

Postembryonic Development of Ovaries in a Phlaeothripine Thrips, *Liothrips kuwanai* (Moulton) (Insecta: Thysanoptera)*

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Adult females of Thysanoptera have a pair of ovaries, each consisting of four ovarioles. We distinguish three types in the interrelationship of the ovariole, germarium and terminal filament in thysanopteran ovaries, *i.e.*, type 1: each individual ovariole has its own germarium and terminal filament; type 2: the four ovarioles in each ovary share a single germarium and terminal filament; type 3: two ovarioles share one germarium equipped with a single terminal filament, and two terminal filaments of two sets of ovarioles unite into a single terminal filament in each ovary. These ovarian types in Thysanoptera are conservative at family or subfamily level: the aeolothripid thrips and the thripid thrips exclusively exhibit type 1 ovaries, some phlaeothripine thrips have type 3 ovaries, while type 2 is found in ovaries of the other phlaeothripine thrips and in all idolothripine thrips (Sharga, 1933; Melis, 1935; Heming, 1970; Lewis, 1973; Haga, 1975; Varadarasan and Ananthakrishnan, 1982; Watane and Thakare, 1987; Moritz, 1989; Ananthakrishnan, 1990; Tsutsumi, 1995). In the present study, we light-microscopically examined the postembryonic development of type 3 ovaries in the phlaeothripine thrips, *Liothrips kuwanai* (Moulton), to shed light on the anagenesis of the ovarian types in Thysanoptera.

Splitting of the ovarian rudiment leading to the formation of ovarioles occurs at the second pupal stage in *L. kuwanai*, as described in other phlaeothripine thrips with type 3 ovaries, *Arrehenothrips ramakrishnae* and *Crotothrips santahasta* (Varadarasan and Ananthakrishnan, 1982). The four ovarioles in *L. kuwanai* are formed by a stepwise splitting of an ovarian rudiment, unlike type 1 and 2 ovaries, in which ovariole formation occurs by synchronous splitting of an ovarian rudiment (*cf.* Davies, 1961; Heming, 1970, 1995; Watane and Thakare, 1987; Tsutsumi, 1995). Each ovarian rudiment in *L. kuwanai* first divides from its anterior end caudally into two ovariole rudiments. Soon after, each ovariole rudiment in each ovarian rudiment divides into two ovarioles. Thereafter, two longitudinal columns of preterminal filament cells amalgamate at the apices of paired ovarioles, which were derived from one ovariole rudiment, to form a single terminal filament, in a manner similar to the fusion of four columns of preterminal filament cells in each ovarian rudiment in type 2 ovaries in phlaeothripine thrips, *Neoheegeria verbasci* and idolothripine thrips, *Bactrothrips brevitubus* (Heming, 1970, 1995; Tsutsumi, 1995).

The present study revealed that splitting the ovary into four ovarioles is involved in the formation of type 3 ovaries at its initial stage. Taking into account that type 2 ovaries also undergo a similar splitting of the ovary into four ovarioles, and that four ovarioles in type 1 are formed by a simple and synchronous splitting of the ovary, such a complete splitting of the ovary into four ovarioles may be deduced to be basic in Thysanoptera. In this respect, it may be safely assumed that the type 1 ovary, which retains the basic state with no modification, should be the most

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ancestral in Thysanoptera. In turn, type 2 and type 3 ovaries with some modification suffered, *i.e.*, fusions of germaria and/or terminal filaments of some degree, may be regarded as being derived from type 1 ovary. As one option, we can speculate a two-directional evolution, that is, one from type 1 ovary to type 2, and another from type 1 to type 3. However, provided that a stepwise splitting of the ovary into ovarioles, which was revealed in the present study for type 3 ovary in *L. kuwanai*, would be an apomorphic feature newly endowed to type 3, and that type 3 would have evolved by the addition of the feature to type 2, it could be speculated that type 3 ovary evolved from type 2. This may be well accepted in light of parsimony, because type 2 ovaries are found in all idolothripine thrips and are predominant in phlaeothripine thrips, whereas type 3 ovaries are restricted to some phlaeothripines.

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