

**BIOECOLOGY OF THE MANGO MEALYBUG, *RASTROCOCCUS ICERYOIDES*
GREEN (HEMIPTERA: PSEUDOCOCCIDAE) AND ITS ASSOCIATED NATURAL
ENEMIES IN KENYA AND TANZANIA**

By

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**A THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE
AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENTOMOLOGY AT
THE UNIVERSITY OF PRETORIA**

JANUARY 2012



DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

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DEDICATION

This thesis is dedicated to my beloved mother, Mrs Tanga Mary Ewoh and to the memory of my late father, Mr Tanga Andrew Apeh (R.I.P) whose love, support and guidance made me what I am today. And to my lovely wife, Mrs Tanga Janice Ghemoh and daughter, Tanga Emely Febeng-Anong who has stood together amidst life's tough hurdles. While it was difficult to work at a time you were all awake, you have filled my life with purpose and made it so meaningful that each passing day with you around me brings great joy and happiness to my heart.

ACKNOWLEDGEMENTS

First and foremost, I wish to thank God, the Almighty, for providing me with the opportunity, will and strength to undertake this study. I recognize with great appreciation and gratitude my supervisors, Dr. Sunday Ekesi, Dr. Samira, Dr. Prem Govender and Professor Clarke Scholtz for their academic guidance, support, constructive criticism and encouragement. I considered myself privileged to have learnt at the feet of such highly experienced persons. We built up a cordial relationship both professionally and socially that was very enriching.

I forever remain indebted to Dr. Sunday and Dr. Samira for facilitating all the field activities whenever the need arose and mentored me to discover my potential in conducting and interpretation of research findings, as well as writing of manuscripts for publication during my most difficult moments of the study.

I am also extremely grateful to late Dr. Adenerin Chabi-Olaya and Dr Daissy Salifu for their assistance with statistical analysis. I simply cannot forget Mrs. Beatrice Pallangyo, Coordinator, National Biological Control Programme (NBCP), Kibaha, and M. Mwatawala, Sokoine University of Agriculture, Morogoro, Tanzania for hosting me and assisting in field collection during my PhD studies. I am grateful to Dr. Seguni Z.S.K, Mikocheni Agricultural Research Institute, Dar es Salaam, Tanzania for assisting with identification of ant species associated with *Rastrococcus iceryoides* Green (Hemiptera: Pseudococcidae). Thanks are also due to the staff of Kenya Plant Health Inspectorate Service (KEPHIS) for their kind assistance in field survey.

I am also grateful to Dr. S. Suresh of Tamil Nadu Agricultural University, Coimbatore, India, for hosting me and assisting in field survey, as well as for his assistance in slide-mounting and identifications of the mealybug samples. Special thanks also goes to Mr. Frank Mbago, Herbarium curator (DSM), Department of Botany, University of Dar es salaam and Adam Nsoma, Forest officer, Department of natural resources, Kibaha for botanical identification of the various host plants collected. I infinitely appreciate the assistance of Dr. Sagadai Manickavasagam of Annamalai University, India for the initial identification of parasitoid samples collected during the study and Dr. G. L. Prinsloo of Agricultural Research Council (ARC), Pretoria, South Africa for further confirmation of the parasitoid species.

I also extend my appreciation to the African Regional Postgraduate Programme (ARPPIS) of *icipe* and the German Academic Exchange Services (DAAD) for the fellowship which enabled me to accomplish this academic achievement. The BMZ provided research funding through the African Fruit Fly Programme (AFFP) for which I am indebted. I appreciate all the support and advice of friends, especially Dr Saliou Naissy, Dr Yusuf Abdullahi Ahmed and colleagues at *icipe*, who were extremely helpful in numerous ways to make my stay in Nairobi as well as in Pretoria memorable both professionally and socially.

Special thanks also go to the staff of *icipe* Capacity Building, Lilian Igweta, Lisa Omondi and Margaret Ochanda for ensuring I did my work smoothly. The AFFP staff especially Peris Machera who was extremely helpful in administrative support, Nderitu Peterson who greatly assisted in laboratory and field related activities. Edda Wasike, Wellington Ambaka and Joash Olago were extremely helpful in searching and retrieving important literature materials necessary for studies.

