Effects of thermal history on *Bactrocera* and *Ceratitis* pests: Who flies better?

Kevin Malod[1], Eleutheria-Maria Bali[2], Corentin Gledel[3], Laura Moquet[3], Anandi Bierman[1], Evmorfia Bataka[2], Christopher W. Weldon[4], Minette Karsten[1], Hélène Delatte[5], Nikos T. Papadopoulos[3], John S. Terblanche[1]

[1]Department of Conservation Ecology and Entomology, Faculty of AgriSciences, Stellenbosch University, Stellenbosch, South Africa, Email: malod@sun.ac.za, [2]Laboratory of Entomology and Agricultural Zoology, Department of Agriculture Crop Production and Rural Environment, University of Thessaly, Volos, Greece, [3]CIRAD,UMR PVBMT, F-97410 Saint-Pierre, La Réunion, France, [4]Department of Zoology and Entomology, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa, [5]CIRAD, UMR PVBMT, 101, Antananarivo, Madagascar

Introduction: The fitness traits expressed by insects are strongly influenced by the thermal environment. Furthermore, it is not only the current ambient temperature that is important, but also temperatures experienced in the past (i.e., thermal history). Thermal history may induce phenotypic plasticity that may benefit or be detrimental to performance and fitness. One type of plastic response triggered by thermal history and known to alter the phenotype is acclimation. In various insect species, acclimation affects traits such as lifespan, heat or cold resistance, or flight performance. In pest tephritids, it is particularly important to understand how thermal history may affect flight performance. This is because flight is linked to invasive potential and underpins the success of pest management tactics such as the sterile insect technique.
Methods: We investigated how thermal history affects the dispersal ability of three major pests, *Bactrocera dorsalis* (Hendel), *Bactrocera zonata* (Saunders) and *Ceratitis capitata* (Wiedemann), to better understand their invasion success. To do so, we tested potential dispersal ability of both sexes of each species after acclimation at either 20, 25 or 30°C. In the laboratory, we recorded tethered flight for 2 hours using flight mills at 25°C, and related wing morphology of flies that flew the most or least. We also inferred movement of *B. dorsalis* in the field over several weeks using a mark release-recapture method in agricultural environments with varying climatic conditions.
Results: In the laboratory, *B. dorsalis* was the species that covered the most distance, and *Bactrocera* species are faster than *C. capitata*. We observed a more fractioned flying pattern in *C. capitata*, resting periods being more frequent. Overall, flies acclimated at 20°C covered shorter distances as they spend less time flying. Supporting this observation, the overall proportion of *B. dorsalis* acclimated at 20°C recaptured in the field was lower than in the other groups. Although the number of captures was temperature dependent, there was no clear pattern linking acclimation temperature to weather conditions.
Conclusions: This work provides a direct inter-specific comparison of the dispersal ability between pest fruit flies that originate from different regions of the world. This is usually not feasible due to restrictions preventing researchers from moving them into novel environments to study their dispersal abilities. We showed that *Bactrocera* species are great dispersers, and this regardless of thermal history. However, our results suggest a cool thermal history within the adult stage may reduce dispersal ability. These results are important to predict movement in these pests with regards to climate change, and may also contribute to improve success of the sterile males.

Keywords: dispersal, acclimation, tethered flight, mark-release-recapture