Short Research Article

EFFECT OF FLORIVORY ON THE DONATION AND DEPOSITION OF POLLEN IN *Ipomea imperatii*

SUMMARY

The potential effect of florivory on donation and deposition of pollen in *Ipomea imperatii* was studied. Three different levels of flowering damage (0%, 25%, and 75%) were applied to emasculated and non-emasculated flowers and the number of pollen donated and deposited was measured. It was found that there are significant differences for the variables measured between the treatment 75% and the rest of the treatments. It is concluded that the florivory has a negative effect on pollen transport of *Ipomea imperatii* it is proposed that this negative effect is associated with a change in visiting patterns and behavior of the pollinators.

KEY WORDS: *lpomea imperatii*, florivory, adequation, deposition of pollen, donation of pollen

INTRODUCTION

Florivory is the process in which a predator consumes totally or partially flowers, differing from the herbivory by the specificity of the tissue removed and their consequences on the plant reproduction. Damage caused by florivory includes bracts, sepals, petals, stamens, and pistils, as well as pollen and ovules (Burgess 1991, McCall and Irwin 2006). Herbivory, however, causes a direct reduction of photosynthetic tissue, deteriorating the competitive capacity and the adequacy of the plants and reducing the availability of resources (Crawley 1983). Likewise, florivory is associated with decreasing the attractiveness to pollinators and hence their success in pollination. Moreover, many reproductive structures, including petals, sepals, anthers, and carpels, can be photosynthetically active and produce a substantial amount of photosynthesis in some plant species (Hogan et al., 1998; Aschan & Pfanz 2003; Aschan et al., 2005).

This antagonists interactions (florivory and herbivory) can sometimes have different effects on plant population dynamics as population growth rates can be differentially sensitive to changes at different life-history stages for example trees vs. vines. The shape, odor, color, and symmetry of the flowers usually work as adaptive systems of restriction of pollinators (Price 1997), so that lost in their attributes caused by herbivores, can represent lost in the capacity of pollination and transport of pollen. The florivory directly affect male and female fitness by consuming all kinds of gametes (pollen and ovules) as well as pistils and stamens (Leege & Wolfe 2002; Canela & Sazima 2003).

The aim of this work is to determine the effects of differential levels of floral area removal on pollen donation and deposition, which may be a good indicator of male and female adaptation of *lpomea imperatii*. our underlying hypothesis is that; Due to the effect of the florivory on the symmetry and appearance towards the pollinators, it would be expected to find that the greater floral area removed less will be the donation and deposition of *Ipomea imperatii* pollen.

MATERIALS AND METHODS

The present study was developed in the biological station of the Coastal Research Center La Mancha (CICOLMA) located in the municipality of Actopan, Veracruz (190 35 '25 N, 960 22' 49 W). CICOLMA has an extension of 83.29 hectares (Moreno-Casasola and Monroy, 2006), in whose heterogeneous landscape there is an area of dunes where this work was carried out.

Ipomea imperatii

Perennial creeping vine, from rhizomes. Stems prostrate, ascending to about 15 cm, rooting at the nodes, reaching up to 30 m from the original root. Leaves are alternate, petiolate, leaf blade variable, often linear, lanceolate to cordate or 3-5-lobed, 10-15 cm long, 5-7 cm wide, glaucous green, densely arranged. Flowers are white with a yellowish center, 5-7 cm across, funnel-shaped, with flat spreading petals, each with a longitudinal crease. Flowers open early in the morning and close at dusk. Fruit is a rounded capsule (Lonard and Jude 1999)

I. imperatii is self-incompatible. The five epipetalous stamens are unequal in length and have anthers that dehisce extrorse. Self-specific incompatibility occurs due to a failure of the echinate pollen grains to germinate. If germination occurs occasionally, pollen tubes rarely grow longer than two pollen diameters (Martin, 1970).

Methods

A total of 72 plants of *Ipomea imperatii* were located taking care that they were developed in an area as homogeneous as possible, to eliminate possible environmental effects. Three groups of 24 flowers were randomized to these plants and three flower removal treatments were applied, 25%, 75% and one control (0%). To perform the damage on the flowers was used a hole maker whose damage resembles the natural damage.

The half flowers of each treatment (12 flowers) were emasculated, for this, the flowers were visited and before they were opened the anthers were cut so that at the end of the day

the pollen grains found in the stigma are the result of deposition by pollinators. The remaining 12 flowers of each treatment were used to calculate the percentage of pollen grains donated per treatment.

At the same time, 10 flowers were chosen, which were pocketed to avoid the movement of pollen by pollinators. From this sample of flowers was calculated the average number of pollen grains offered by the flower. With this data, the percentage of removal of pollen can be calculated by counting the grains of the non-emasculated flowers.

The analysis was performed as follows: To determine the percentage of pollen donation, we used data from non-emasculated flowers and compared them with a one-way ANOVA test with data transformation with arcosene (Zar, 2005). To compare pollen deposition data, the number of pollen grains per anther of the emasculated flowers per treatment was analyzed using a one-way ANOVA with data transformation with square root plus .5 (Zar., 2005).

