WING SIZE AND DISPERSAL ABILITY OF LABORATORY REARED *ANASTREPHA LUDENS* (LOEW) MALES

Paula Gómez Cendra[1], Sebastián Szpilbarg[1], María Eugenia Utgés[2], Pablo Liedo Fernández[3], Juan César Vilardi[1]

[1] Universidad de Buenos Aires. Consejo Nacional de Investigaciones Científicas y Técnicas. Inst. Ecología, Genética y Evolución (IEGEBA). Fac. Cs Exactas y Naturales. Dept Ecología, Genética y Evolución. Genética de Poblaciones Aplicada (GPA). (C.P. 1428) Buenos Aires, Argentina. [2] Centro Nac. Diagnóstico e Investigación en Endemo-epidemias (CeNDIE) Adm Nac Laboratorios e Institutos de la Salud "Dr. C. G. Malbrán" (ANLIS) Ministerio de Salud de la Nación. Buenos Aires, Argentina. [3] El Colegio de la Frontera Sur (ECOSUR). Tapachula, México.

Introduction

The Mexican fruit fly *Anastrepha ludens* (Loew) is native from North Mexico and has tropical and subtropical distribution in North and Central America. It is one of the most prevalent pests of citrus (orange, grapefruit). Currently it is regarded as eradicated from USA and is under control programs in Mexico.

The pest management involves several methods including the sterile insect technique (SIT). The efficiency of the SIT relies on the dispersal and mating ability of the released insects, which may be affected by nutritional status and individual phenotypic properties.

On the one hand it was observed that a trade-off between mating success and longevity was shown when comparing the effects of protein vs. sugar rich diets, and it is expected that optimizing pre-release diets will contribute to improve the performance of mass reared and released sterile insects.

On the other hand, dispersal ability and mating competitiveness may also depend on insect morphology, which is partially determined by genetic factors and partially affected by rearing conditions. In particular, wing shape and size may differ among strains and can be modified by laboratory rearing conditions. In time, wing phenotype might affect field performance of released insects.

The main goal of this study was to evaluate the hypothesis that wing size and shape (represented by wing length and width) affect the dispersal ability in *A. ludens.*

In order to evaluate the potential interaction between morphology and pre-release diet the flies used in this work were fed 3 different diets.

Materials and Methods

Design and Pre-release treatment:

In June-July 2007 a central point release and recapture experiment was performed in a mango orchard located in the outskirts of Tapachula (Chiapas, México) as described in Utgés et al. 2013. It was assumed that the distance from each trap to the release point was an estimation of captured fly dispersal. Therefore, the number of flies captured and trap location were used as estimators of field dispersal.

All flies had been reared in the Moscafrut facility (Metapa de Domínguez, Chiapas), irradiated 48 hs before emergence and marked with fluorescent dyes.

Three diet treatments were implemented:

- **S:** 6 days of sugar diet
- **F:** 6 days of proteinaceous full diet (3:1, sugar/hydrolyzed yeast)
- **MS:** exposure to mango fruit for 3 days, followed by sugar only for other 3 days.

Captured flies were conserved in alcohol 70% and taken to the Lab.

Morphometric measurements:

In this study only males from two groups of traps were tested. One group was captured in the 4 closest traps to the central point (average 15m) and was composed of 218 individuals. The second group included 309 males captured in the 23 farthest traps.

Flies were dissected and their wings were mounted between slides and coverslips and sealed with nail polish. Photographs were taken using a camera incorporated to a stereoscopic microscope Leica EZ4HD (16 X magnification).

Wing width (WW) and wing length (WL) were measured on the photographs with the ImageJ software (Fig.1).

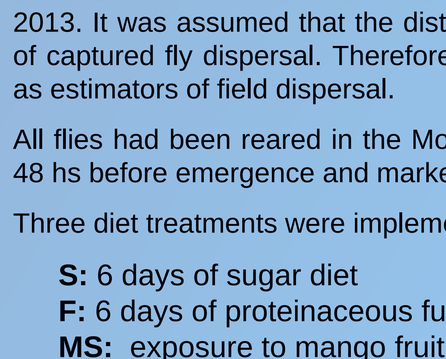

Figure 1: *Anastrepha ludens* wing. WW: Wing width, WL: Wing length.

Analysis:

Differences in wing size were tested among diets (**S**, **F**, and **MS**) and trap distances (far and near) using two way ANOVA and MANOVA.

Spatial distribution pattern of the captured males' wing morphology was also analyzed with a Bayesian method using the *Geneland* package of the R software. In this case each trap coordinates were incorporated but prior groups were not defined.

Utgés ME, Vilardi JC, Oropeza A, Toledo J & Liedo P (2013). Pre-release diet effect on field survival and dispersal of *Anastrepha ludens* and *Anastrepha obliqua* (Diptera: Tephritidae). J. Appl. Entomol. 137 (S1): 163–177)

Results

About 4% of the released individuals were recaptured and there were more flies from **S** treatment and less from **F** treatment than expected by random (Utgés et al. 2013).

