Notes on rhythms observed in the duration of flower anthesis throughout flowering in cherimoya on the island of Tenerife

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Rhythms and duration of flower anthesis in cherimoya on the island of Tenerife.

ABSTRACT
Hand pollination is the only certain strategy to ensure commercial production of the cherimoya, since its dichogamic flowers do not allow self-pollination and cross-pollination by insects cannot be assured, as only few possible pollinating insects are usually observed on the flowers. To make judicious use of this technique, studies on the length of anthesis and anther dehiscence were done on trees growing on the island of Tenerife. Data covering different periods of the flowering season in 1992 show that the flowers alternate rhythmically between the male and female state. Normally they do not present both states in the course of the same day except at the end of the flowering period, when a high rate of daily overlapping occurs. During the greater part of the flowering period, flowers can remain between 1 and 2 days in anthesis, whereas anthesis lasts for 2 days when male-female overlap occurs.

KEYWORDS
Canary Islands, *Annona cherimola*, pollination, anthesis, flowering.

Rythmes et durée de l'anthèse du chérimolier dans l'île de Ténérife.

RÉSUMÉ
La pollinisation manuelle est la seule technique fiable qui garantisse une production commerciale de chérimoles. En effet, les fleurs dichogames ne peuvent pas s'autopolliniser et la pollinisation croisée entomophyle ne peut pas être assurée. Des études sur la durée de l'anthèse et sur la déhiscence des anthères ont été effectuées aux îles Canaries, à partir d'arbres cultivés dans l'île de Ténérife. Les données montrent que les fleurs alternent de façon rythmique entre les états mâles et femelles. Elles ne présentent pas, habituellement, l'un et l'autre état au cours d'une même journée, si ce n'est à la fin de la période de floraison, où un fort taux de chevauchement journalier peut être observé. Pendant la plus grande partie de la période de floraison, les fleurs peuvent rester entre 1 ou 2 jours dans l'anthèse, alors que dans le cas de chevauchement des états mâle-femelle, cette phase dure 2 jours.

MOTS CLÉS
Canaries (îles), *Annona cherimola*, pollinisation, anthèse, floraison.

Ritmos y duración de la antesis del chirimoyo en la Isla de Tenerife.

RESUMEN
La polinización manual es la única técnica fiable que garantize une producción comercial de chirimoyas. Efectivamente, las flores dicógamas no pueden autopolinizarse y la polinización cruzada entomófilos no se puede asegurar. Se efectuaron estudios sobre la duración de la antesis y sobre la dehiscencia de las anteras en las Islas Canarias, a partir de árboles cultivados en la isla de Tenerife. Unos datos indican que las flores alternan de manera rítmica entre los estados machos y hembras. Habitualmente, no presentan uno y el otro estado en el transcurso de un mismo día, si no es al final del período de floración, donde un porcentaje importante de imbricación diario se puede observar. Durante la mayor parte del período de floración, las flores pueden permanecer entre uno y dos días en la antesis, cuando en caso de imbricación de los estados macho-hembra, esta fase dura dos días.

PALABRAS CLAVES
Canarias, *Annona cherimola*, polinización, antesis, floración.