RESULTS

As a first step, we quantified the total number of pollen grains *Ipomea imperatii* available for dispersion, finding that it was 866.41 (± 253.2 n = 10) grains per flower.

In order to analyze if there were differences in the pollen donation process, the total number of pollen grains in the three treatments without emascularity was found to be statistically significant in the total percentage of donated pollen ($F = 5.43$ $P = 0.009$). The treatment that pollen donated most was control with 95.9% of its total pollen. While the treatment of floral removal to 75% managed to donate 78.1% of the total of its pollen. A posteriori test of the means (Tuckey test) showed that the treatment of 75% of floral removal differs significantly from the rest, with no difference between the remaining two (25% vs. control) (Fig. 1).

Regarding pollen deposition, the emasculated plants of the three treatments were analyzed and found significant differences in the number of pollen grains found in the stigma ($F = 6.81$, $P = 0.003$). The treatment that showed the highest number of pollen deposited was in the control (0% florivory) with an average of 62.6 pollen grains in each stigma, while the treatment that received the least pollen was 75% of the floral area removed with an average of 24.4 grains per stigma. The a posteriori test of the means showed that the flowers with the 75% florivory treatment differed significantly from the two remaining groups (Fig. 2).

DISCUSSION

Traits such as flower color, size, number and type of reward all for pollen dissemination and receipt (Herrera, 1993; Conner and Rush, 1996; Galen, 1996) The results of this work suggest that there is an effect of florivory on the donation and deposition of pollen in

Ipomea imperatii, this observation can have two connotations, the first that florivory directly affects the ability of the plant to receive and donate pollen by processes (ie, it is possible that the plant may discriminate and limit the donation and deposition of pollen on heavily damaged flowers), this hypothesis can only be proved if we analyze the real adequacy (# of offspring) both male and female on damaged flowers. The other hypothesis, which is supported by the present study, would suggest that damaged flowers are poorly visited by pollinators, that is, their attractiveness is diminished, affecting not only the visit rate of pollinators but their foraging behavior, this hypothesis, which would be feasible to analyze, would suggest that in very damaged flowers pollinators would only make superficial visits, without showing clear pollination behaviors. In general the empirical evidence show a detrimental impact of flower herbivores on plant fitness. Inclusive when is analyzed the natural and artificial florivory, both tracks imposed a negative cost to plant reproductive. In fact, the natural damage is two-fold stronger than that of artificial damage (González-Browne *et al.*, 2016) this is a hard evidence of the evolution presure of the florivory on the plants

On the other hand, despite showing significant differences between treatments for the response variables, it is observed that for donation and deposition of pollen in the treatment of 75% of floral removal, deposition and donation values are relatively high (78.1% donation and 24 pollen grains per stigma). These could indicate that the effect of florivory might not be so severe, however, flowers with excessive damage do not close at the end of the day, therefore, reproductive structures are exposed to floral visitors who usually do not visit these flowers, and this may cause a compensation effect. In this respect, it would be interesting to explore a possible spatial and temporal segregation in the visitors of *lpomea imperatii* with high levels of flavor and its effect on the production of fruits and seeds.

An interesting aspect is that there is a large variation in the percentage of pollen donation in the treatment of 75%. This may support the idea of the temporary segregation of visitors since it seems that the visit of pollinators to this type of flowers, should be subject to the temporary shortage of less damaged flowers. It would be important to carry out similar studies with intermediate levels of floral damage, to determine the damage thresholds that show effects on pollen donation and deposition, as well as the behavior and rate of visits of pollinators to *Ipomea imperatii* or related species, due to the strong pressure of selection that is the florivory.

