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PROCEDURES FOR MASS REARING THE WEST INDIAN FRUIT FLY, *Anastrepha obliqua*

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Abstract

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A series of bioassays resulted in a promising colony of *Anastrepha obliqua* (Macquart) for artificial production. A new model circular cage has been designed to achieve an increase in density of adults per cages, thus resulting in an increase in egg production. A bioassay for best egg production as well as constant hydration of eggs until collection time was chosen.. Cotton fabric gave the best results of the fabrics used in the oviposition panel. A new diet based on corn cob particles and with citrus acid instead of hydrochloric acid was tested and showed promising results in good production, quality and less risk in handling. The optimum humidity range for larva to pupa conversion was found to be 70-80%.

1. INTRODUCTION

With the purpose of eliminating restrictions to export mango, citrus caducipholious, guava and other non-traditional tropical commodities, as well as to eliminate direct damages to fruit production, the Mexico National Campaign against Fruit Flies was undertaken. This campaign let to the construction of a plant to produce insects at a massive level, in order to apply the Sterile Insect Technique (SIT) combined with integrated control strategies to reach control of fruit flies of economic importance, with the active participation of fruit growers and State governments.

Among the species of economic importance that the Fruit Flies Complex will produce a massive level is *Anastrepha obliqua* (Macquart). At present a promising colony is available for artificial production, after a series of bioassays for its adjustment process. This paper describes the procedures and advances reached in the rearing process of this species.

2. COLONY

2.1. Cages

At present the breeding colony is handled in Mission type cages with dimensions of 2.15 m (height) x 1.8 m (width) x 0.3m (depth). The front and rear of the cage are covered with a mesh made of glass fiber of 49 holes per square centimeter, except the center of the cage where the oviposition device is located which is called oviposition panel. Each cage houses 55,000 pupae and, with 90% emergence, it is possible to obtain an average of 0.5 adults per square centimeter. This density has allowed us to increase egg production to our present level in spite of the recommendation of Moreno [4] that the maximum density per cage must not exceed 0.2 adults per square centimeter in cages of 30 x 30 x 30 cm (5400 cm^2).

Since the beginning of mass rearing, a new model circular cage has been designed with the purpose of reaching an increase in density of adults per cage and a better egg production. Light intensity required for copulation under lab conditions will also be determined as a behaviour parameter prior to the oviposition period to increase breeding efficiency.

2.2. Oviposition panel

The oviposition panel has the following dimensions 1.5m (height) x 0.7m (wide) x 0.2m (depth). Searching for substrates that fulfill the needs of handling in a massive way, several bioassays were conducted to choose one with the greatest perspective for egg production which, at the same time, allows constant hydration of eggs until collection time.

The first of the assessed substrates was parafilm (American Company™) which although at the beginning was feasible for egg production has the disadvantage that, in order to keep eggs hydrated, it is necessary to use an ultrasonic humidifier in a permanent way; this is an electronic device not manufactured for this specific purpose but if it fails there is a direct effect on egg quality. On the other hand, this is a very fragile substratum which after 5 days in use (the average of egg production is from 12 to 15 days) tends to break down easily and needs to be totally replaced, which is not suitable.

Several types of synthetic fabrics were later assessed (commercially known as *organza, chiffon*, etc.) with 50 to 60 holes per lineal centimeter. A thin layer of silicon was applied to these fabrics on both sides and once placed in the panel some applications of fussellerone at 2% were added to keep eggs hydrated. Results of these assessments were not encouraging because of a lack of adherence of the fussellerone since the fabric was too thin; besides, flies preferred fabrics with fewer numbers of holes per lineal centimeter, which at the same time makes easier handling.

Later, the Research Laboratories in Welsaco, Texas, USA, reported that after several replicates they found a fabric with 16 to 18 holes per linear centimeter showed a better response to the oviposition behaviour in domes with natural red color paraffin (Moreno, D.S. 1994. Personal communication). However, this way of obtaining eggs was not operative in mass rearing processes; for this reason only the number of selected fabrics was evaluated. The result was a cotton fabric with 18 holes per linear centimeter, adapted to the vertical panel in the Mission type cages, which produced encouraging results and surpassed those obtained with other fabrics.

