Journal of Biology and Nature

Volume 15, Issue 2, Page 28-31, 2023; Article no.JOBAN.11531
ISSN: 2395-5376 (P), ISSN: 2395-5384 (O), (NLM ID: 101679666)

Floral Nectar Production of *Jaltomata grandiflora*, a Rare Mexican Nightshade

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.56557/JOBAN/2023/v15i28263

Short Research Article

Received: 25/03/2023
Accepted: 27/05/2023
Published: 08/06/2023

ABSTRACT

Understanding morphological, phenological, or chemical characters that promote reproduction, or limit it, is particularly important for rare plants. *Jaltomata grandiflora* is a rare member of the nightshade family (Solanaceae) from Mexico. In floral nectar, the mean cumulative sugar content per flower was 0.9 mg during the pistillate phase (day 1) and was significantly higher (1.25 mg) during the hermaphroditic phase (day 2). The mean cumulative nectar volume per flower was 0.99 µL during the pistillate phase and was higher (1.36 µL) but not significantly higher during the hermaphroditic phase. The mean sugar concentration (^{o}Brix) was 67.8 during the pistillate phase and slightly higher (70.3) but not significantly higher during the hermaphroditic phase.

Keywords: Dichogamy; Jaltomata; NECTAR; Solanaceae.

1. INTRODUCTION

Jaltomata grandiflora (B.L.Rob. & Greenm.) D'Arcy, Mione & Tilton Davis is a rare member of the nightshade family (Solanaceae) from Michoacán, Mexico [1,2]. Mione et al. [3] provide an account of the reproductive biology and nectar chemistry of this species. However, flowers of this species have two phases, pistillate and hermaphroditic (Fig. 1), and their sampling of nectar was limited to the pistillate phase (corolla fully open but anthers not yet dehisced). Given that nectar is the most important reward to animal pollinators [4], our goals were to expand the sample size used to study nectar production, and to fill in a gap in our knowledge by sampling both floral phases.

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Fig. 1. Flowers of *Jaltomata grandiflora*, pistillate phase (day 1, anthers not yet dehisced) on left and hermaphroditic phase (day 2, filaments fully elongated and anthers dehisced) on right. Units along the bottom are mm. Photo by Mileena Alvarez and TM

2. METHODS

Plants were grown at Central Connecticut State University from seeds generously provided by Tilton Davis IV, who collected them some four decades ago near or at the type locality (Mione accession 454). From 15 April to 3 May 2023, we sampled 114 flowers from four generously watered greenhouse-grown plants. Nectar was removed from flowers with microcapillary tubes [5] while viewing through a dissecting microscope, immediately after removing flowers from the plant. The nectar of 5 or 6 flowers was pooled for each recorded nectar volume and refractometer reading. For each pooled sample, we divided nectar volumes and the amount of sugar by the number of flowers, allowing us to graph (Fig. 2) on a per-flower basis. Thus, each plotted point (Fig. 2) represents the pooled nectar of 5 or 6 simultaneously collected flowers (divided by the number of flowers in the sample, as mentioned). After removal, a very thin film of nectar remained at the base of the corolla and thus measured volumes and amount of sugar reported are underestimates. The cumulative nectar volume, sugar concentration and the total sugar content of each sample was calculated as described by Mione et al. [3, 6].

2.1 Statistical Analysis

To test for significant differences between the two floral phases T-tests (two-tailed) were done when the two groups both passed the Shapiro-Wilk normality test and the variances of the two groups were similar [7, pp. 297–298]. The Mann Whitney test (two-tailed) was used when one or both groups did not pass this normality test and / or the variances of the two groups were not similar. Flowers removed for sampling were randomly chosen [8, p. 394] with respect to plant and location on a plant. Statistical analyses were done with Prism 8.4.3 (GraphPad Software, San Diego, CA, USA).

