



## CHROMOSOMES IN SPIDER MITES (TETRANYCHIDAE-ACARI)

BY H. BOLLAND<sup>1</sup>, J. GUTIERREZ<sup>2</sup> AND W. HELLE<sup>1</sup>

### KARYOTYPES TAXONOMY

ABSTRACT : The chromosomes of fifteen tetranychid species were studied in embryonic tissue cells in acetic-orcein squashes. All bisexual species exhibit a haplo-diploid sex determination, resulting from arrhenotokous parthenogenesis. The taxonomic significance of karyotype information is discussed in relation to the genera *Oligonychus* and *Tetranychus*. A diploid number of  $2n = 8$  occur in *Tetranychina moutiai*, *Oligonychus gramineus*, *O. leandrianae*, *O. plegas*, *Tetranychus fijiensis* and *T. marianae*; of  $2n = 6$  in *Schizotetranychus reticulatus*, *Eotetranychus uncatus*, *Oligonychus thelytokus*, *Tetranychus lambi*, *T. lombardinii*, *T. macfarlanei*, *T. yusti* and *T. lintearius*; of  $2n = 4$  in *Eutetranychus africanus*.

### CARYOTYPES TAXONOMIE

RÉSUMÉ : Les caryotypes de quinze espèces de tétranyques ont été étudiés, à partir de cellules de tissu embryonnaire écrasées et traitées à l'acéto-orceine. Chez toutes les espèces où mâles et femelles sont représentés, la détermination du sexe résulte de la parthénogenèse haploïde arrhénotoque. La valeur de l'information apportée à la taxonomie par la détermination du nombre de chromosomes, est discutée pour les genres *Oligonychus* et *Tetranychus*. Un nombre diploïde de  $2n = 8$  a été trouvé chez *Tetranychina moutiai*, *Oligonychus gramineus*, *O. leandrianae*, *O. plegas*, *Tetranychus fijiensis* et *T. marianae*;  $2n = 6$  chez *Schizotetranychus reticulatus*, *Eotetranychus uncatus*, *Oligonychus thelytokus*, *Tetranychus lambi*, *T. lombardinii*, *T. macfarlanei*, *T. yusti*;  $2n = 4$  chez *Eutetranychus africanus*.

### INTRODUCTION

Chromosome data and types of parthenogenesis of tetranychid mites have been presented for 63 species in previous studies (HELLE & BOLLAND, 1967, 1972; HELLE et al., 1970; GUTIERREZ et al., 1970 and 1979; GUTIERREZ & HELLE, 1971; GUTIERREZ & BOLLAND 1973 a/b). In the present work the data for 15 other tetra-

nanychid species are given, viz. for *Tetranychina moutiai* (B & P), *Eutetranychus africanus* (Tucker), *Schizotetranychus reticulatus* P & B, *Eotetranychus uncatus* Garman, *Oligonychus gramineus* (McGregor), *O. leandrianae* Gutierrez, *O. plegas* B & P, *O. thelytokus* Gutierrez, *Tetranychus fijiensis* Hirst, *T. marianae* McGregor, *T. lambi* P & B, *T. lombardinii* B & P, *T. macfarlanei* B & P, *T. yusti* McGregor, *T. lintearius* Dufour.

O.R.S.T.O.M.

1. Laboratory of Experimental Entomology, Kruislaan 302, 1098 SM Amsterdam, the Netherlands.
2. Centre ORSTOM, B.P. A5, Noumea, New Caledonia.

Acarologia, t. XXII, fasc. 3, 1981.

Fonds Documentaire

N° : 82/81/01062

Cote : B-... e1

Date : 23 MARS 1982

MATERIAL AND METHODS

Karyotype examinations were performed on eggs containing undifferentiated embryonic tissue. An intact egg is placed on a slide with a droplet of 1 % sodium acetate. After one minute, the sodium acetate is removed by a droplet of a 1 % aceto-orcein stain. By pressing slightly on the coverglass, the egg is broken. After a staining period ranging between 5 and 10 minutes, the egg is firmly squashed. Permanent preparations were obtained by using Euparal.

The species *Eutetranychus africanus*, *Eotetranychus uncatatus*, *Oligonychus gramineus*, *O. thelytokus*, *Tetranychus fijiensis*, *T. marianae*, *T. lambi*, *T. lombardinii*, *T. macfarlanei*, *T. yusti* and *T. lintearius* were maintained on detached leaf cultures. For karyotype examination eggs were taken from these cultures. By isolating female teleiochysalids on detached leaf cultures, the sex of the partheno-produced offspring of virgin females could be assessed. The species *Tetranychina moutiai*, *Schizotetranychus reticulatus*, *Oligonychus leandrianae* and *O. plegas*

were not reared in the laboratory. Fertilized females from these species collected in the field were maintained for some days in perspex cells adjusted to the leaves of the original host plant. Eggs deposited in the cells were used for examination.

