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5.6 Exotic or Native? Interspecific Competition in the Parasitization of the Fruit Fly *Ceratitis cosyra*

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Multiple natural enemies of a pest might enhance the pest control or in contrast be less efficient for the management of the nuisance. Additive reduction of the pest might occur if natural enemies co-inhabitat and do not compete for space or nutrients. Parasitoids obligate dependence on the same host for its survival may possibly generate intra- or interspecific competition when the number of parasítoids per host reduces the availability of food and thus affects the survival, fecundity, growth and development of one or both parasitoids as well as the host species (Aluja *et al.*, 2013). Interspecific competiton is more likely to occur between parasitoids if they develop within the same host, and if they are have similar habitat requirements. Introduction and release of an exotic parasitoid that shares a habitat and host with a native parasitoid might be affected by interspecific competition, which might affect the effectiveness of the biological control agent (Miranada *et al.*, 2015). *Fopius arisanus* Sonan and *Fopius caudatus* Szèpligeti (Hymenoptera: Braconidae) are two solitary endoparasitoids of tephritid fruit flies that parasitize eggs of fruit flies infesting the same fruits. We studied intraspecific competition between these two parasitoids species in the mango fruit fly *Ceratitis cosyra* (Walker) (Diptera: Tephritidae). Based on previous documentation of the equal chance of survival between *F. arisanus* and *Fopius ceratititvorus* Wharton (Hymenoptera: Braconidae) while co-parasitizing (Bokonon-Ganta *et al.*, 2005), we hypothesized that we would not find a superior competitor between the two parasitoids.

Both *F. arisanus* and *F. caudatus* are egg-pupal parasitoids of tepritid fruit flies. The former is a known Asian biological control agent, released on three continents and the latter is a parasitoid of African origin, occasionally tested as a biological control agent. Releases of *F. arisanus* have been made during the last ten years in Africa, i.e., Senegal, Benin, Cameroon, Kenya and Mozambique (Kibira *et al.*, 2015; Ndiaye *et al.*, 2015; Gnanvossou *et al.*, 2016). *Fopius arisanus* was brought to Africa after the invasion of the Asian *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) because this wasp parasitizes *B. dorsalis* both in its native environment and in Hawaii, etc.. *Fopius arisanus* also parasitize other tephritid fruit fly species, such as *Ceratitis capitata* (Wiedemann), *C. cosyra* and *Anastrepha* (Rousse *et al.*, 2006). *Fopius caudatus* parasitizes *C. capitata* and *C. cosyra*

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that infest mango, coffee and other cultivated and wild fruits (Wang *et al.*, 2004; Vayssières *et al.*, 2011).

We designed preference tests and competition experiments in the laboratory with the two parasitoids. In the preference test, we studied their preference for developmental stages of *C. cosyra*, presenting eggs at diffent intervals after fruit infestation. Preference between parasitized and non-parasitized *C. cosyra* infested fruits were also conducted. Their parasitizing ability and survival after co-parasitizing the fruit fly eggs were observed. Dissections of the eggs and first instar larvae (Fig. 5.6.1) revealed the parasitism rate.

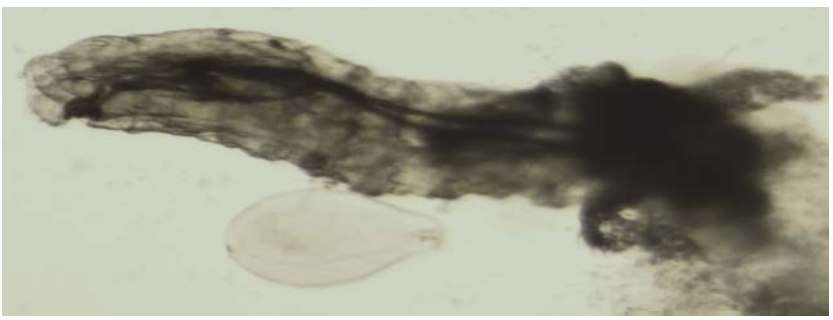

Figure 5.6.1. *Fopius caudatus* egg dissected from 1st instar *Ceratitis cosyra* larvae.

Parasitization by *F. arisanus* and *F. caudatus* resulted in 10-35% mortality of host eggs, depending on species and age of the host egg. Emergence of *F. caudatus* was higher then for *F. arisanus*, i.e., a higher rate of eggs laid by *F. caudatus* developed and emerged as adults. Multiparasitism, i.e., eggs of the two species ovipositied in the same fruit fly egg, of 8% was observed. *Fopius arisanus* avoided super- and multi parasitism more than *F. caudatus* which is an disadvantage for the latter wasp, since only one parasitoid can emerge from one parasitized fruit fly. *Fopius caudatus* oviposition was not lower in hosts previously parasitized by *F. arisanus*, suggesting that *F. caudatus* can not discriminate against parasitized hosts. Behavioural observations showed that *F. arisanus* won the extrinsic competitions against *F. caudatus* as it was more active and chased away its cogener from searching on the oviposition substrate. Our experiments revealed that *F. arisanus* is a stronger competitor than *F. caudatus* in some cases, while survival in *C. cosyra*. is superior for *F. caudatus* than for *F. arisanus*. These results support our hypothesis that the two *Fopius* species have complementary capacities for competiton and we demonstrate the first results of interaction between these two endoparasitoids.

Competitive superiority of early acting parasitoids species in fruit flies (Wang and Messing, 2003) is one of the reasons that the egg parasitoid *F. arisanus* has had a superior establishment record than other braconids that attack various larval instars of fruit flies and why it is widespread for use in biologcal control programs. The strategy to parasitize eggs is rare among fruit fly parasitoids. The knowledge about the range of fruits parasitized by the two parasitoids in Africa is scarse, yet it is known that both wasps parasitize fruit fly eggs in mango, which is infested by both *C. cosyra* and *B. dorsalis*. *Fopius caudatus* parasitism in mango in Benin was almost 10% (Vayssières *et al.*, 2011) while early records

of recovery of *F. arisanus* in mango is less than 1% 1-3 years after release (Ndiaye *et al.*, 2015). Their choice of fruit fly host and their survival in them, together with habitat preferences, will further define the occurance of interspecific competition, its outcome and possibilities for co-existence. Our study is the first comparison of the two closely related parasitoid species. Further studies and survillance will show if the competition and niche differences will cause spatial displacement or host shifts as a response to competition avoidance.

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