3. RESULTS AND DISCUSSION

The mean nectar volume per flower was 0.99 µL (range 0.4–1.9 µL, SD 0.415) during the pistillate phase and 1.36 µL (range 0.82–2.21 µL, SD 0.43) during the hermaphroditic phase. The mean sugar concentration (^{o}Brix) per flower was 67.8 (range 45–74, SD 7.99) during the pistillate phase and 70.3 (range 35–79, SD 12.24) during the hermaphroditic phase. The mean sugar content per flower was 0.9 mg (range 0.4–1.6 mg, SD 0.37) during the pistillate phase and 1.25 mg (range 0.9–1.8 mg, SD 0.25) during the hermaphroditic phase (Fig. 2).

There was significantly more sugar present during day 2, the hermaphroditic phase (P = 0.018, T = 2.57, df=20). However, even though there generally was more nectar present during the hermaphroditic phase, nectar volume was nearly significantly but not significantly different

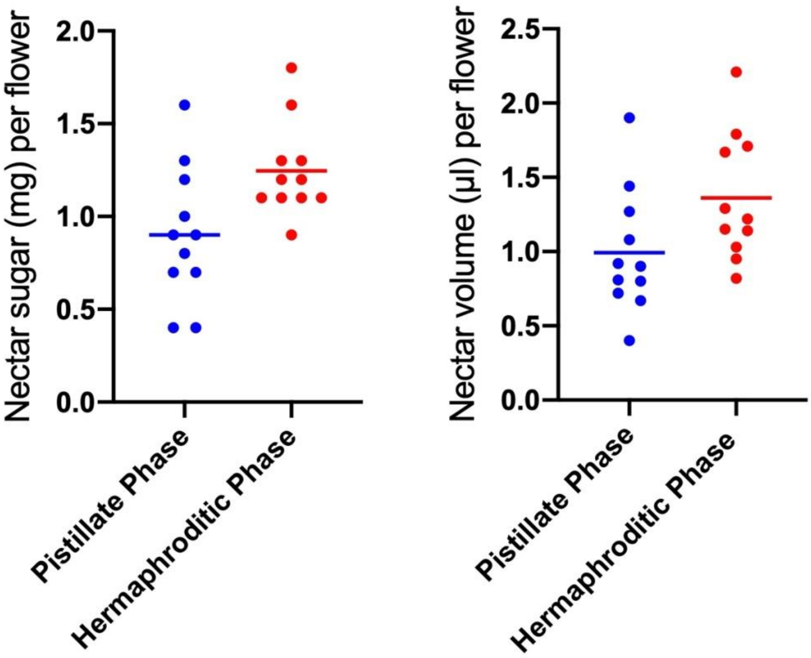

Fig. 2. Cumulative sugar content per flower is significantly higher during the hermaphroditic phase (day 2) than the pistillate phase (day 1). Cumulative nectar volume is generally higher during the latter phase but is not significantly higher

during the two floral phases (P = 0.052, T=2.064, df=20). Sugar concentration (^{o}Brix) was higher but not significantly higher during the hermaphroditic phase (P=0.078, Mann Whitney U = 33.5, n = 11 in each group).

If nectar is not removed manually or by a pollinator, the water component of nectar evaporates while the sugar component of the nectar remains [9, p. 212]. And thus it is possible that the lack of significantly higher volume during day 2, and the slightly higher mean sugar concentration during day 2, are due to the evaporation of water. Our objective was to fill in a gap in our knowledge about the reproductive biology of this species given that study of plant reproductive biology is fundamental to understanding systematics, evolution and ecology [10, 11]. Seeds of this species are freely available from TM.

4. CONCLUSION

There are few museum collections of *Jaltomata grandiflora* and little is known about this rare species. We measured cumulative nectar production on days 1 and 2, the pistillate and hermaphroditic phases, respectively. We demonstrated that nectar is secreted during both floral phases given that amount of sugar per flower is significantly higher during day 2, the hermaphroditic phase, and nectar volume is generally higher during this latter phase.

ACKNOWLEDGEMENTS

We thank Gregory J. Anderson and Gabriel Bernardello for creating the atmosphere that was conducive to the birth of this project, Donald Blume for the care of living plants, and the curators of B, BH, BM, C, COL, CONN, F, G, K, M, MA, MO, NY, US, WIS for loan of specimens. Support was from Connecticut State University-AAUP grants awarded to TM.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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