RESULTS

The results are presented in table 1; photomicrographs are given in plate 1. The chromosomes of all species examined do not display peculiarities of characteristics in shape or size: all chromosomes in metaphase are ranging in length between 1 and 2  $\mu$ m. Virgin females of the species *Eut. africanus*, *Eot. uncatatus*, *O. gramineus*, *T. fijiensis*, *T. marianae*, *T. lambi*, *T. lombardinii*, *T. macfarlanei*, *T. yusti* and *T. lintearius* produce exclusively male offspring; this was ascertained for a minimum number of 20 eggs per species. The parthenogenetic offspring of *O. thelytokus* is entirely of the female sex.

TABLE 1. — Chromosomes of 15 species of Tetranychidae.

Species	Chromosome number		Sex of offspring from virgin females	Number of eggs examined	locality	Host plant
	2n	n				
<b>BRYOBIINAE</b>						
<i>Tetranychina moutiai</i> (B & P)	8	4	—	13	Mauritius	<i>Verbena bonariensis</i> (L.)
<b>TETRANYCHINAE</b>						
<i>Eutetranychus africanus</i> (Tucker)	4	2	♂	15	Mauritius	<i>Citrus</i> sp.
<i>Schizotetranychus reticulatus</i> P & B	6	3	—	9	Madagascar	<i>Grewia andramparoi</i> Vig.
<i>Eotetranychus uncatatus</i> Garman	6	3	♂	13	The Netherlands	<i>Malus</i> sp.
<i>Oligonychus gramineus</i> (McGregor)	8	4	♂	22	New Caledonia	<i>Panicum maximum</i> Jacq.
<i>O. leandrianae</i> Gutierrez	8	4	—	8	Madagascar	<i>Brachiaria leandriana</i> J. Bosser
<i>O. plegas</i> B & P	8	4	—	3	Mauritius	<i>Cocos nucifera</i> L.
<i>O. thelytokus</i> Gutierrez	6	—	—	15	Madagascar	<i>Terminalia catappa</i> (L.)
<i>Tetranychus fijiensis</i> Hirst	8	4	♂	50	New Caledonia	<i>Dysoxylum</i> sp.
<i>T. marianae</i> McGregor	8	4	♂	10	New Caledonia	<i>Hibiscus</i> sp.
<i>T. lambi</i> P & B	6	3	♂	11	New Caledonia	<i>Manihot utilissima</i> Pohl.
<i>T. lombardinii</i> B & P	6	3	♂	50	Kenya	<i>Irisine herbstii</i> Hook.
<i>T. macfarlanei</i> B & P	6	3	♂	8	Mauritius	<i>Hibiscus esculentus</i> (L.)
<i>T. yusti</i> McGregor	6	3	♂	33	Columbia	<i>Passiflora</i> sp.
<i>T. lintearius</i> Dufour	6	3	♂	21	France	<i>Ulex europaeus</i> L.