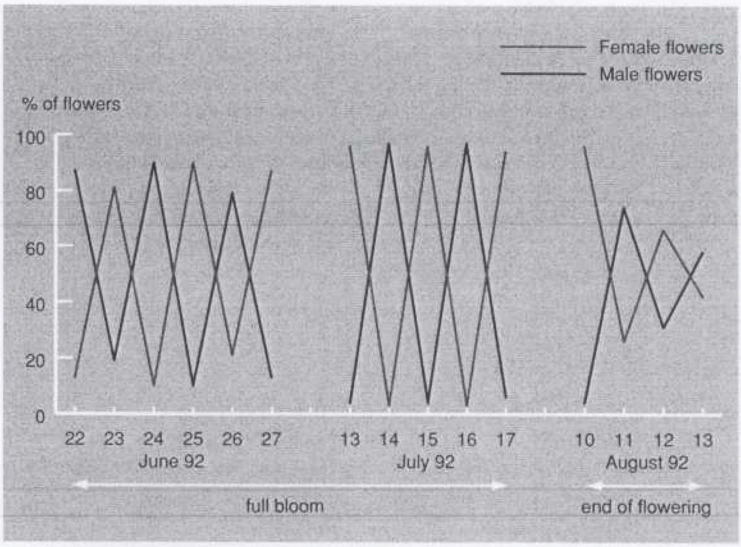
introduction

On the island of Tenerife, as in most other areas where cherimoya (*Annona cherimola* Mill) is grown, there is deficient natural pollination leading to a decline in fruit production frequently accompanied by malformations (WESTER, 1910; SCHROEDER, 1947). Reduced production has been linked to the dichogamic nature of the flowers, which hampers self-pollination (WESTER, 1910; VENKATARATNAM, 1958; THAKUR AND SINGH, 1965). Although the species is reputedly entomophilic (WESTER, 1910; GAZIT, 1982), literature clearly linking insect action to fruit set is scarce. Moreover, as male and female flower states do not often overlap, vector-engineered pollination is unreliable (SORIA *et al*, 1988) and hand pollination is necessary to ensure good production (WESTER, 1910; SCHROEDER, 1941; FARRÉ *et al*, 1976; SORIA *et al*, 1990).

The cherimoya flower is hermaphroditic and protoginous. Flower opening varies, depending mainly on climate, from any time between the late afternoon, around 17.30 hours, and noon of the following day (THAKUR and SINGH, 1965; GARDIAZABAL *et al*, 1985; SORIA *et al*, 1988). The female stage lasts some 26 hours (BLUMENFELD and GAZIT, 1974; SORIA *et al*, 1990) although SORIA *et al* (1990) report that stigmatic receptivity ceases some two to three hours before anther dehiscence. The transition to the male state is again variable according to climate but usually takes place between 1530 and 2000 hours (WESTER, 1910; VENKATARATNAM, 1958; GARDIAZABAL, 1985; SORIA *et al*, 1990).

This study examines anthesis and anther dehiscence under the climatic conditions of the island of Tenerife in order to establish the need to use artificial pollination.

Figure 1
Percentage of cherimoya flowers in male and female stages.



materials and methods

Ten plants of 20 year old cherimoyas cv Fino de Jete (planting distance 8 x 8 m), growing on the north slope of Tenerife at an altitude of 300 m, were selected for study. Normal cherimoya flowering in this area takes place from May to August and picking during June and July. Data were recorded for the periods 22-26 June, 13-16 July and 10-13 August of 1992.

To establish male- and female-stage flower percentages, four main branches were tagged on each tree, each branch corresponding roughly to the cardinal points. Flower stages (female, male, or floral buds in different phases of development) were recorded by randomly-selecting daily, on each of the four branches, a section containing a maximum of 25 flowers. Starting each day with a different tree, readings were begun at 1700 hours, shortly after flowers changed from the female to the male state.

Anthesis evolution was monitored by marking 100 randomly selected flowers in pre-female stage, *ie* closed but tip of petals just opening (SORIA *et al*, 1990); each day, for each of the three data recording sessions. Data were recorded over three consecutive days as follows:

- day 0: pre-female flowers are marked;
- day 1: at 1000 hours, number of flowers either undergoing anthesis (female flowers) or wilted; at 1700 hours, number of flowers which had passed to the male state;
- day 2: at 1000 hours, number of flowers still in the female state; at 1700 hours, number of flowers which had passed to the male state.

Data are presented in percentages, graphically; maximum and minimum temperatures during observation periods are also presented.

results

percentages of male and female flowers

The daily alternance of maximum percentages of male and female is clearly seen in figure 1. Although alternance is constant throughout flowering, the percentages tend to converge towards the end of the flowering period.

length of anthesis

Depending on individual flowering periods and marking dates, flowers can either undergo anthesis in which case, they stay either one or two days in anthesis or pass directly to the male state (fig 2).

It can also be observed that during most of the flowering period there are clear differences from one day to the next for those flowers which transit from female to male: for day 'i', this takes two days; for day 'i+1', only one day is needed. Changes directly from the prefemale to the male state only occur on alternate days. Only at the end of the flowering season do practically all of the flowers remain two days in anthesis.

