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Original Research Article

Chromosomal studies on gall aphids *Eriosoma ulmi* and *Tetraneura nigriabdominalis* from Kullu, Himachal Pradesh

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ABSTRACT:
In the present investigation, karyotypes of two species of gall forming aphids, viz., *Eriosoma ulmi* (Linnaeus), and *Tetraneura nigriabdominalis* (Sasaki) have been studied. These aphid species were found to be infesting *Ulmus wallichiana* from Kullu district of Himachal Pradesh. The diploid chromosome number in *E. ulmi* is ten (2n=10), whereas *T. nigriabdominalis* is eighteen (2n=18). The chromosomes were holocentric. The karyotypes have been described. Idiograms were prepared on relative length data.

Keywords: *Eriosoma*, *Tetraneura*, Gall, Aphid, Karyotype, Holocentric, Chromosome.

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INTRODUCTION

Aphids are commonly known as plant lice or green flies representing large group of small sap sucking soft bodied homopteran insects. They constitute one of the most important group of insects because of their polymorphism, host alternating heteroecious behaviour, reproductive habits as for their role as largest group of insect vectors of plant viruses and malformations like galls. These insects enjoy a more or less cosmopolitan distribution and are found in abundance in places of temperate climate (Ghosh 2008).

About 5000 species of aphids are found around the world (Blackman & Eastop 2015, Favret 2020). Approximately 10-20 % of the 4,700 known aphid species worldwide are gallicolous (Chakrabarti 2007). Each aphid forms species specific galls (Wool 2004). The shape of the galls is determined by the aphids inducing it (Stern 1995; Crespi and Worobey 1998; Inbar et al. 2004). Galls can be described as swelling on the external tissue of plants, and these are theabnormal plant structures induced by various organisms, in particular by the insects (Mani, 1964). There are little variation in a gall aphid population with in gall because all the aphids are offspring of single female (Wool, 1977).

Chromosomes of many species of aphids were reported by earlier workers, but there is a little information available on chromosomes of gall aphids from Himachal Pradesh. It was an attempt to expand the chromosomal account of gall forming aphids and to analyse their karyotypes. The present paper reveals karyomorphology of two gall forming aphid species viz., *E. ulmi*, and *T. nigriabdominalis***.**

MATERIALS AND METHODS

The gall forming aphids were collected from galls on the leaves of *Ulmus wallichiana* plant from Kullu district of Himachal Pradesh (Table no. 1). Galls were observed in the months of April and May for shape, size and colour at regular interval. For chromosomal study, only apterous, parthenogenetic and viviparous females were used. The embryos were taken out by puncturing the posterior end of abdomen. Then, pretreated in 0.7% sodium citrate solution for 30 min. The pretreated embryos were then fixed in 1:3 acetic acid-ethanol solutions for about 15–20 min at room temperature. After fixation, embryos were placed on a glass slide in a drop of 45% acetic acid for 3–5 min. A cover slip was put on the material. Staining of slides was done with 2% Giemsa. Well spread metaphase plates were selected and lengths of chromosomes were measured using ocular micrometer. Photomicrography was done by LEICA DML-S2 microscope fitted with LEICA DFC-320 camera. From actual lengths, the total complement length (TCL) and relative lengths of chromosomes were calculated for each species.

Table 1: Table showing aphid species, host plant, place and month of collection

S. No.	Aphid species	Host plant	Place of Collection	Months of collection
1.	*Eriosoma ulmi* (Linnaeus)	*Ulmus wallichiana*	Bhunter1100 m,	April and May
2.	*Tetraneura nigriabdominalis* (Sasaki)		Manikaran (Kullu) 1760 m	April and May

For identification of species, keys developed by Blackman and Eastop (1984) were used. The whole mounts of aphids were prepared. Specimens were gently boiled in 95% alcohol for 2 to 5 minutes then alcohol was pipetted off and 10% KOH solution was added up to 1 cm depth. After that specimens were again boiled till they become transparent then KOH solution was pipetted off and the specimens were washed to remove all the KOH using 2 to 4 change of distilled water after that aphids were dehydrated by taking through series of progressively higher grades of alcohol from 30% to 100%. Then these aphids were put into clove oil for 20 to 30 minutes for clearing. After clearing, 1 to 2 aphids were transferred

to a drop of fairly thin Dibutylphthalate Xyol (D.P.X.) on a clean slide and the appendages were arranged. A clear coverslip was then dipped in Xylene and carefully placed onto specimens so as to spread the mountant evenly without trapping air bubble. The slides were then dried in oven at 60˚C for about one week. Photography of whole mount slides was done under binocular microscope LEICA M205 C.