	ANOVA WL		ANOVA WW		MANOVA	
	F	*P*	*F*	*P*	*F*	*P*
Distance	**23.733**	**$1.5\ 10^{-6}$**	**29.413**	**$9.0\ 10^{-8}$**	**15.580**	**$2.7\ 10^{-7}$**
Diet	**4.750**	**0.009**	**3.838**	**0.022**	**2.597**	**0.035**
Distance:Diet	**0.436**	**0.647**	**0.998**	**0.369**	**1.496**	**0.201**

Table 1: MANOVA and ANOVA analysis revealed significant differences between distance classes (near and far traps) and among diets. Interaction between the factors distance and diet was not significant in any case.

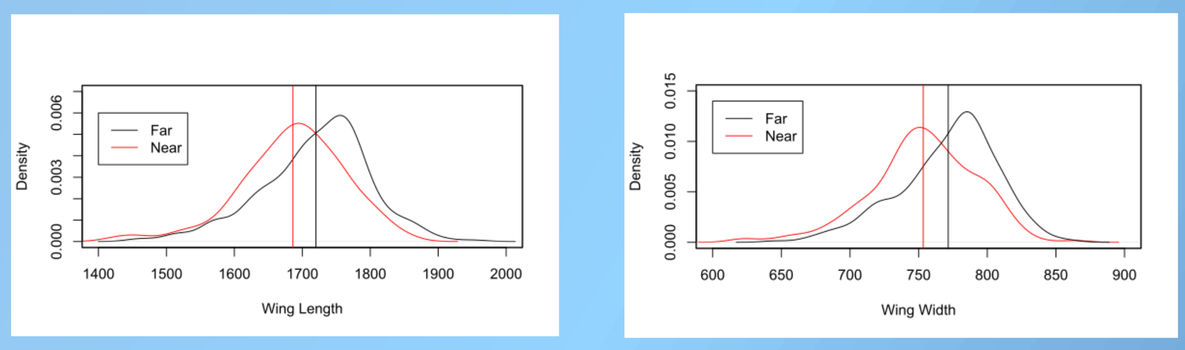

Figure 2 shows the empirical distribution and means of wing length (left) and width (right) for *Anastrepha ludens* males captured in the far and near traps. In average males from farthest traps have larger wings.

Spatial analysis (*Geneland*) identified two posterior clusters (depicted below in grey and green).

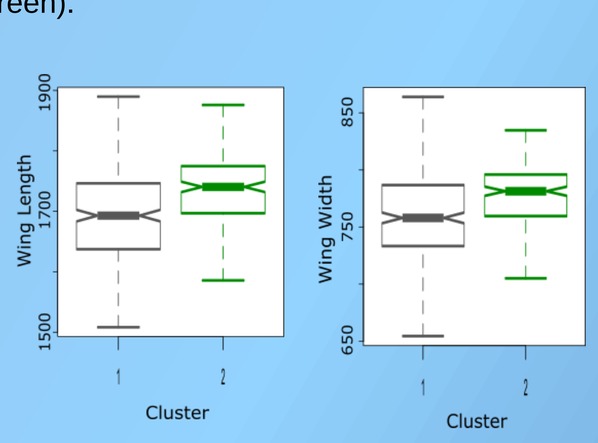

Figure 3 shows the differences between the posterior clusters for wing length (WL, left) and width (WW, right). Differences between clusters were highly significant according to both ANOVA (WW: P=5.74*10^{-10}, WL: P=3.61 10^{-10}) and MANOVA (P= 1.18 10^{-9}).

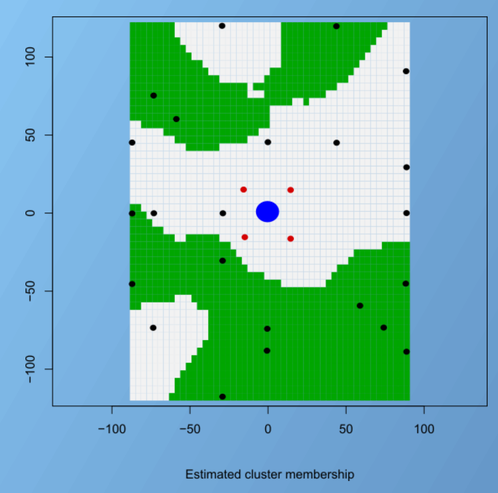

Figure 4. Spatial distribution of posterior clusters. Red dots: Near traps. Black dots: Far traps. Blue dot: release point. Cluster 2 included only individuals captured by the far traps while cluster 1 had individuals from both trap groups.

Conclusions

- An effect of diet treatment was observed in fly dispersal ability although it could be an artifact due to the different number of individuals evaluated as a consequence of differences in the number of capture flies among treatments.
- Two groups of phenotypically different flies were found occupying different regions within the study site.
- At first sight, data would support the hypothesis that individuals with larger wings are able to disperse farther than those with smaller wings. This would suggest that, in order to enhance the SIT efficiency, it would be advisable to release flies with larger wings. This could be included in the quality control tests.
- The approach used in this study may contribute to evaluate the effects of rearing conditions over morphometric traits and its consequences over the range and direction of the dispersal of the released insects.