discussion and conclusion

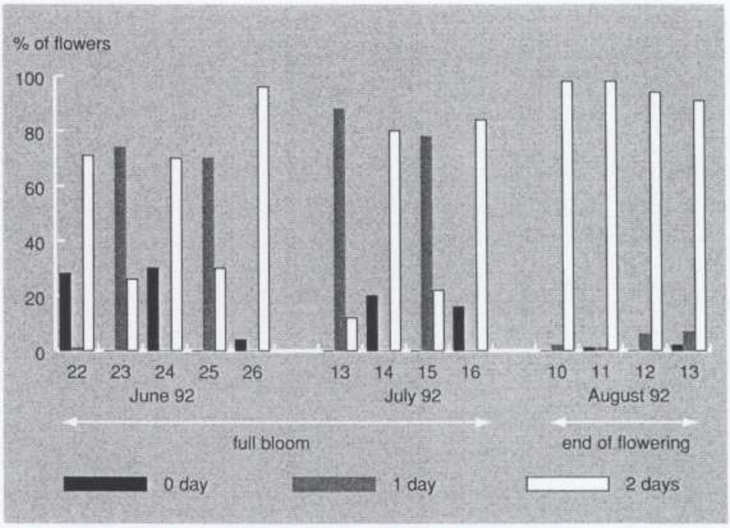
The synchronic rhythm of change from female to male stage would explain the lack of overlapping of both flower stages during the period of maximum flowering not only at the tree level but also at the plot level. A brief period of overlap does appear at the end of the flowering season (fig 1). In general this agrees with the findings of SORIA *et al* (1988) and GARCIA DEL CORRAL (1989), although the latter notes overlap precisely during maximum flowering. This rhythm does not appear to be temperature-dependent (fig 3), which is in line with other biological rhythms also not dependent on temperature (SALISBURY and ROSS, 1985).

The different length of the interval 'pre-female flower to male flower' (0, 1, or 2 days) can also be attributed to a biological rhythm, as represented in figure 4a, which shows a different behaviour pattern for the flower marked on day 'i' with a lower percentage passing directly from pre-female to male stage from the ones marked day 'i+1': the 'i' flower is in anthesis for two days, whereas the 'i+1' is in anthesis only for one day.

This is a cycle which is repeated throughout the period of maximum flowering, with no overlap either of flowers from the same tree or among those of different trees.

The mechanisms governing this type of rhythm are not clearly understood on a physiological level (SALISBURY and ROSS, 1985). A tentative explanation, requiring physiological corroboration, could be the intervention of an endogenous mechanism related to the existence on day 'i+2' of a large quantity of female flowers in the process of changing

Figure 2
Percentage of cherimoya flowers undergoing 0, 1 or 2 days pre-female-male intervals on given tagging dates.