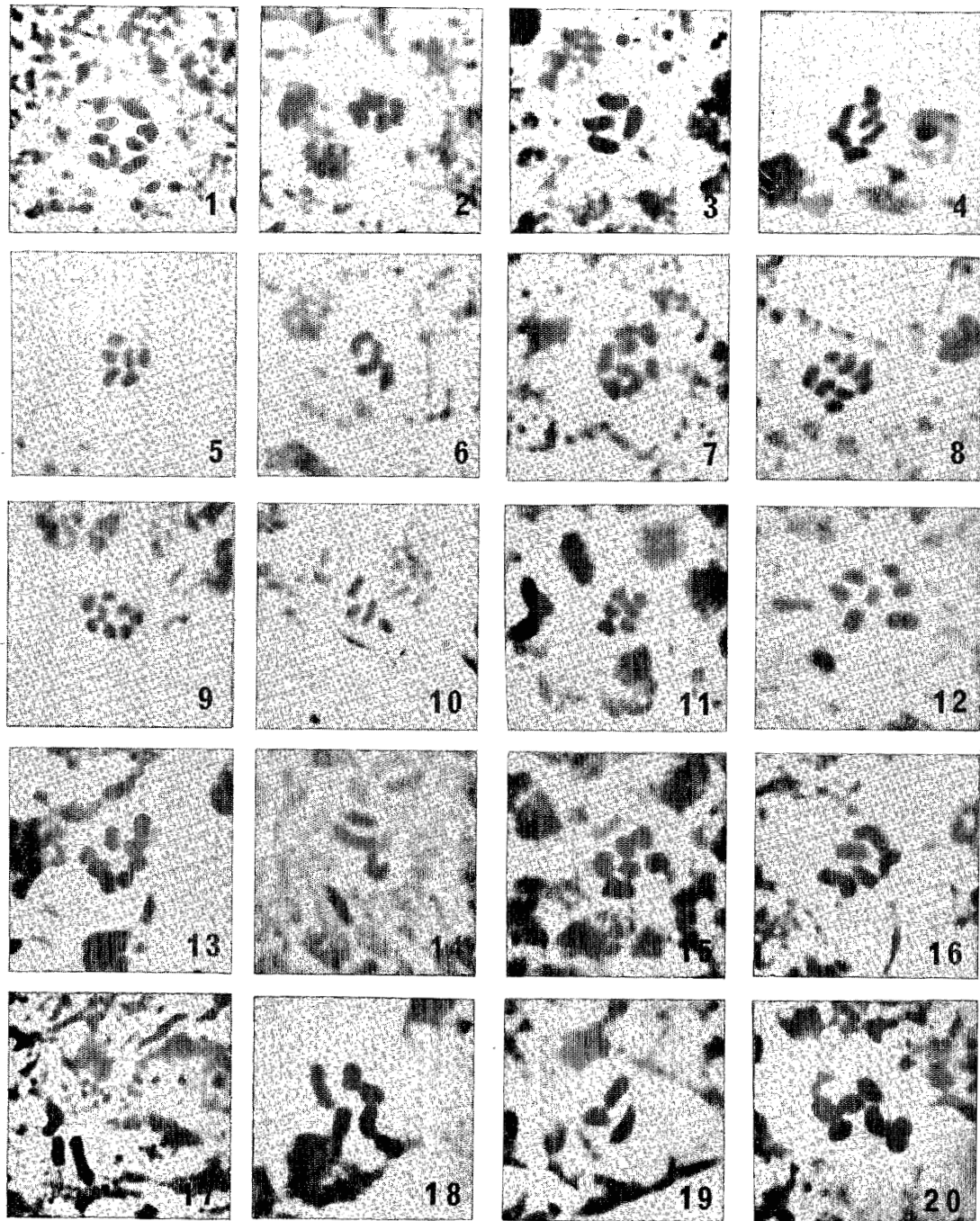


FIG. 1-20. — Photomicrographs of mitotic stages in egg squashes of different species.

1) *Tetranychina moutiai*,  $2n = 8$  (2 100  $\times$ ) ++; 2) *T. moutiai*,  $n = 4$  (2 100  $\times$ ) ++; 3) *Eutetranychus africanus*,  $2n = 4$  (2 800  $\times$ ) ++; 4) *Schizotetranychus reticulatus*,  $2n = 6$  (2 100  $\times$ ) ++; 5) *Eotetranychus uncatus*,  $2n = 6$  (2 800  $\times$ ) ++; 6) *E. uncatus*,  $n = 3$  (2 800  $\times$ ) ++; 7) *E. gramineus*,  $2n = 8$  (2 800  $\times$ ) ++; 8) *E. leandrianae*,  $2n = 8$  (2 800  $\times$ ) ++; 9) *Oligonychus plegas*,  $2n = 8$  (2 100  $\times$ ) ++; 10) *O. plegas*,  $n = 4$  (2 100  $\times$ ) ++; 11) *O. thelytokus*,  $2n = 6$  (2 100  $\times$ ) ++; 12) *Tetranychus fijiensis*,  $2n = 8$  (2 800  $\times$ ) ++; 13) *T. marianae*,  $2n = 8$  (2 800  $\times$ ) ++; 14) *T. marianae*,  $n = 4$  (2 800  $\times$ ) ++; 15) *T. lambi*,  $2n = 6$  (2 800  $\times$ ) ++; 16) *T. lombardinii*,  $2n = 6$  (2 400  $\times$ ) ++; 17) *T. macfarlanei*,  $n = 3$  (2 100  $\times$ ) ++; 18) *T. yusti*,  $2n = 6$  (2 800  $\times$ ) ++; 19) *T. yusti*,  $n = 3$  (2 800  $\times$ ) ++; 20) *T. lintearius*,  $2n = 6$  (2 800  $\times$ ).

## DISCUSSION

The results provide information for discussion of the subgeneric grouping in *Oligonychus* and *Tetranychus*. The available chromosome data for the genera *Tetranychina*, *Eutetranychus*, *Schizotetranychus* and *Eotetranychus* are too fragmentary for an appropriate discussion. The genera *Oligonychus* and *Tetranychus* have been subdivided into a number of subgenera by TUTTLE & BAKER (1968) using the integumentary striation as a main character for delineation of the taxa.

In *Oligonychus* the accumulated chromosome data involve 17 species, belonging for the greater part to the subgenera *Reckiella* and *Oligonychus s.str.* The situation in *Reckiella* is interesting since this subgenus includes two distinct groups, each characterized morphologically as well as by its host plant preferences. The first group lives on dicotyledons, and the four species examined so far have  $2n = 4$  chromosomes. The other group lives on grasses and the 8 species studied, including *O. gramineus*, *O. plegas* and *O. leandrianae*, have  $2n = 8$ . Considering the karyotypic information both groups are probably worthy of subgeneric level.