RESULTS

Eriosoma ulmi (Linnaeus)
This aphid species formed leaf curls galls. These were formed by downward rolling of leaves enclosing a cavity inside, sometimes on the both the edges of leaves (Figure 1) on host plant, *Ulmus wallichiana*. Galls formed by this species are pseudogalls. Colour of gall varies from whitish green to reddish green. Galls were seen mainly in the months of April and May. Enclosing parthenogenetic and alate generations within (Figure 2).

The diploid chromosome number was found to be ten (2n=10) (Figures 3, 5). The mean actual length of chromosomes ranged from 0.75 µm ±0.00 S.E. in shortest chromosome to 2.09 µm ±0.19 S.E. in the longest chromosome. Total complement length was 13.29 µm ±0.93 S.E. The relative lengths of chromosomes were calculated from actual length data and these ranged from 5.87 ±0.37 S.E. in the shortest chromosome to 15.58 ±0.62 S.E. in the longest chromosome. The idiogram was constructed based on relative length data (Figure 6) and it revealed gradual decrease in chromosomal length. Chromosome record of this species is new report from Himachal Pradesh. Karyotypic variation was recorded in this species as 2n=12 (Figure 4) was also found in aphids of this species in the present investigations.

Tetraneura nigriabdominalis (Sasaki)
This aphid species found to form hollow, stalked, elongated, spindle or pear shaped, pointed apex galls on the dorsal side of leaves on host plant, *Ulmus wallichiana* in the months of April and May (Figure 7). Galls were closed completely and sealed. Galls were formed by the feeding action of parthenogenetic wingless females on the leaves. Colour of galls was green and reddish with yellowish tinge. Enclosing parthenogenetic in early galls and alate generation in late galls (Figure 8).

The diploid chromosome number was found to be eighteen (2n=18) (Figures 9, 10). The mean actual length of chromosomes ranged from 0.90 µm ±0.10 S.E. in shortest chromosome to 2.61 µm ±0.30 S.E. in the longest chromosome. Total complement length calculated was 24.48 µm ±2.53 S.E. The relative lengths of chromosomes were calculated from actual length data and these ranged from 3.83 ±0.32 S.E. in the shortest chromosome to 10.62 ±0.46 S.E. in the longest chromosome. The idiogram was constructed based on relative length data (Figure 11) and it revealed gradual decrease in chromosomal lengths.

