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RESEARCH ARTICLE

KARYOTYPIC STUDIES IN FIVE SPECIES OF *CHAETOSIPHON* FROM SHIMLA

KAMLESH KUMARI AND D. C. GAUTAM*

Department of Biosciences, Himachal Pradesh University, Shimla 171 005, India

*For correspondence. Email: dcgautam_hpu@hotmail.com

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SUMMARY

Karyotypic studies on 5 species belonging to aphid genus *Chaetosiphon* infesting rose plants of Shimla Hills were made. These species are, *C. fragaefolii* (2n = 12, 13 and 14), *C. glabrum* (2n = 12), *C. gracilicorne* (2n = 16), *C. tetrarhodum* (2n = 14 and 16) and *C. thomasi* (2n = 12). The diploid chromosome number in these species ranged from 2n = 12 to 16. Chromosomes are holocentric. Chromosome lengths were measured at metaphase stage and total complement length as well as relative lengths of chromosomes were calculated. Idiograms were constructed based on relative length data.

Keywords: *Chaetosiphon*, holocentric chromosomes, karyotypes, idiograms.

INTRODUCTION

Aphids (Hemiptera:Aphididae), with a recorded diversity of about 5000 species in about 500 presently accepted genera on about 87000 plant species, are small, soft-bodied insects with sucking mouth parts that feed mainly on phloem (Blackman & Eastop 2000, 2006, Remaudiere & Remaudiere, 1997). Aphids are considered as economically important, often invasive pests threatening the agricultural ecosystems throughout the world (Blackman & Eastop 2006). Findings of various workers show that in many species, karyotype variations occur as a result of fusion or dissociation of chromosomes which lead to continuous evolution of new biotypes (Blackman 1980, Gautam et al. 1993a, b, Gautam & Dutta 1994).

Rose is one of the most beautiful ornamental flowers in the world and is universally acclaimed as the "Queen of flower" (Datta 1997). Rose is attacked by numerous pests, amongst them, aphids are considered as a major pest. Severe infestations of aphids result in curling of leaves upward and in some cases small plants die. Since rose aphids are of particular importance because of their economic damage, an attempt has been made to throw light on their chromosomes and record karyotypic variations if any, in colourful biotypes of rose aphids from Shimla Hills.

Chaetosiphon includes about 20 species mostly associated with Rosaceae and belongs to family Macrosiphini. The present paper deals with the karyotypic analyses of 5 species of *Chaetosiphon* viz. C. *fragaefolii* (Cockerell), *C. glabrum* David, Rajasingh and Narayanan, *C. gracilicorne* David, Rajasingh and Narayanan, *C. tetrarhodum* (Walker) and *C. thomasi* Hille Ris Lambers.

MATERIALS AND METHODS

Rose plants from different localities of Shimla (31.10°N latitude, 77.17°E longitude) were screened for aphids and different species of *Chaetosiphon* were collected. For each sample collected, information pertaining to host plant, month and year and place of collection were recorded (Table 1).

TABLE 1: Aphid species along with host plant, month and year and place of collection.

Species	Host plant	Month and year of collection	Place of collection
C. fragaefolii	*Rosa* sp.	October, 2015	Mashobra, Shimla
C. glabrum	*Rosa* sp.	April, 2016	Summer Hill, Shimla
C. gracilicorne	*Rosa* sp.	November, 2015	Potter Hill, Shimla
C. tetrarhodum	*Rosa* sp.	October, 2015	Mashobra, Shimla
C. thomasi	*Rosa* sp.	May, 2015	Chailly, Shimla

For chromosomal studies, the embryos were taken out by puncturing the posterior end of the abdomen of an adult parthenogenetic female aphid. The embryos were pretreated in 0.7% sodium citrate solution for 30 min. The pretreated embryos were fixed in 1:3 acetic-ethanol solution for about 15 to 20 min at room temperature. After fixation, embryos were squashed on a glass slide in a drop of 45% acetic acid for 3 to 5 min and stained with 2% Giemsa for about 25 to 30 min followed by mounting in DPX.