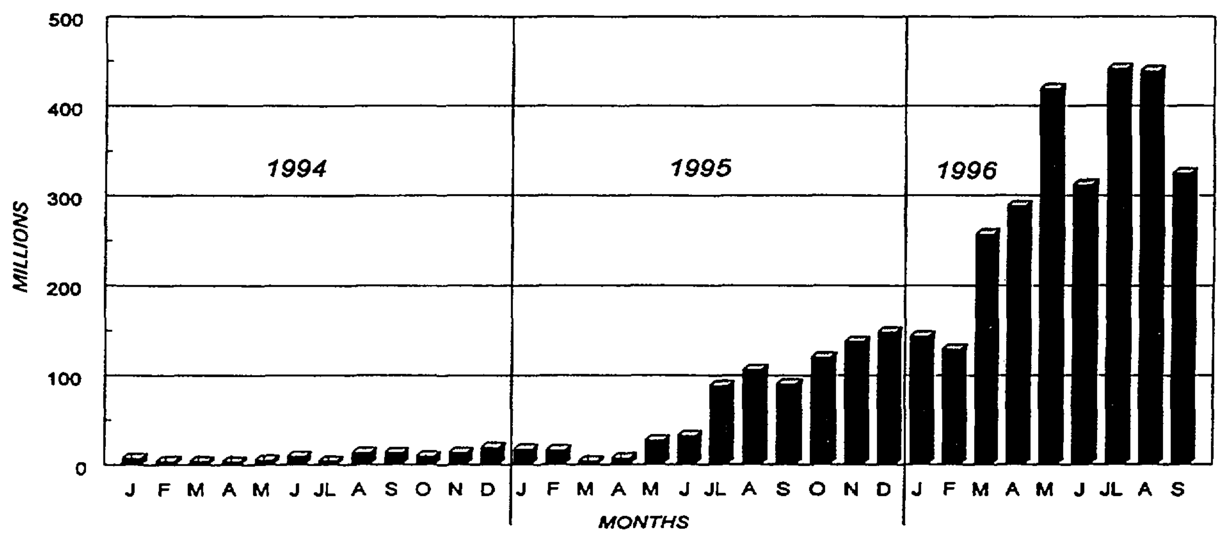

Figure 1. Egg production.

This fabric is called "*tuzor*" and is coated with a thin layer of silicon both sides, which allowed a uniform adherence of the fusselerone applied over it later. This kept the eggs hydrated. Finally, considering that most of the fruit flies present different responses to color attraction, and since yellow and green are the best attractants for *A. ludens,* [6] in *A. obliqua* the response of the adult to green, yellow, white and clear green was assessed. The best results in egg production were obtained on the dark green panel (Figure 1).

2.3. Luminosity

At the beginning and end of the photoperiod a low light intensity is used to favour mating behaviour. This is made by reducing gradually the number of fluorescent lights until a range of 30-40 candles is obtained. Once oviposition starts, light intensity is directed to the oviposition panel in a range of 70-80 candles.

2.4. Photoperiod

During the colonization stage, breeders were kept with light for 24 hours but at the beginning of the mass rearing, the photoperiod was modified to 10 hours of light and 14 hours of darkness.

3. EGG INCUBATION

To determine the adequate process for egg incubation, several methods were evaluated.

3.1. Petri dishes

First, eggs are placed on a humid mesh within the Petri dishes which are also placed inside containers made of styrofoam in order to keep a temperature of 26-27°C to favor hatching at the seeding time. However, since these containers are not hermetically sealed , dehydration of eggs was continuous. To solve this problem, a light layer of fusselerone was placed on the fabric but as it was a favourable medium for development of microorganisms there was contamination that reduced the efficiency of recovery of larvae.

3.2. Bubbling system

Finally as production increased, the handling of these containers was not cost effective and led to the assessment of the bubbling system by means of a pump for a fish bowl with a semi-industrial capacity. This method allowed us to handle a constant temperature within the bubbling bottle at 26-27°C and to assure hatching at the seeding time in 25% at 48 hours of incubation. It also made disinfection of the biological material feasible, avoiding an increase of the microbial population to the point of affecting eggs viability.

4. DIETS

Knipling [2], Guerra *et al.* [1] and other authors state that for mass rearing purposes, the insect must be reared at the lowest possible cost, which means that the maximum number of insects has to be produced with a minimum of material resources, manpower and time, without affecting the quality of the final product.

4.1. Gel diet

Originally, A. obliqua rearing was kept in a diet based on texturized beet but as it was not operative the search of a better alternative started. At the same time and to the end of increasing production, a diet of gel texture that follows the formula of the Welsaco, Texas, USA laboratories [5] was used. This diet is completely rich in nutrients for insects, although it has the inconvenience of a high cost and more handling during its preparation for mass rearing purposes.

4.2. Corn cob particle diet

In order to decrease costs and to keep the quality, a new diet was tested; it was based on corn cob particles as texturizer, sugar as a carbohydrate source, torula yeast as a protein source, and microbial inhibitors and vitamins as insect fortifier. Finally a standard formula was obtained with perspectives of increasing the egg to larvae transformation and assure a constant quality of the final product.

The only inconvenience of this formula is that contains hydrochloric acid which for rearing at massive levels presents a potential risk not only for personnel health but also for deterioration of facilities. For this reason, since the beginning of this year the gradual replacement of this ingredient has been under research. It has been replaced by citric acid which has shown promising results taking into account good production and quality and less risk in handling.