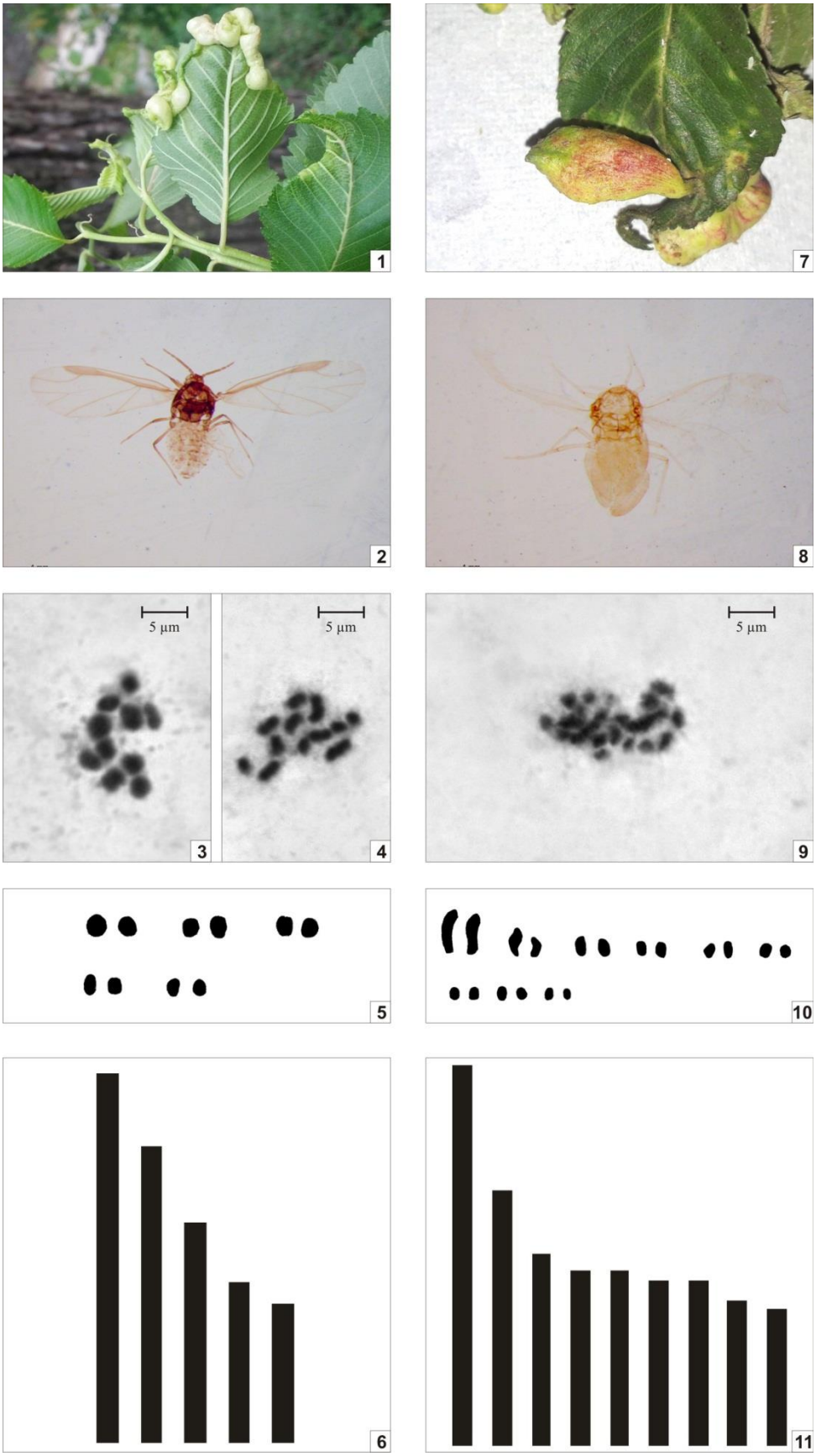

Figure 1-11: (1-6): *Eriosoma ulmi* 1. Galls 2. Alate 3. Somatic Metaphase plate 4. Karyotipic variation 5. Karyotype 6. Idiogram. **(7-11):** *Tetraneura nigriabdominalis* 7. Galls 8. Alate 9. Somatic Metaphase plate 10. Karyotype 11. Idiogram.

DISCUSSION

Two gall forming aphid genus viz. *Erisoma* and *Tetraneura* belonging to tribe Eriosomatini were studied. *Eriosoma* comprises about 30 species. Out of which most of species have host alternation between galls on *Ulmus* and secondary hosts in Pyroidea, Grossulariaceae or Compositae. Feeding by parthenogenetic females on a growing shoots of elm tree induces the leaf roll or leaf curl (Akimoto, 1981). Galls of *E. ulmi* were leaf curls and these were formed by downward rolling of leaves sometimes on the both the edges of leaves (Fig. 1) Similar descriptions were also reported earlier by Blackman and Eastop (1994).The deformed parts become yellowish or whitish green. Adult alates are dark green to bluish grey migrating in June-July to form colonies on roots of *Ribes rubrum* and *R. nigrum* (Danielsson, 1982). The diploid chromosome number was found to be ten (2n=10) (Figs. 3, 5). The mean actual length of chromosomes ranged from 0.75 µm to 2.09 µm with total complement length as 13.29 µm (Table 4). Same chromosome number was earlier reported by Blackman and Eastop (1984, 1994) and Gavrilov *et al.* (2015). Karyotypic variation occurred in this species as diploid chromosome number of twelve (2n=12) (Figs. 4) was reported earlier by Baehr (1908, 1909).

Tetraneura comprises about 30 species, out of which about seven species have host alternation between leaf galls on *Ulmus* and roots of Gramineae. Elm galls are usually stalked; pouch like outgrowths on the dorsal side of leaves (Blackman and Eastop, 1994). In the present studies, *T. nigriabdominalis* also formed stalked elongate spindle or pear shaped usually with pointed apex galls on the leaves of host plant, *Ulmus* (Fig. 7). The diploid chromosome number was found to be eighteen (2n=18) (Figs. 9, 10). The mean actual length of chromosomes ranged from 0.90 µm to 2.61 µm with total complement length of 24.48 µm. Same diploid chromosome number was reported by earlier workers such as Chen and Zhang (1985a); Blackman (1986); Blackman and Eastop (2018); Gavrilov *et al.* (2015).

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