The slides were observed under research binocular microscope and photomicrographs were taken. Well spread metaphase plates were selected for chromosomal measurements. Actual lengths of chromosomes were measured using ocular micrometer. From actual lengths, the total complement length (TCL) was calculated for each species. From actual length data, the relative lengths of chromosomes were calculated. Karyotypes were prepared by arranging the chromosomes in decreasing order of their lengths and idiograms were constructed by using haploid complements. Chromosome pairs can be categorized into long, medium and short by comparing idiograms as well as by analysis of morphometric data (relative lengths of chromosomes) of individual chromosome pairs which showed considerable differences among them.

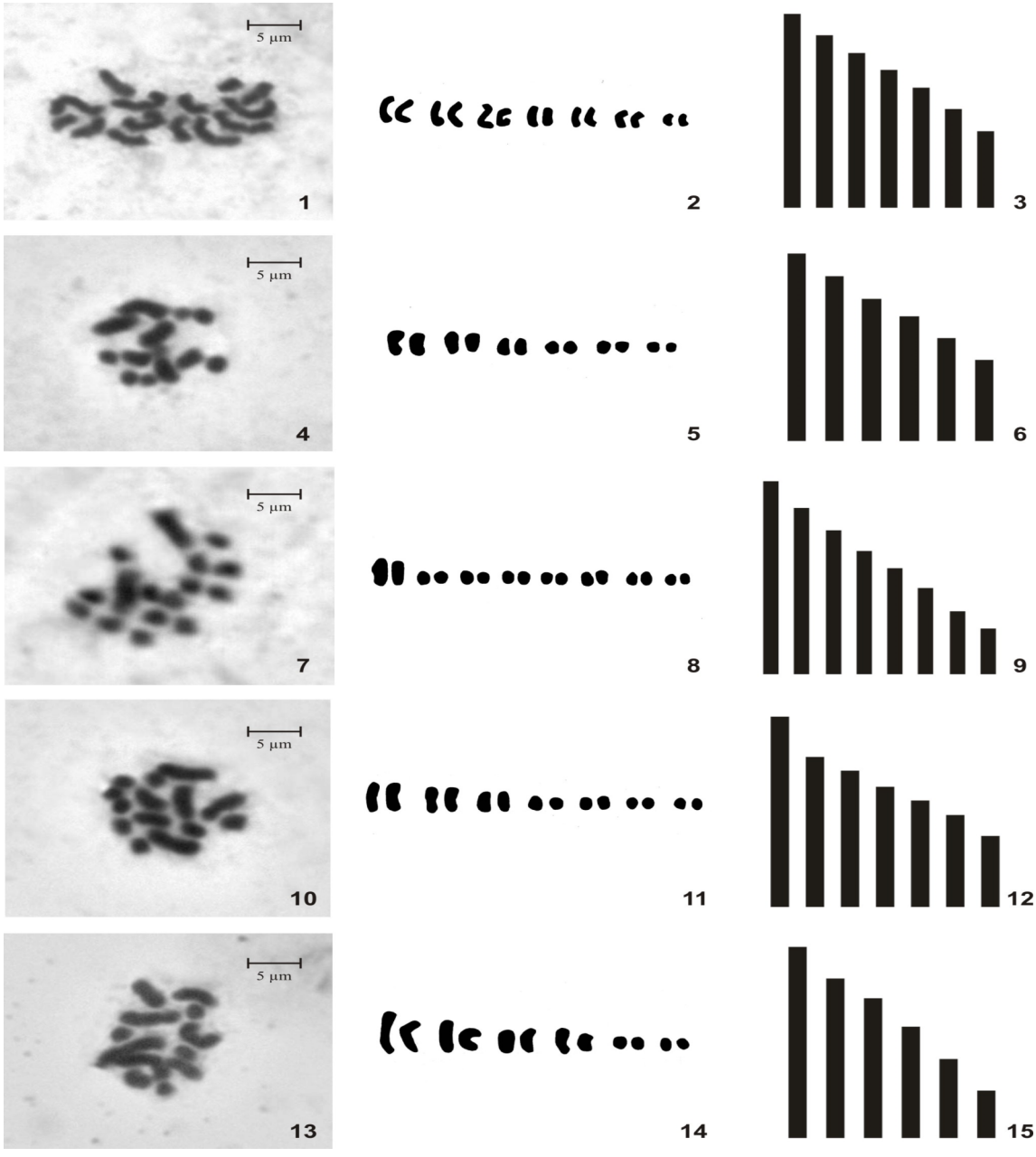
For identification of aphid species, keys developed by Blackman & Eastop (1984) were used.

