

EFFECTS OF NON-PREY AND ARTIFICIAL FOOD RESOURCES ON BIOLOGY OF ORIUS PREDATORS AND ENCYRTID PARASITOIDS ATTACKING INVASIVE PEST INSECTS

アイヴァン, ガサングワ

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Name: Gasangwa Ivan

Title: EFFECTS OF NON-PREY AND ARTIFICIAL FOOD RESOURCES ON BIOLOGY OF ORIUS PREDATORY BUGS (HEMIPTERA: ANTHOCORIDEA) ATTACKING INVASIVE PEST INSECTS (非獲物系餌と人工餌が侵略的害虫を攻撃する捕食者ヒメハナカメムシと寄生性トビコバチへ与える影響)

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Thesis summary

Agriculture intensification and expansion for food production have increased pest problems and the subsequent globalization of the problem due to worldwide invasive pests. Trans-boundary invasive pests threaten food security especially in poor rural areas of developing countries. Such invasive pests are often “internationally shared” species. Although there are a variety of counter-measures to combat such internationally shared pests, application of multiple measures together with an integrated management approach is essential for effective control of the pests. Biological control with insect natural enemies is one of the main methods to control invasive pests. Although biological control is often effective in controlling pests, selection of proper bio-control agents or natural enemy species is crucial to successful biological control. Also, establishment of effective mass-rearing systems is on strong demand because production or rearing of bio-control agents is usually costly and laboring. In my thesis, I focused on two main topics regarding biological control of transboundary pests. First, I studied laboratory food of a commercialized and effective natural enemy, *Orius strigicollis* Poppius (Hemipetra: Anthocoridae), in order to seek for an effective mass-rearing food resource. Second, I studied globalized eucalyptus pests, *i.e.*, eucalyptus psyllids, in Africa and their potential natural enemies.

Recent records suggest occurrence of eucalyptus psyllids in many African countries, eucalypt trees were introduced to the continent from Australia for over a century ago and are now used for fuel, medicine and lumber. In the present study, a field survey was conducted to investigate whether any eucalypt pests occurred in Rwanda and if any natural enemies were also present. My field survey provided the evidence

that eucalyptus shoot psyllid *Blastopsylla occidentalis* Taylor (Hemiptera: Psyllidae), a well-known invasive pest of eucalyptus trees, occurred widely in the country and were found to severely affect eucalypt trees. Parasitoid wasps *Psyllaephagus blastopsyllae* (Hymenoptera: Encyrtidae) were collected in large number from psyllids on eucalypt trees, suggesting this parasitoid as a potential agent for psyllids control. Detection of *P. pilosus* but not its specific host *Ctenarytaina eucalypti* (Hemiptera: Psyllidae) suggests the occurrence of the latter in the country. Further, *Orius* predatory bugs capable of predating on the psyllids were detected from eucalyptus trees infested by *B. occidentalis*, signifying that the predators were also candidates for pest psyllids control on eucalyptus trees.

Then, a series of laboratory studies were carried out to examine nutritional biology of *Orius* predators. To improve its mass rearing, commercial biocontrol agent *O. strigicollis* known to predate on psyllid pests was reared on non-prey food resources to improve its fitness and to reduce cost of mass production. Therefore, the impact of non-prey sugar-rich versus protein-rich resources for reproduction of *O. strigicollis* was examined. The bugs responded similarly to test fruit foods (strawberry, apple, raisin and banana) but residence time significantly differed among diets. Fecundity was lower for fruit-fed than moth egg-fed females but was higher than females fed on water only. Fruit foods was shown to enhance *Orius strigicollis* survival. Thus, *Orius strigicollis* accepted and utilized fruits as food source, and the fruits enhanced its fitness but for maximized fitness, protein rich resources are required for mass rearing.

Protein rich natural (*i.e.*, honeybee pollen, *E. kuehniella* eggs and 2 aphid spp.) and artificial foods (*i.e.*, chicken egg yolk, cat food, brine shrimps and their mixed food) were tested as food sources. Artificial diets positively affected fecundity of *O. strigicollis* and, among the artificial diets, brine shrimp eggs had the best results both for fecundity and survivorship. Although artificial diets had positive effects on the fitness of *O. strigicollis*, natural food resulted in the best performance. Although mixed food diets would be potential for the *Orius* rearing, any single artificial food did not provide satisfactory outcome. For effective mass-rearing, we need to explore other artificial food source.