EFFECT OF FRUIT MATURITY ON MANGO INFESTATION BY FRUIT FLIES

FROM EXPERIMENTAL ANALYSIS TO MODELING

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Introduction

Fruit flies (Diptera: Tephritidae) are pests of economic importance in many crops including mango, *Mangifera indica* L. Flies lay eggs into fruit where the subsequent larvae feed and develop, causing both quantitative and qualitative losses. Fruit maturity is known as a major factor of fruit fly infestation. Our aim is to better characterize and model the relationship between fruit maturity and mango infestation by fruit flies.

Material and Methods

The study was conducted in Reunion Island and Senegal on four mango cultivars ('Kent', 'Irwin', 'Cogshall' and 'José') and consisted in monitoring **artificial infestations in the laboratory (no-choice tests in cages)** with two *Bactrocera* species (*B. zonata* in Reunion Island and *B. dorsalis* (syn. *B. invadens*) in Senegal) and **natural infestations in the orchard.**

➢ **Fruit infestation recording**

▲ *Fruits exposed to flies in cages or harvested in the orchards were placed in boxes with sand until pupation. Then, pupae were extracted from the sand, counted and stored until adult emergence for species identification.*

➢ **Fruit maturity description**

− qualitative indicator: visual phenological stages (Green, Turning and Ripe)

The 3 stages for cv. 'Kent' ▲

− quantitative indictor: chlorophyll fluorescence (Fig.1)

Measurements were made at the bottom of fruits with a fluorimeter after dark-adaptation of the skin using clips ▶

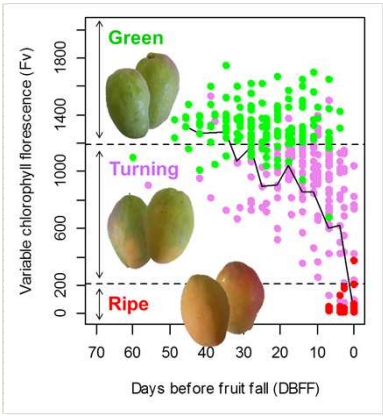


Fig 1. *Relation between variable chlorophyll fluorescence (Fv) of mango fruits, their visual phenological stages and their maturity level expressed in days before natural fruit fall (DBFF) for cv. 'Cogshall'. The solid line is one fruit dynamic.*

Results

❖ **In the orchards, mangoes were mainly infested by *B. dorsalis* in Senegal and *B. zonata* in Reunion Island**.
In Reunion Island, infestation rates of turning/ripe mangoes observed in orchards without pesticide applications were 8%, 12% and 37% (2014) and 15%, 8% and 19% (2015) for cv. 'Cogshall', 'José' and 'Kent', respectively.

❖ **Fruit flies displayed an egg-laying preference for mature mangoes but the maturity level at which the fruit elicits an egg-laying behavior of flies varied between fly species, mango cultivars** (Tables 1, 2) **and conditions of choice (in orchards) vs. no-choice (in cages)** (Table 2).

Table 1. *Mean number of B. dorsalis pupae per fruit according to mango cultivar and fruit phenological stage in no-choice tests*

Phenological stage	Kent	Irwin
Green	0 b	0 b
Turning	0 b	19 ab
Ripe	42 a	36 a

Individual fruits (n=15) were exposed to 25 B. dorsalis flies during 48h.

(Senegal, 2013)

Table 2. *Infestation rate of fruits according to mango cultivar and fruit phenological stage in no-choice tests (1) and natural infestations in orchards (2)*

Phenological stage	Kent [2]	José [2]	Cogshall [2]	Cogshall [1]
Green	0% a *(15)*	0% a *(31)*	0% b *(33)*	0% b *(11)*
Turning	25% a *(8)*	-	7% ab *(42)*	24% ab *(17)*
Ripe	13% a *(8)*	8% a *(24)*	22% a *(45)*	41% a *(22)*

Fruit number is indicated between brackets.
[1]No-choice test: individual fruits were exposed to 3 B. zonata flies during 24h.

(Reunion Island, 2015)

❖ **Infestation probability of mangoes (cv. 'Cogshall') significantly increased with the decrease in fruit variable chlorophyll fluorescence** (Fig. 2).
The relationship was modeled using a GLM with a binomial distribution and incorporated into a mango crop model predicting fruit yield and quality development (Fig. 3; *see Grechi et al. in this conference*).

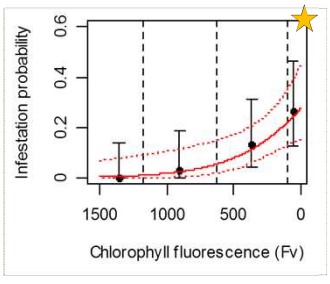
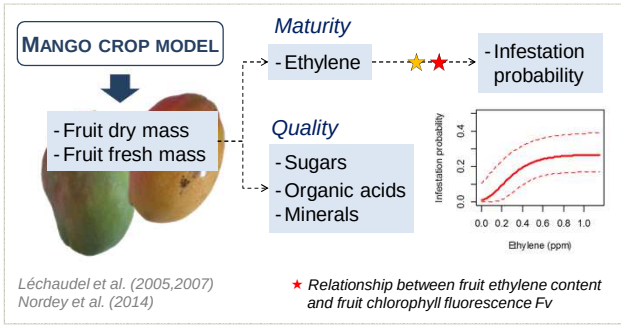


Fig 2. *Probability of a mango (cv. 'Cogshall') to be infested by flies according to variable chlorophyll fluorescence (Fv) for fruits in an orchard in Reunion Island in 2015.*

− *model predictions and 95% CI*
● *mean and 95% CI of observations per class of Fv*

Fig 3. *Schematic description of the modeling framework*



Léchaudel et al. (2005,2007)
Nordey et al. (2014)

★ *Relationship between fruit ethylene content and fruit chlorophyll fluorescence Fv*

Discussion and conclusion

- A further step is to improve the model by incorporating the effect of fly abundance (i.e., fly to mango ratio).
- From an applied point of view, the mango crop-pest model should be used to optimize harvest stage of mangoes for a compromise between fruit quality and risk of production losses, and design of management solutions for a sustainable mango production.

References

- Léchaudel et al. (2005) Tree Physiol. 25:583-597
- Léchaudel et al. (2007) Tree Physiol. 27: 219-230
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