

Karyotype of the gall fly *Tomoplagia rudolphi* (Lutz & Lima) (Diptera, Tephritidae)

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ABSTRACT. The objective of the present study is to describe the karyotype of the fruit fly *Tomoplagia rudolphi* (Lutz & Lima, 1918). This fly induces the formation of galls on the stems of *Vernonia polianthes* (Asteraceae). The cytogenetic analysis of cerebral ganglia (larva and pupa) and testis (adults) of *T. rudolphi* showed a diploid chromosome number of $2n = 10 + XX$ (female) and $2n=10 + XY$ (male). The diploid chromosome number $2n = 12$ and the XX/XY sex determination system have been found in most of the species studied. The present investigation constitutes the first cytogenetics study of the genus *Tomoplagia* Coquillett, 1910.

KEY WORDS. Chromosome, Cyclorrhapha, cytogenetic, fruit fly, sex determination system

Species of the family Tephritidae have been extensively studied because of their economic importance, especially those belonging to the genera *Rhagoletis* Loew, 1862 and *Anastrepha* Schiner, 1868, which are important pests infesting apples and other fruits all over the world (BORROR *et al.* 1989). Other species belonging to various tephritid genera are gall inducers (MANI 1964; DREGER-JAUFFRET & SHORTHOUSE 1992). *Tomoplagia rudolphi* (Lutz & Lima, 1918) lay eggs in shoot apical meristems. Larvae feed on cells of the medullar parenchyma and gall tissue proliferates as the larvae develop, resulting in a globulous gall. Adults emerge 15 to 20 days after oviposition to begin a new reproductive cycle (ANDRADE *et al.* 1995; SILVA *et al.* 1996).

The family Tephritidae is poorly known in terms of its cytogenetics and few studies were conducted on pests species (CANOVAI *et al.* 1994; ZAMBETAKI *et al.* 1995). However, two patterns have emerged thus far and are becoming more clear. Within the family Tephritidae the diploid chromosome number of 12 is thought to be the rule and the male, the heterogametic sex (SOLFERINI & MORGANTE 1987, see table I). In the present study we examined the karyotype of the gall inducer *Tomoplagia rudolphi*. This is the first time that a study was conducted on the karyotype of a species belonging to the genus *Tomoplagia* Coquillett, 1910.

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MATERIAL AND METHODS

Species of the genus *Tomoplagia* are endemic to the Neotropical Region, and about 44 species have been described so far. *T. rudolphi* induces the production of galls in stems of *Vernonia polianthes* (Asteraceae). Galls are monothalamous presenting a variable number of larvae (SILVA *et al.* 1996). Galls of *Vernonia polianthes* Less containing larva and pupa of *T. rudolphi* were collected in three different sites in Viçosa, Minas Gerais, Brazil. Two sites were located in campus of the Universidade Federal de Viçosa, and the third one along the highway, which runs from Viçosa to Coimbra. The galls were collected randomly in each region during January and February 1996. Galls containing larvae, young pupae and adults were collected and taken to the laboratory. Slides preparation were carried out using cerebral ganglion cells of larva and pupa according to the technique of IMAI *et al.* (1988). In order to differentiate the male and female karyotypes germinative tissue from of adult males cells was also analysed. A total of 604 metaphases were obtained from 24 specimens (20 larva, 2 pupa and 2 adults) found in 14 galls from three different populations were analysed. Chromosomes were cut out and mounted in decreasing order of size and the morphology was classified according to the nomenclature by LEVAN *et al.* (1964).

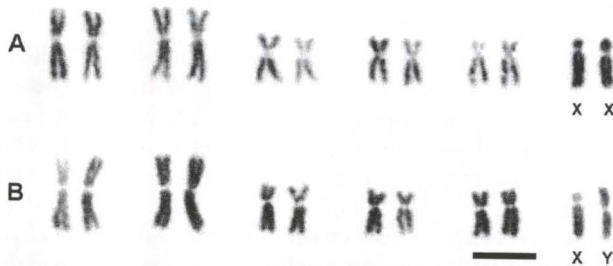


Fig. 1. Karyotype of *Tomoplagia rudolphi*, $2n=12$ chromosomes. (A) female; (B) male. Bar=5 μ m.

RESULTS AND DISCUSSION

All individuals of *Tomoplagia rudolphi* presented the diploid chromosome number $2n = 12$ chromosomes. With the analysis of pupa and larva, two karyotypes were detected. The first consisted of 12 submetacentric chromosomes, and second consisted of 11 submetacentric chromosomes, and one metacentric chromosome (Fig. 1). Male germ cells presented the metacentric chromosome showing that the male is the heterogametic sex. On basis in this observations the sex determination system in *T. rudolphi* is XX in the female (Fig. 1A) and the XY in the male (Fig. 1B). The present study agrees with previous reports, which showed that in the family Tephritidae the diploid chromosome number is $2n = 12$ (Tab. I). Only two species did not present $2n = 12$ chromosomes, *A. pickeli* Lima, 1934 ($2n = 8$) and *R. meigenii* (Loew, 1844) (male $2n = 9$; female $2n = 10$), and the males of *A. bistrigata* Bezzi,

1919 and *A. serpentina* (Wiedemann, 1830) ($2n = 11$). The most frequent sex determination system is XX/XY found in 13 out of 17 species. In only three species it was found a different sex determination system. *A. bistrigata* and *A. serpentina*, ($X_1X_1X_2X_2/X_1X_2Y$), *R. meigenii* (XX/X0) and no sex chromosome was detected in *Rhagoletis berberidis* Jermy, 1961 (Tab. I).

Table I. Diploid number and sex determination systems of Tephritidae species.

