FUNCTIONAL DIOECY IN THE AFRICAN BAOBAB

Prepared by Anastashia Chetty (MSc student)

University of the Witwatersrand

Adansonia digitata L. (the African baobab) provides exceptional value to communities across Africa. People across the continent have relied on baobab fruit for various domestic and medicinal needs for centuries. They also generate an income from selling baobab fruit. In recent years, the commercial demand for baobab fruit has grown rapidly with increasing global awareness of the baobab's nutritional value. The increasing demand for the baobab and the effects of climate change becoming more severe may affect baobab populations' sustainability, and local people may be at risk of losing a source of income. By understanding factors that influence fruiting patterns, we can liaise with the local people to establish sustainable strategies to maintain stable baobab populations.

The baobab's fruit production has been monitored and researched extensively, with both local people and researchers noticing differences in fruit set within African baobab populations. Some trees yield up to 200 fruit annually (producers –referred to as "females") and others produce less than five fruit per year (poor producers – referred to as "males") – a phenomenon that to date, has only been recorded in the African baobab. Previous work has found that the fruit disparity within populations is not due to differences in sexes (baobabs are hermaphroditic, having bisexual flowers), environmental factors (both tree types grow in the same conditions) or species (both tree types are *A. digitata*). Baobabs do not self-pollinate and thus, the low fruit in poor producers is not a result of self-pollination. Further, although baobabs are self-incompatible, both tree types have similar outcrossing rates and genetic diversity. To date, understanding the drivers for the fruit disparity has remained challenging. Thus, we investigated if reproductive traits differed between producers and poor producers and if the observed variation related to fruit disparity within African baobab populations.

We identified three aspects of reproduction and investigated 1) the female organ (stigma characteristics – stigma angle, colour, moistness and receptivity), 2) the male organ (stamens – pollen number and viability produced by stamens), and 3) factors influencing interactions between male and female organs to allow for successful pollination (nectar-pollinator interactions, optimal pollination time, and reproductive success indicated by fruit set and number of pollen tubes present 24 hours after pollination). We also measured the relative size of reproductive organs of flowers from photographs. Changes and differences in these factors were compared over time between producers and poor producers. Fieldwork was conducted in November 2017 over five weeks in Vhembe, Limpopo (home to South Africa's largest baobab population), as baobabs begin flowering in early summer, and fruit were collected from the trees in March 2018.

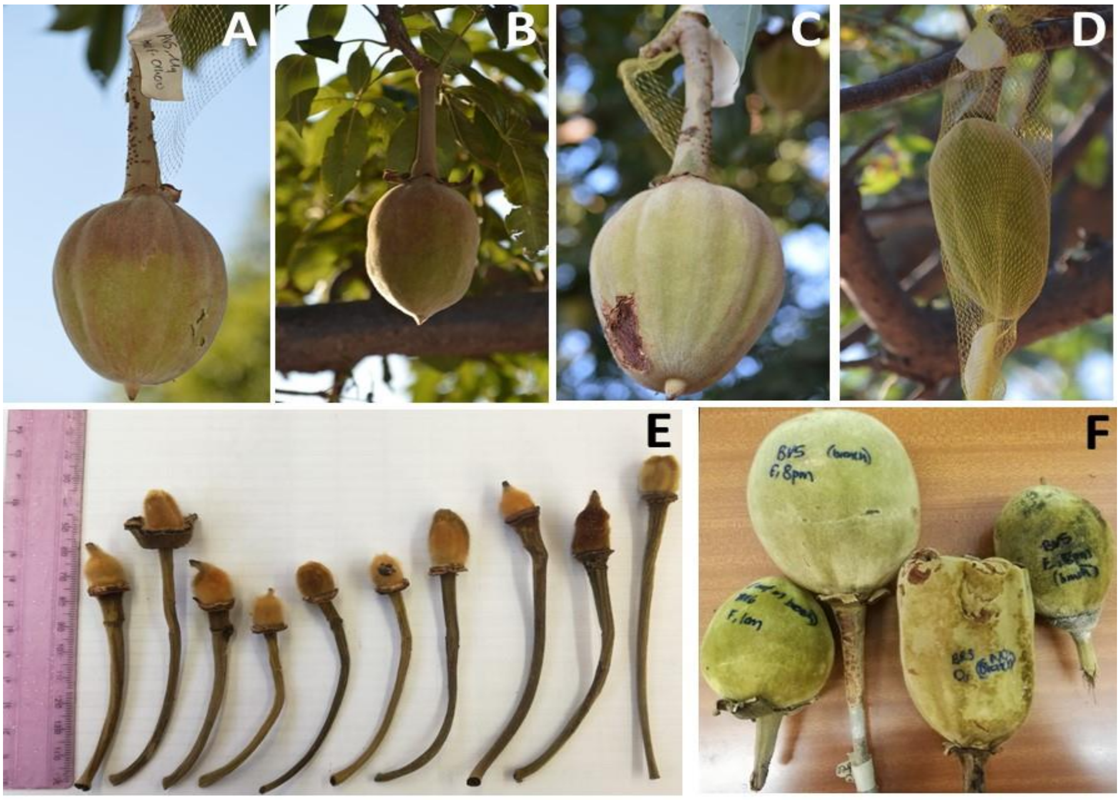

Figure 1. Fruit yielded by producer trees (A–D) and poor producers (E–F) from hand-pollinations, taken at 06h00 (Photos by Alekzandra Szewczuk, March 2018).

We investigated reproductive traits in flowers of 14 baobab trees (seven trees of each tree type). Each trial was repeated three times during the flower's lifecycle – at 20h00, 01h00 and 06h00 – as baobabs flower at night, for one night only. Our findings show significant differences in the morphology and behaviour of reproductive traits between producers and poor producers. Producers have large, highly receptive (to pollen) stigmas but reduced, waxy stamens – suggesting low pollen production, whilst poor producers have small, less receptive stigmas but larger, fluffy stamens – indicative of high pollen production. Pollen tube growth was similar in all hand-pollinated treatments of both tree types. Pollen tubes in both tree types appeared to enter ovules and effect fertilization, indicating that despite the low receptivity of reduced stigmas in poor producers, they could successfully support pollen germination. Despite similarities in pollen tube growth between tree types, there were significant differences in fruit set between tree types. Poor producers aborted the majority of their fruit (85%) whereas most fruit yielded by producers were mature (65%). Therefore, it seems plausible that the mechanisms driving differences in fruit production are post-zygotic.

Our findings suggest that producers allocate resources primarily to female fitness, whilst limiting the amount of resources allocated to male fitness, and the opposite is true for poor producers. The limited resources allocated to fruit production in poor producers explain why fruit are aborted soon after they develop. These results indicate that the African baobab, a well-known hermaphroditic species, is evolving towards dioecism, where the producers are functioning as females and poor producers are functioning as males. These findings are exciting and relevant, as producers are deemed more valuable than poor producers because of their high fruit production. Yet, poor producers serve as pollen producers and donors, and without their contribution, producers would very likely not yield high fruit sets. Therefore, both tree types should be conserved to maintain stable baobab populations. This valuable information will help to develop effective conservation strategies for sustainable harvesting from Southern African baobab populations.

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