) (Dasgupta and Chakravarti 1972; Dasgupta 1973).
where $8 + X_y$ and $17 + X_Y$ occur; in *Cassida viridis*, northern and southern race (= sibling species?), with meioformulas $11 + X_y$ and $14 + X_y$ respectively (Petitpierre 1977, 1985); and in *D. guttata*, for which Smith (1960) reported $8 + X_y$ from North American material and for which we have determined $9 + X_y$. A similar process may have occurred in the Hispinae. For example, *Dicladispa armigera* (Olivier) (possibly misidentified) have five and eight pairs, respectively, of autosomes (Saha and Sood 1978, 1979). Such supernumeraries could contribute to enlargement of regular chromosomes through translocations.

**Derived sex chromosome systems.** The sex chromosome system is even more conservative than the autosomal number in these two subfamilies where the inferred ancestral Polyphagan $X_y$ prevails. The only known exception among Hispinae is $8 + neoXY$ in *Lesiochila excavata* (Baly) (misspelled in Dey 1986 as *Lesiochila* in the Cassidinae). This novel system is shared by one Cassidini, *C. subferruginea* (18 + neoXY, Petitpierre 1985). Apart from the Uruguayan *Botanocarha* spp., where some of the most complicated sex chromosome systems have been found and interpreted (Vaio and Postiglioni 1974; Mazzella and Panzera 1983; Panzera et al. 1983), the deviations from the $X_y$ have been minor. The Argentinian *Botanocarha duodecimverrugata* (Boheman) lacks a Y chromosome (15 + XO, Vidal 1984). The stolaine *H. exclamationis* (this study) and the aspidomorphine *Laccoptera quadrimaculata* (Thunberg) (Dey 1986) have 16 + $X_y$, and $8 + X_y$, respectively. In both cases, the $y$ chromosome is unusually large and may mask $X_y$ or neoXY conditions.

Extra $y_p$ chromosomes have been reported in four species of Cassidiniae: *Chirida* sp., *Cassida circumdata* (Herbst) (Yadav and Pillai 1975), and *C. enervis* Boheman and *L. quadrimaculata* (Sharma and Sood 1978). Since Shaw’s (1968) study on the accumulation of $y_p$ chromosomes, frequent reports on naturally occurring $Xy_y$ conditions have been published. Following up the formation of $X_y$ bivalent in curculionids, Virkki et al. (1990) show that a segment separated by decondensation from the main body of $X$ approximates the chromosome in late prophase $X_y$’s. This resembles $Xy_y$, always when the segment and $y_p$ are of similar size. Thus, observation of A I segregation and M II may be necessary to confirm the true $Xyy_p$ conditions.

Little is known on pairing of extra $X_p$ chromosomes in male meiosis. Two $X$ chromosomes, supposedly fission products of a larger, original $X_p$, organize a relatively well functioning $X, X, y_p$ in the *Monochamus scutellatus oreogonensis* (LeConte) (Cerambycidae) species complex (Lanier and Raske 1970). We have interpreted the sex chromosome case in a tetraploid spermatocyte of *Chalepus sanguinicollis* (Fig. 4C) as $XX_p + y_p$, meaning that the homologous $X$ chromosomes have paired in the parachute fashion, outcrowning the $y_p$ from the parachute. Because the organization of a parachute requires incorporation of an adhesive (Virkki et al. 1990), the function of $X$ chromosomes differs from that in oogenesis, where the $X$ chromosome conjugation should be comparable to conjugation of autosomes.

*Charidotella sexpunctata* is a potential pest of *Ipomoea batatas* (L.) Lam. (sweet potato) in Puerto Rico because, as with several other cassidines, it is known to attack this crop in the United States (Walsh and Riley 1869). Another cassidine in the sweet potato guild, *D. guttata*, differs in autosomal number from its North American conspecific. This difference should be examined more carefully as it may have interesting taxonomic and practical implications.
Literature Cited


Systematics Agenda 2000

A new initiative in systematics, Systematics Agenda 2000, has been organized to 1) identify important research trends and questions in systematics, and establish priorities among them, 2) assess the present infrastructures supporting systematics research and evaluate future needs, and 3) document the broad role that systematics plays in human affairs and evaluate its future contributions and needs in these endeavors. Twenty-eight committees have been set up to address these objectives.

A detailed description of the project, as well as a list of the members of the steering committee and the co-chairs of the committees, is given in the journal Cladistics, Systematic Botany, and Systematic Zoology, No. 4, 1991. All interested parties are invited to contribute to the effort. (See ASC meeting notice.)

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