Species	Chromosome number (2n)		Sex determination system		Authors
	Male	Female	Male	Female	
<i>Anastrepha barnesi</i> Aldrich, 1925	12	12	XX	XX	SOLFERINI & MORGANTE (1987)
<i>A. bistrigata</i> Bezzi, 1919	12	11	X1X1X2X2	X1X2Y	SOLFERINI & MORGANTE (1987)
<i>A. fraterculus</i> (Wiedemann, 1830)	12	12	XX	XY	SOLFERINI & MORGANTE (1987)
<i>A. obliqua</i> (Macquart, 1835)	12	12	XX	XY	SOLFERINI & MORGANTE (1987)
<i>A. pickeli</i> Lima, 1934	08	08	XX	XY	SOLFERINI & MORGANTE (1987)
<i>A. pseudoparallela</i> (Loew, 1873)	12	12	XX	XY	SOLFERINI & MORGANTE (1987)
<i>A. serpentina</i> (Wiedemann, 1830)	12	11	X1X1X2X2	X1X2Y	SOLFERINI & MORGANTE (1987)
<i>A. striata</i> Schiner, 1868	12	12	XX	XY	SOLFERINI & MORGANTE (1987)
<i>Bactrocera oleae</i> (Gmelin, 1790)	12	12	XX	XY	MAVRAGANI-TSIPIDOU <i>et al.</i> (1992)
<i>Ceratitis capitata</i> (Wiedemann, 1824)	12	12	XX	XY	ZACHAROPOULOU (1987)
<i>Rhagoletis berberidis</i> Jermy, 1961	12	12	*		BUSH & BOLLER (1977)
<i>R. cerasi</i> (Linnaeus, 1758)	12	12	XX	XY	BUSH & BOLLER (1977)
<i>R. meigenii</i> (Loew, 1844)	10	09	XX	X0	BUSH & BOLLER (1977)
<i>Tomoplagia rudolphi</i> (Lutz & Lima, 1918)	12	12	XX	XY	Present Study
<i>Trupanea chrysanthemifolli</i> Frias, 1985	12	12	XX	XY	FRIAS (1985)
<i>T. foliosi</i> Frias, 1985	12	12	XX	XY	FRIAS (1985)
<i>T. thuriferae</i> Frias, 1985	12	12	XX	XY	FRIAS (1985)

(*) Sex chromosomes not identified.

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REFERENCES

- ANDRADE, G.I.; I.M. SILVA; G.W. FERNANDES & V.L. SCATENA. 1995. Aspectos biológicos das galhas de *Tomoplagia rudolphi* (Diptera: Tephritidae) em *Vernonia polyanthes* (Asteraceae). **Rev. Brasil. Biol.** **55**: 819-829.
- BORROR, D.J.; C.A. TRIPLEHORN & N.F. JOHNSON. 1989. **An introduction to the study of insects**. Philadelphia, Saunders College, XIV+875p.
- BUSH, G.L. & E. BOLLER. 1977. Chromosome morphology of the *Rhagoletis cerasi* species complex (Diptera, Tephritidae). **Ann. Ent. Soc. Amer.** **70**: 316-318.
- CANOVAI, R.; B. CATERINI; L. CONTADINI & L. GALLEN. 1994. Karyology of the medfly *Ceratitis capitata* (Wied.) mitotic complement: ASG bands. **Caryologia** **47**: 241-247.
- DREGER-JAUFFRET, F. & J.D. SHORTHOUSE. 1992. Diversity of gall-inducing insects and their galls, p.8-33. In: J.D. SHORTHOUSE & O. ROHFRITSCH (Eds). **Biology of insect-induced galls**. New York, Oxford University, X+275p.
- FRIAS, D.L. 1985. Cuatro nuevas especies chilenas del genero *Trupanea* Shrank (Diptera, Tephritidae). **Revta bras. Zool.** **2**: 363-381.

- IMAI, H.T.; R.W. TAYLOR; M.W.J. CROSLAND; H.R. & H.R. CROZIER. 1988. Modes of spontaneous chromosomal mutation and karyotype evolution in ants with reference to the minimum interaction hypothesis. **Jpn. Jour. Genet.** **63**: 159-185.
- LEVAN, A.; K. FREDGA & A.A. SANDBERG. 1964. Nomenclature for centromeric position on chromosomes. **Hereditas** **52**: 201-220.
- MANI, M.S. 1964. **Ecology of Plant Galls**. The Hague, W. Junk, V+640p.
- MAVRAGANI-TSIPIDOU, P.; G. KARAMANLIDOU; A. ZACHAROPOULOU; S. KOLIAIS & C. KASTRITSIS. 1992. Mitotic and polytene chromosome analysis in *Dacus oleae* (Diptera: Tephritidae). **Genome** **35**: 373-378.
- SILVA, I.M.; G.I. ANDRADE; G.W. FERNANDES & J.P.L. FILHO. 1996. Parasitic relationships between a gall-forming insect *Tomoplagia rudolphi* (Diptera: Tephritidae) and its host plant (*Vernonia polyanthes*, Asteraceae). **Ann. Bot.** **78**: 45-48.
- SOLFERINI, V.N. & J.S. MORGANTE. 1987. Karyotype study of eight species of *Anastrepha* (Diptera: Tephritidae). **Caryologia** **40**: 229-241.
- ZACHAROPOULOU, A. 1987. Cytogenetic analysis of mitotic and salivary gland chromosomes in the Medfly *Ceratitis capitata*. **Genome** **29**: 67-71.
- ZAMBETAKI, A.; K. KLEANTHOUS & P. MAVRAGANI-TSIPIDOU. 1995. Cytogenetic analysis of malpighian tubule and salivary gland polytene chromosomes of *Bactrocera oleae* (*Dacus oleae*) (Diptera: Tephritidae). **Genome** **38**: 1070-1081.

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