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Artisanal extraction of native chili seeds (*Capsicum* sp.)

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ABSTRACT

Objective: To establish a methodology for the artisanal extraction and benefit of chili pepper seed from native and wild chili pepper varieties.

Design/Methodology/Approach: From 2016 to 2019, nine chili pepper ecotypes were evaluated. The ecotypes include: habanero (*Capsicum chinense* Jacq); Ixcat ik, Bobo, Sweet, Maax, Bolita, Green (with red ripening), green (with yellow ripening), all of which belong to the *Capsicum annuum*; and Pico Paloma (*Capsicum frutescens*). The aim of the evaluations was to determine the morphological characteristics and the degree of genetic diversity. The extraction and exploitation method of the seeds was also evaluated. Cutting knives were used to extract the seeds. The seeds were dried in the open air, sheltered in closed and ventilated places. Both glass and plastic containers were used to store the seeds; the jars were lined with kitchen foil.

Results: Two seed extraction procedures were used. Medium and large ecotype fruits were subject to circular and longitudinal cuts. For their part, small fruits were macerated. In order to dry the seeds, they were placed on metal trays or in perforated plastic baskets. The trays or bags were placed in ventilated and cool places (<40 °C) for 8 to 10 days. Afterwards, they were stored at 5 °C with low moisture and without light.

Findings/Conclusions: The proposed methodology to obtain and exploit seeds in humid tropic conditions will support the conservation of the *Capsicum* resource, in the state of Campeche and the Yucatan Peninsula.

Keywords: Extraction, artisanal, native varieties of chili, wild chili peppers.

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INTRODUCTION

The Yucatan Peninsula is an important region for the diversification of chili (*Capsicum* spp.) species (Morales-Soriano *et al.*, 2018); consequently, their conservation is fundamental, given the economic and cultural importance that chili has for the rural communities. Native and wild chili species can be found in rural areas. In many backyards and *milpas* of the Yucatan Peninsula, there are wild chili peppers populations. The seeds of these chili plants have been spread by birds, sometimes from the environment, sometimes from other backyards and *milpas*, and they grow without human intervention. These plants are tended and used by local farmers, who harvest their fruits (Jardon-Borbolla, 2017).

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Given the importance of the *Capsicum* genera conservation as a native regional resource, the seed must be considered as a basic link in the production and reproduction of native species. Additionally, it plays a key role in the conservation of genetic resources. Commercially speaking, although introduced seeds are used, many producers in rural communities sow their own chili plants, extracting the seeds of the fruits of plants grown in small plots or backyards. Regarding wild chili species, producers extract the seeds from the fruits they harvest.

Therefore, the objective of this study was to provide chili producers with knowledge that allows them to improve how they select and conserve seeds. This study includes recommendations that can be applied by the producers based on the evaluations carried out in the research.

MATERIALS AND METHODS

From 2016 to 2019, nine chili pepper ecotypes were morphologically evaluated. The varieties were: habanero (*Capsicum chinense* Jacq); Ixcat ik, Bobo, Sweet, Maax, Bolita, Green (with red ripening), and green (with yellow ripening), all of which belong to the *Capsicum annuum* variety; and Pico Paloma (*Capsicum frutescens*). They were collected in the rural areas of Calkiní, Campeche, Champotón, and Palizada. Additional to the morphological evaluation, an artisanal seed extraction method was established, taking into account the color and size of the fruits, as well as the extraction, drying, and storage of the seeds. The experimental design used in the study of the chili ecotype morphologies consisted of random blocks, with three repetitions, 1.5-m long furrows, and 0.25 m between plants. Taking into account the abovementioned arrangement, seed samples were collected from 10 plants per repetition. The seed was extracted from the best fruits, which were chosen according to their size and color. Crop management was carried out according to the recommendations proposed by Soria *et al.* (2002).

RESULTS AND DISCUSSION

The results of the research carried out in four sowing cycles in order to evaluate the morphology and genetic diversity of native and wild chilis, allowed us to determine the artisanal seed extraction method in the humid tropic. This method took into account the different fruit selection stages: seed extraction, seed drying and exploitation, and seed storage.

Selecting fruit for seed extraction

The artisanal extraction of the seed begins with the selection of ripening fruits from healthy and pest-free plants. This selection is carried out using both native varieties grown by the farmers and wild chili varieties.

The results showed that the best fruits based on their germination capacity (90%) were those that reached their physical maturity. Red chilies prevailed, although the final coloring included yellow, orange, brown, and red shades, among others. These results matched the findings of Ayala-Villegas *et al.* (2014), who obtained 80% gemination using ancho pepper and árbol chili. Preferably, the fruits must have the same size, color,

Figure 1. Chili (*Capsicum* sp.) ecotypes evaluated. From left to right and from top to bottom: Habanero (*Capsicum chinense* Jacq), Ixcat ik, Bobo, green (with red ripening), Sweet, Maax, green (with yellow ripening), Pico de paloma, and Bolita.

shape, and number of loci. They can also be selected by their pungency level (Reveles-Hernández *et al.*, 2013).

In the small plots where the fruits were selected for seed extraction, the best fruits belong to the second cut, when the plant is still young and strong. They were selected taking into account the physical and physiological characteristics of the seeds. In order to obtain the fruits and extract the seeds, selecting complete competition, healthy, non-flattened, pest- and disease-free plants is recommended. This selection was carried out according to the Reveles-Hernández *et al.* (2013) methodology.