OBSERVATIONS

The chromosomes in all 5 species studied here have been found to be holocentric.

C. fragaefolii

This species has diploid chromosome number of 14 (Figs 1, 2). However, karyotypic variations with 2n = 12 and 13 were also recorded (Figs 16, 17). The length of chromosomes ranged from 1.45 µm to 3.58 µm. The karyotype consists of 1 pair of long, 4 pairs of medium-sized and 2 pairs of short chromosomes (Fig. 3). TCL was 35.73 µm. Relative length of chromosomes ranged from 4.01 to 10.15.



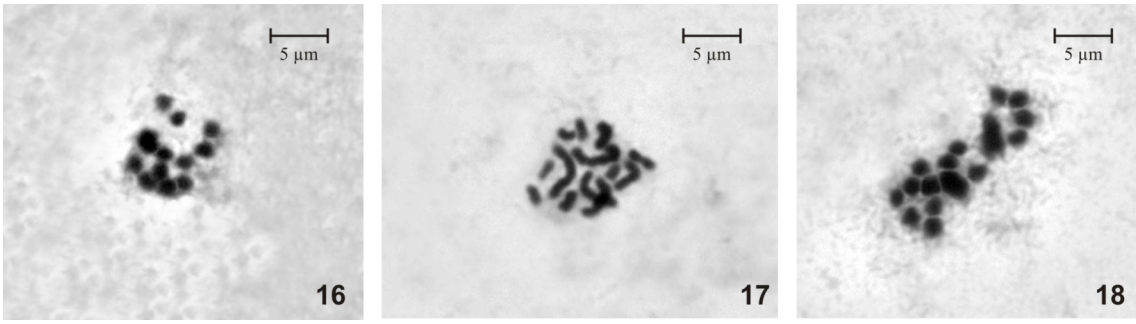
Figs 1–15: Karyotypes of aphids. 1–3. *C. fragaefolii*. 1. Somatic chromosomes. 2. Karyotype. 3. Idiogram. 4–6. *C. glabrum.* 4. Somatic chromosomes. 5. Karyotype. 6. Idiogram. 7–9. *C. gracilicorne.* 7. Somatic chromosomes. 8. Karyotype. 9. Idiogram. 10–12. *C. tetrarhodum.* 10. Somatic chromosomes. 11. Karyotype. 12. Idiogram. 13–15. *C. thomasi.* 13. Somatic chromosomes. 14. Karyotype. 15. Idiogram.

C. glabrum

It has diploid chromosome number of 12 (Figs 4, 5). The length of chromosomes ranged from 1.29 µm to 2.95 µm. The karyotype includes 1 pair of long, 3 pairs of medium-sized and 2 pairs of short chromosomes (Fig. 6). TCL was 25.48 µm. Relative length of chromosomes ranged from 5.05 to 11.65.

C. gracilicorne

C. gracilicorne has diploid chromosome number of 16 (Figs 7, 8). The length of chromosomes ranged from 0.90 µm to 3.67 µm. The somatic complement consists of 1 pair of long, 4 pairs of medium-sized and 3 pairs of short chromosomes (Fig. 9). TCL was 35.51 µm. Relative length of chromosomes ranged from 2.48 to 10.43.