Figures

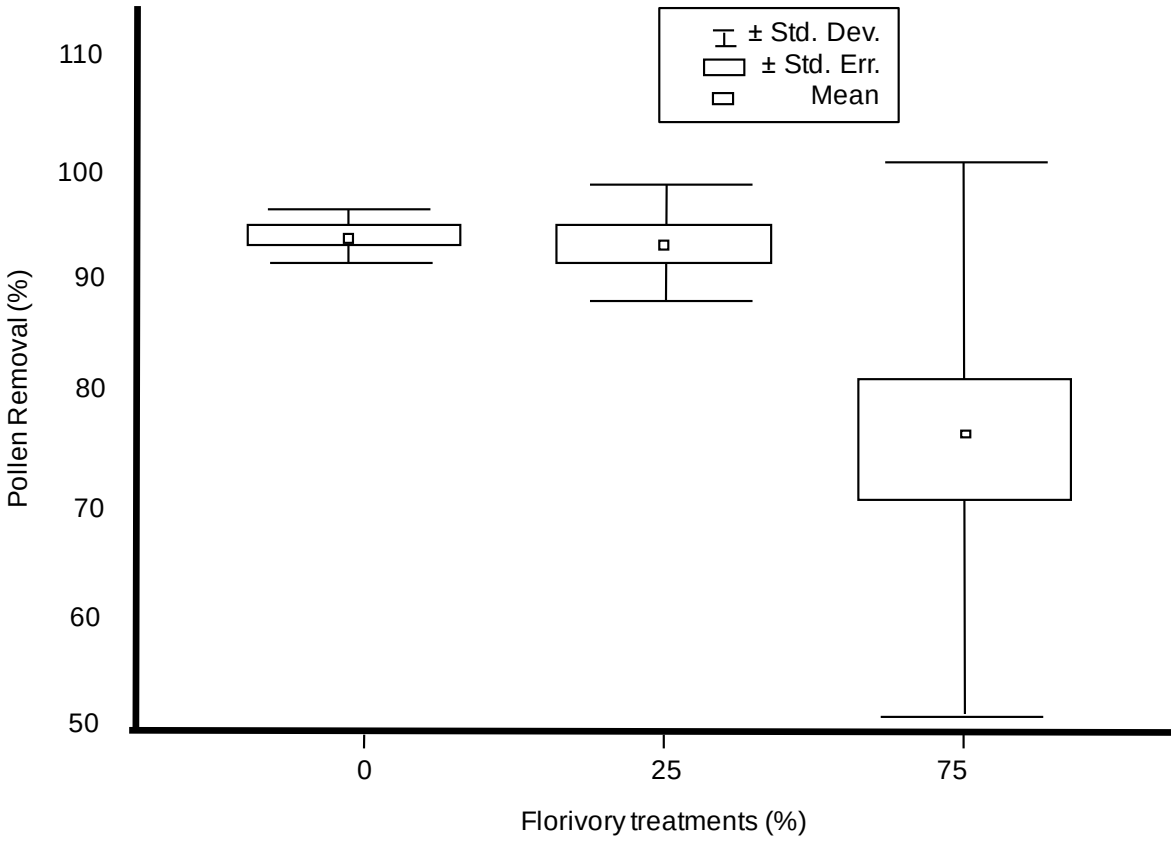

Figure 1.- Percentage of removal (donation) of pollen in florivory treatments.

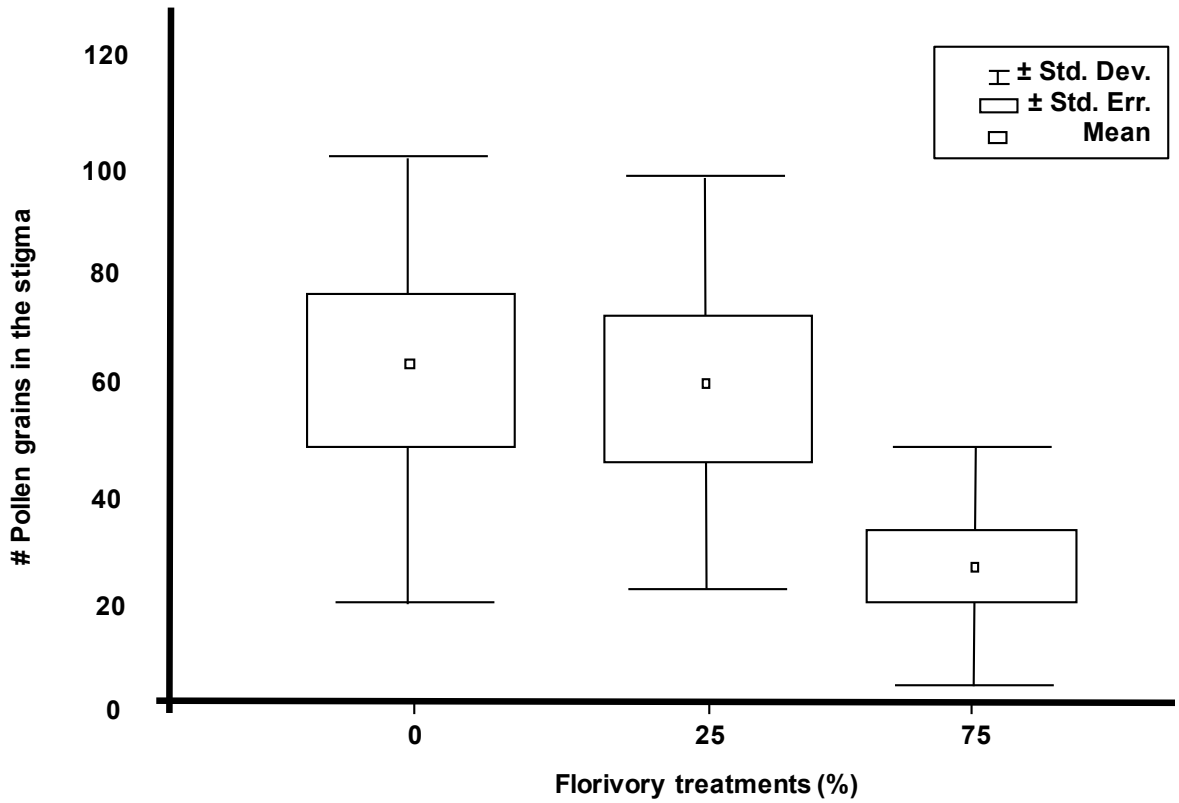

Figure 2.- Number of pollen grains per stigma in flowers subject to three levels of florivory.

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