From the subgenus *Oligonychus s.str.*, three species are known to have the diploid number of 6 chromosomes (*O. coffeae*, *O. quercinus* and *O. ununguis*). The chromosome number of  $2n = 6$  for *O. thelytokus* is in agreement with the number of *O. coffeae*, being a very closely related species. In *Tetranychus*, *T. fijiensis* with  $2n = 8$  has to be separated from the subgenus *Tetranychus s.str.*, which is contrary to the views of TUTTLE and BAKER (1968). This species with typical tarsal appendages, and characteristic aedeagus should rather belong to the subgenus *Pentanychus* created by WAINSTEIN (1960). It should be noted that *T. fijiensis* is generally collected on Monocotyledones (Palmae), as the species of the subgenus *Polynychus* whose typical number is  $2n = 8$ .

The five other examined species (i.e. *T. marianae* with  $2n = 8$ ; *T. lambi*, *T. lombardini*, *T. macfarlanei* and *T. yusti* with  $2n = 6$ ) belong to the subgenus *Tetranychus s.str.* The number  $2n = 8$  of *T. marianae* is exceptional since ten species in this subgenus were already found to have  $2n = 6$ , and one (*T. tumidus*)  $2n = 12$ . *T. marianae*, however is clearly different from *Polynychus* species. *T. tumidus* exhibits possibly tetradiploidy (HELLE et al., 1970).

From the rearing experiments, it appears that in all bisexual species the parthenogenetically produced offspring are males, indicating that arrhenotoky is invariably underlying haplo-diploidy in the Tetranychidae. Both arrhenotoky and thelytoky are very common forms of parthenogenesis in the more primitive subfamily Bryobiinae. In the Tetranychinae, the other subfamily of the Tetranychidae, the species *O. thelytokus* represents a rare exception, since all other species are arrhenotokous (GUTIERREZ, 1977).

## REFERENCES

- GUTIERREZ (J.), 1977. — Un tétranyque polyphage de la zone intertropicale : *Oligonychus thelytokus* n. sp. — Cah. ORSTOM, sér. Biol., **12** : 65-72.
- GUTIERREZ (J.) & BOLLAND (H. R.), 1973a. — *Schizobolia sycophanta* Womersley (Acariens : Tetranychidae) décrit de Tasmanie est probablement originaire d'Europe. Complément de la description et étude cytogénétique. — Ent. Berich., Amsterdam, **33** : 54-60.
- GUTIERREZ (J.) & BOLLAND (H. R.), 1973b. — Description et caryotype d'une nouvelle espèce du genre *Tetranychus* Dufour (Acariens : Tetranychidae) récoltée au Tchad, sur *Dolichos lablab* L. (Papilionaceae). — Ent. Berich., Amsterdam, **33** : 155-158.

- GUTIERREZ (J.) & HELLE (W.), 1971. — Deux nouvelles espèces du genre *Eutetranychus* Banks (Acariens : Tetranychidae) vivant sur plantes cultivées à Madagascar. — Ent. Berich., Amsterdam, **31** : 45-60.
- GUTIERREZ (J.), HELLE (W.) & BOLLAND (H. R.), 1970. — Étude cytogénétique et réflexions phylogénétiques sur la famille des Tetranychidae Donnadieu. — Acarologia, **12** (4) : 732-751.
- GUTIERREZ (J.), HELLE (W.) & BOLLAND (H. R.), 1979. — Étude d'une souche de *Tetranychus piercei* (Acariens : Tetranychidae) d'Indonésie : redescription, caryotype et reproduction. — Ent. Berich., Amsterdam, **39** : 88-94.
- HELLE (W.) & BOLLAND (H. R.), 1967. — Karyotypes and sex-determination in spider mites (Tetranychidae). — Genetica, **38** : 43-53.
- HELLE (W.) & BOLLAND (H. R.), 1972. — Artificial induction of males in a thelytokous mite species by means of X-rays (Arach., Acari). — Ent. exp. appl., **15** : 395-396.
- HELLE (W.), GUTIERREZ (J.) & BOLLAND (H. R.), 1970. — A study on sex-determination and karyotype evolution in Tetranychidae. — Genetica, **41** : 21-32.
- TUTTLE (D. M.) & BAKER (E. W.), 1968. — Spider mites of Southwestern United States and a revision of the family Tetranychidae. — Univ. Arizona Press : 1-143.
- WAINSTEIN (B. A.), 1960. — Tetranychoid mites of Kazakhstan (with revision of the family) (in Russian). — Trud. Nauk. Issled., Inst. Zash. Rast., **5** : 1-276.

Paru en octobre 1981.