Thanks are also due to all the members of the Scarab Research Group, Department of Zoology and Entomology, University of Pretoria for their social and moral support during the last phase of my studies. I am infinitely indebted to Prof. Clarke H. Scholtz for his fatherly connection and for instilling in me a sense of belonging, and going an extra mile in helping with administrative issues to see that I ran the course to the end.

Last but not the least, the Mbufung's family in Bamunka-Ndop, Cameroon will always be remembered for their endless prayers and support. Working and spending time with you all was a richly rewarding experience I will forever cherish.

ABSTRACT

Rastrococcus iceryoides Green (Hemiptera: Pseudococcidae), an alien invasive mealybug pest of Asian origin was first detected in Tanzania in 1989. This pest rapidly spread by the mid-1990s and was soon present in Coastal Kenya and Northern Malawi, where it has been regarded and remains a major pest of mango. Because of its novelty status, there was no information on its biology, ecology and its natural enemies that could aid development of management efforts. This study, therefore, was initiated to establish the bioecology of *R. iceryoides* and its natural enemies in Kenya and Tanzania, and to explore for efficient co-evolved natural enemies in the aboriginal home of the pest in India. Based on the exploratory survey data, two correlative approaches, Desktop-GARP (Genetic Algorithm for Rule-set Prediction) and Maxent (Maximum entropy) were used to identify climatically suitable areas in Africa that are agro-meteorologically similar to the aboriginal home of the pest. The first step was to carry out a countrywide survey in Kenya and Tanzania to establish the distribution, host-plant relationship and natural enemies of this pest. The survey revealed that *R. iceryoides* infested twenty-nine plant species particularly *Mangifera indica* L. and *Cajanus cajan* (L.) Millspaugh, and the wild plants *Parkinsonia aculeata* L., *Caesalpinia sepiaria* Roxb, and *Deinbollia borbonica* Scheft. A total of six primary parasitoid species were recovered from *R. iceryoides* with *Anagyrus pseudococci* Girault (Hymenoptera: Encyrtidae) predominating. Thirty-eight species of predators belonging to 14 families were also recorded. Despite the presence of these indigenous natural enemies, their ability to regulate the population of *R. iceryoides* was inadequate. In laboratory host preference studies, *M. indica*, *Cucurbita moschata* Duchesne, *P. aculeata* and *C. cajan* were found to be the most preferred host plants in view of improving laboratory mass rearing of this pest and the parasitoid. The impact of *O. longinoda* on the biological control activities of *A. pseudococci* in the laboratory revealed that percentage parasitism of *R. iceryoides* by *A. pseudococci* was significantly higher on ant-excluded trials than on ant-attended trials. Worker ants were observed to remove mummified mealybugs, which resulted in significantly reduced percentage of adult parasitoid eclosion. *Oecophylla longinoda* showed aggressive behaviour and caused a significant mortality of *A. pseudococci* during the exposure period. The spatial and temporal population dynamics of this pest was also studied and revealed that populations of *R. iceryoides* followed an annual cycle which is synchronized with the mango fruiting season, with a peak incidence

occurring during the dry season (December to February) on all plant parts. The population dynamics of *R. iceryoides* and its natural enemies were significantly and positively influenced by temperature, while it was significantly and negatively correlated with rainfall. The exploratory survey in India showed that *R. iceryoides* is widely distributed throughout the state of Tamil Nadu and infested ten cultivated and wild plant species with extremely low levels of infestation. Percentage parasitism based on the proportion of mummified *R. iceryoides* was high on all host plants. Out of eleven primary parasitoid species, *Praleurocerus viridis* Agarwal (Hymenoptera: Encyrtidae) and *Anagyrus chryos* Noyes & Hayat (Hymenoptera: Encyrtidae) were the most dominant and widely distributed species. In addition to the parasitoids, 10 predator species from 7 families were recorded. Based on the model established with data from India, it was determined that climatically suitable areas for introduction of promising parasitoids in Africa include the humid tropical coastlines of Kenya and Tanzania, as well as some restricted areas in West and Central Africa. Studies of the potential worldwide distribution of *R. iceryoides* showed that the pest might pose a serious threat on a worldwide scale as it could narrowly become established in all the mango producing countries in the continents.

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