Figs 16–18: Karyotype variation in aphids. 16, 17. *C. fragaefolii.* 16. Somatic chromosomes (2n = 12). 17. Somatic chromosomes (2n = 13). 18. *C. tetrarhodum.* Somatic chromosomes (2n = 16).

C. tetrarhodum

This species has diploid chromosome number of 14 (Figs 10, 11). However, karyotypic variation with 2n = 16 was also recorded (Fig. 18). The length of chromosomes ranged from 1.24 µm to 3.29 µm. The somatic complement has 1 pair of long, 4 pairs of medium-sized and 2 pairs of short chromosomes (Fig. 12). TCL was 29.93 µm. Relative length of chromosomes ranged from 4.10 to 10.98.

C. thomasi

C. thomasi has diploid chromosome number of 12 (Figs 13, 14). The length of chromosomes ranged from 0.83 µm to 3.31 µm. The karyotype consists of 1 pair of long, 4 pairs of medium-sized and 1 pair of short chromosomes (Fig. 15). TCL was 25.20 µm. Relative lengths of chromosomes ranged from 3.28 to 13.11.

DISCUSSION

Of the 5 species of *Chaetosiphon* studied here, in *C. thomasi* and *C. glabrum,* the diploid chromosome number is 2n = 12. Whereas *C. fragaefolii* and *C. tetrarhodum* have 2n = 14, *C. gracilicorne* has 2n = 16. However, in *C. fragaefolii,* cells with 2n = 12 (23%) and 13 (17%) of 52 plates examined showing hypoploidy and in *C. tetrarhodum,* cells with 2n = 16 (29%) of 39 plates examined

showing hyperploidy have been found. This change in ploidy of the chromosome complement is due to autosome fusion or translocation resulting in hypoploidy and autosome dissociation resulting in hyperploidy.

C. thomasi with diploid chromosome number of twelve reported here is in conformity with the earlier reports of Blackman et al. (1987) for this species. Karyotype of *C. thomasi* includes 6 pairs of chromosomes which show gradual decrease in size.

Chromosome number 2n = 12 in *C. glabrum* is reported here for the first time. Karyotype of *C. glabrum* includes 6 pairs of chromosomes which show gradual decrease in size.

The chromosome number of 2n = 14 reported here for *C. fragaefolii* is in conformity with the earlier reports for this species (Blackman & Eastop 1984). Blackman et al. (1987) reported 2n = 12 and 13 (hypoploid) and 2n = 15 (hyperploid) in this species. However, Blackman & Eastop (2015) recorded 2n = 13 and 15, one hypoploid and another hyperploid number for the same species. According to them, these variations in chromosome number are attributed to chromosome fusion resulting in hypoploidy or dissociation of chromosomes leading to hyperploidy. Karyotype of *C. fragaefolii* includes 7 pairs of chromosomes which show gradual decrease in size.

The chromosome numbers 2n = 14 and 16 recorded here for *C. tetrarhodum* are in conformity with the earlier reports of Blackman (1980) and Blackman & Eastop (2006). Karyotype of *C. tetrarhodum* includes 7 pairs of chromosomes in which first to third pairs show gradual decrease in size while fourth to seventh pairs are almost equal in size.

The chromosome number of 2n = 16 reported here for *C. gracilicorne* is in conformity with the earlier reports of Dutta & Gautam (1993) from Shimla. Karyotype of *C. gracilicorne* includes 8 pairs of chromosomes in which first pair is the longest one while other 7 chromosome pairs are almost equal.

Aphids possess holocentric chromosomes with diffused kinetic activity throughout their length. These chromosomes appear featureless, rod or dot shaped depending upon the size due to lack of constrictions in these chromosomes. Karyotype variations occured when these chromosomes break into two or more parts. The parts thus formed can still move independently into daughter cells.

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