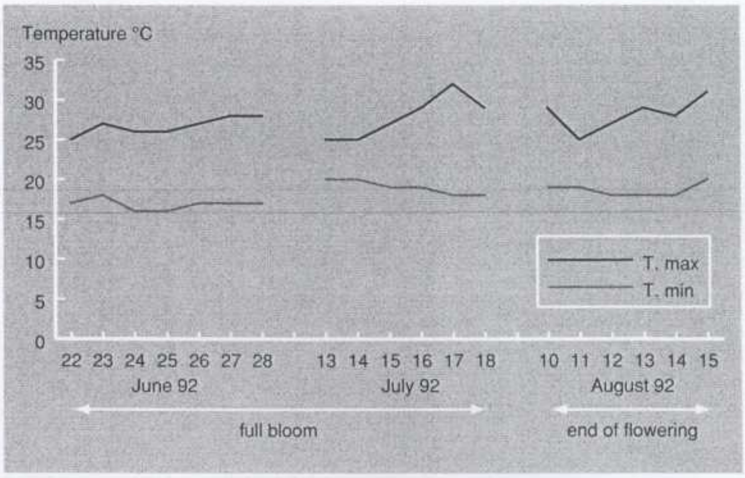
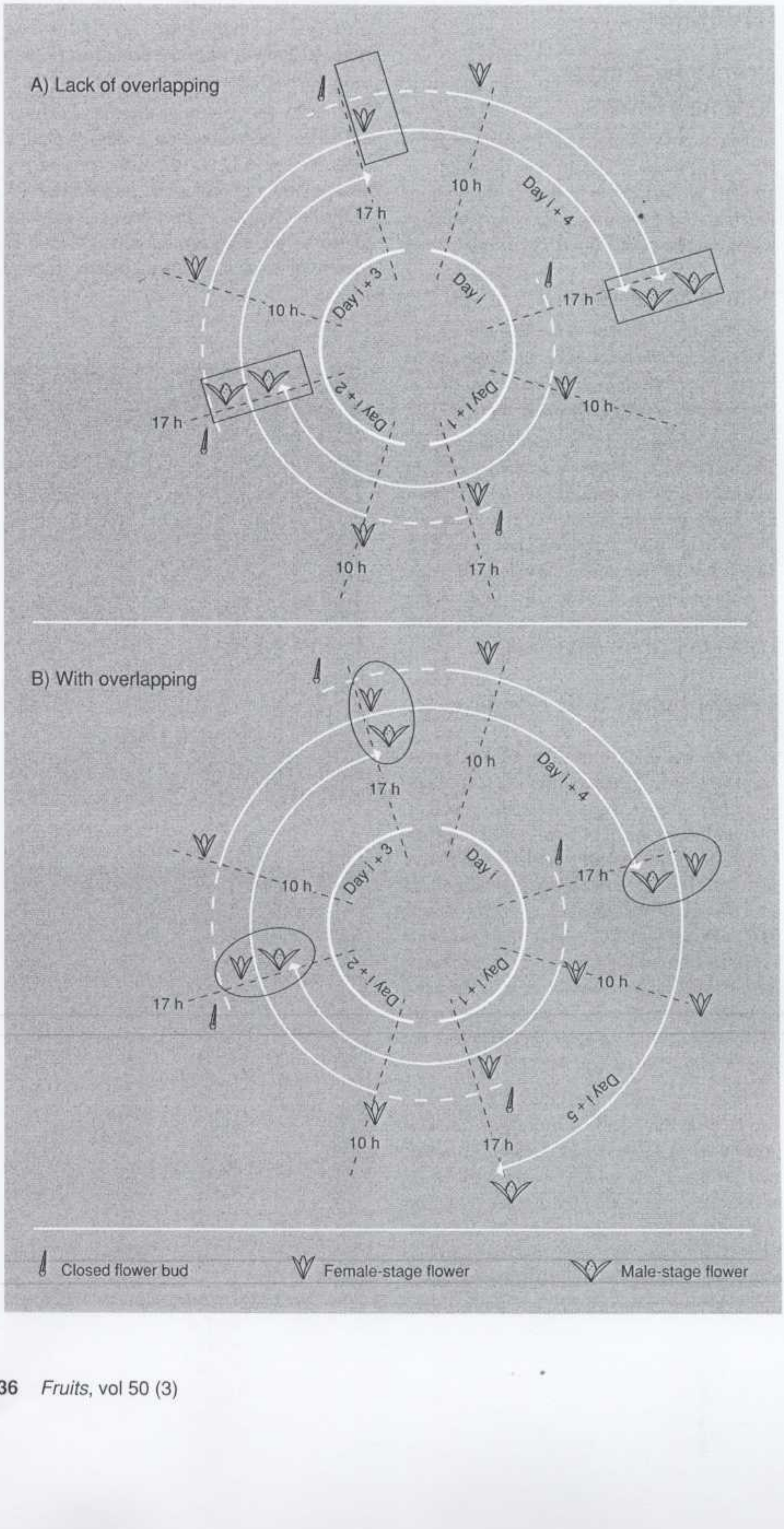


Figure 3
Local temperatures registered during cherimoya flowers trials.

Figure 4
Biological rhythms observed in cherimoya flowers.



to the male state, which would shorten the interval female flower-male flower of those flowers undergoing their first day of anthesis. This hypothesis could also explain the considerable quantity of pre-female flowers found in the afternoon 'i+2', whose anthers mature without producing anthesis and which does not occur on alternate-day flowers.

It is clear that this synchronism observed during cherimoya flower anthesis could represent the dichogamic mechanism by which this species tries to assure cross-pollination; for this reason, in our case with only one cultivar, synchronism is established not only between flowers on the same tree, but is extended to the entire population. At the end of the flowering period, overlapping of the male and female states between the different flowers is observed as a consequence of almost all of the flowers remaining two days in anthesis (fig 4b). This could be explained by the existence each day of a hormonal balance which impedes premature anther dehiscence and floral part abscission.

In conclusion, manual pollination is necessary throughout all the flowering period but particularly in the picking months in which virtually no overlap occurs. The alternance of the male-female states and the alternance in the duration of the flowers are of prime importance when choosing the day on which pollen should be collected and the day on which to pollinate.

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