The fruits of wild chili plants are usually collected taking into account their red coloring or ripening color. The fruits were gathered from plants with similar characteristics to plants in production plots. The characteristics of the seed (*e.g.*, size, weight, and germination percentage of a given ecotype) change depending on the harvesting region or area. This matches the findings of Carrillo *et al.* (2009), who concluded that the characteristics of the seed of water chili change according to the gathering place.

Seed extraction

In the case of habanero chili and sweet chili, a longitudinal and circular cut must be made along the base of the fruit. Using this technique, the seeds will remain attached to the placenta and they will easily come off. Subsequently, the seeds can either be kept in the fruit and extracted once they are dry or they can be extracted immediately. Therefore,

the most appropriate method for fruits with an elongated shape in which the placenta runs along the fruit is a longitudinal cut.

For small chilies such as Maax, Pico de Paloma, or Bolita, the fruits are placed in a container with water and macerated with a solid object. They must be treated carefully, trying not to harm the seed. Another way of extracting the seed is to place a certain number of fruits and water in a blender and blend the mixture for very short periods, at the lowest possible speed. Subsequently, the content must be poured into a container, where the seed extraction will begin. The pulp with which the seed is mixed can be removed washing the mixture with water. The waste pulp and seed will become a supernatant that can be removed with a small sieve. The useful seeds will remain in the bottom of the container.

Drying and exploitation of the seeds

Once the seeds were extracted and washed, they were left in a sieve to drain. Subsequently, they were dried for 8-10 days, following the recommendations of Gaviola (2020). They suggest placing the seeds in metallic meshes or big sieves that allow air circulation. The seeds should be placed in a dry, shaded, and ventilated place, at less than 40 °C; these recommendations are different from those of Gaviola (2020), who recommended drying the seeds directly in the sun in dry weather regions. Under the humid tropical weather

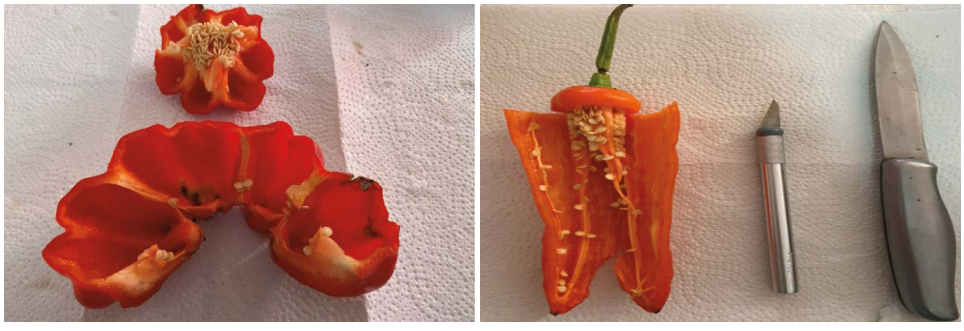

Figure 2. Extraction of seeds from large *Capsicum annum* fruits. Left: sweet chili. Right: Ixcat ik chili.

Figure 3. Extraction of seeds from small-sized fruits Maax (*Capsicum annuum*).

conditions of this study, drying the seeds in the sun damaged the embryo and, consequently, the germination capacity was lost. In addition, the seeds must be constantly shaken during the drying process to promote an even loss of humidity, avoiding fungi diseases. This procedure confirms the findings of Reveles *et al.* (2013). Common fans at low speed can be used to accelerate the drying process, as proposed by Gaviola (2020).

In order to avoid the appearance of fungi during the storage of the seeds, Captan 50 WP (fungicide) can be applied in a 1.0 g L^{-1} water dose. Other treatments such as 5 mL^{-1} water of Vitavax 200F® (Carrbonin and Thiran) or 5.0 g L^{-1} of Interguzan (Cabañas and Galindo, 2004) can also be used. Under rural conditions, a good practice to avoid diseases is to mix the seeds of larger chilies with ash, which reduces the humidity in the seeds. Once the seeds were subjected to these treatments, they were left to dry at room temperature for three days. Subsequently, they were placed in plastic or glass containers, covered with kitchen foil (Reveles-Hernández *et al.*, 2013). Glass containers are the preferred option for this process.

Seed storage

After the seeds were dried, they were put into glass jars and kept in refrigeration at 5 °C, with relatively low humidity (Colley *et al.*, 2010) and scarce light. We used plastic and glass jars to store the seeds. The results were positive, due to their hermetic seal; however, aluminum cans and bags can also be used to store the seeds. According to this research, the containers must be covered with kitchen foil to avoid light during the storing stage; this technique favors the viability of the seed for longer periods (3 to 5 years) as mentioned by Berke (2001).

Figure 4. Pico Paloma (*Capsicum frutescens*), Rosita habanero (*Capsicum chinense* Jacq), Bolita, and Green (*Capsicum annuum*) seeds after the drying process.

Inadequate storing conditions can cause a reduction in the seed quality, as a result of the loss of its germination capacity, the reduction of its longevity, or its exposure to antagonistic pathogens (Steiner, 2012). The humidity content of the seed was not measured at the moment of its storage; however, in order to extend its viability, a 5% humidity is recommended (Tay, 2004).

CONCLUSIONS

The proposed methodology for the extraction and exploitation of seeds, under humid tropic conditions, will help greenhouse growers and a great number of chili producers in the state of Campeche and the Yucatan Peninsula. It will contribute to the conservation, reproduction, and production of the native chili ecotypes.

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