5. LARVAE

The percentage of larval recovery reflects the egg to larva efficiency in any mass rearing process. At the beginning there were problems to reach the present production levels, which were due to egg collection and poor larval diet. However, in mid 1996, larval recovery started to be more consistent as a result of changes made at the colony, mainly because of the establishment of the new oviposition panel and the use of the new larval diet; the colony slowly has been getting adjusted to mass rearing conditions. Figure 2 shows the larval increase obtained. At present an egg to larva conversion of 30% is obtained with a weight of 20 mg which favours 90% pupation at 24 hours.

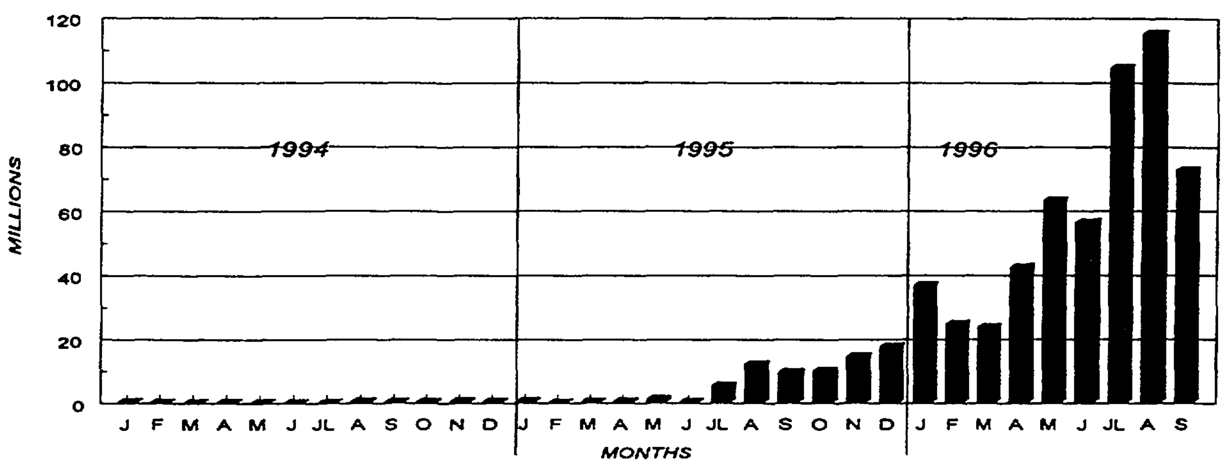

Figure 2. Larvae production.

6. PUPAE

Since the beginning of the colonization the part of the process with less problems has been the larva to pupa conversion, which registers a transformation of 85-90%. However, it is important to mention that the optimum humidity range is 70-80% but if it gets out of this range the quality is seriously affected, and is reflected in the quality of the adult to be released in the field and in the colony members. These facts demand that environmental conditions remain at the established ranges.

Figure 3 shows monthly pupal production indices which have allowed maintenance of a constant number of cages in the colony. At present, average pupa weight oscillates from 15 to 16 mg.

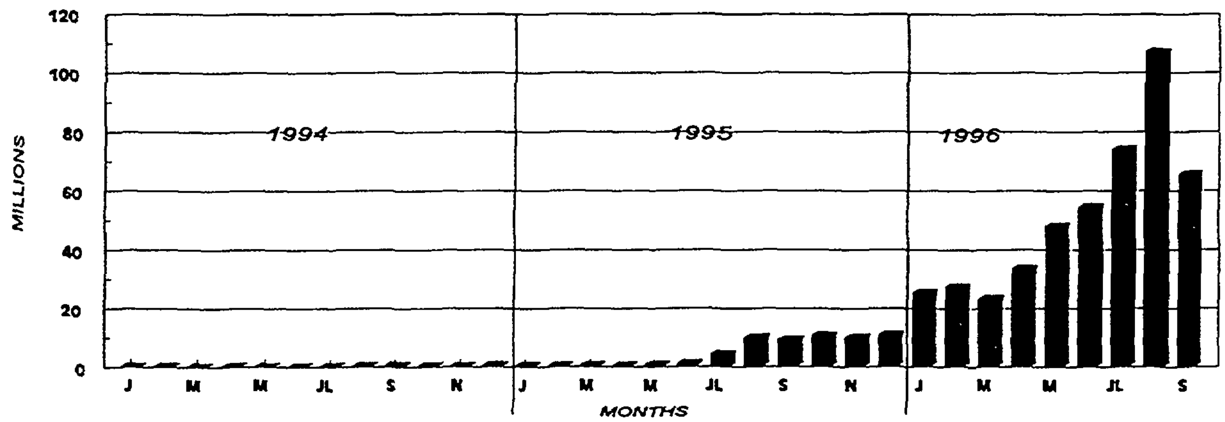

Figure 3. Pupae production.

Special care has been given to the quality of *A. obliqua* since all the biological material is returned to the breeding colony. Liedo and Carey [3] recommend this special care in the rearing of flies that will form the colony to minimize adverse effects on quality of the produced flies.

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