

Resilience of exotic fruit trees in Puerto Rico to the impacts of Hurricanes Irma and María: *Nephelium lappaceum* (Rambutan) and *Averrhoa carambola* (Carambola)

Abstract

In 2017 Puerto Rico was hit by two hurricanes. Irma passed through northern Puerto Rico on September 6, 2017 with sustained winds of 285km / h and rains of 50.8mm-203.2mm. On September 20, 2017, Hurricane María touched land with sustained winds of 135 km / h, according to the National Hurricane Center Report. The inches of rain that were reported in neighboring municipalities were between 247.904mm-386.588mm. An estimate made a few days after the hurricane determined that 80% of the crops in Puerto Rico had been destroyed by the hurricane.

The main objective of this research is to study the effects of hurricanes Irma and María on the crops of rambutan and carambola located in the Municipality of Corozal; the secondary objective is to establish a comparison between which of the two crops was more resilient to hurricane winds.

The study is about rambutan and carambola crops; They are two species native to Southeast Asia and easily adapt to the tropical climate. Two lots were evaluated, one of each species; of rambutan 80 trees were evaluated in an area of 7500 m² and of carambola 108 trees in an area of 4000 m². The trees varied from 15-20 years in both cases and from 10-12 feet in both cases. It is intended to demonstrate the quantity and percentage of trees that were impacted by hurricanes Irma and María according to the impact levels of the trees: tree did not survive-destroyed; tree survived with the trunk base; tree survived without a top; tree survived with severe damage; tree survived with damage; and tree survived with minor damage.

Several influential factors are seen in the results; however, at first sight the resilience of the carambola species was evident in contrast to rambutan. In the case of rambutan, more than 60% of the trees did not survive and in carambola, it was more resilient with 90% of survival rate, which did survive with only damage to their secondary branches.

After initial observations we found that most of the carambola trees had survived and that some already have fruits. We found that most of the rambutan trees had perished completely. This leads us to consider whether Puerto Rico should restructure its agriculture with species that are more resilient to the impact of hurricanes to minimize economic damage to the country's agriculture.

Methodology

- The acquisition of data was made through two field trips to the Agricultural Experimental Station in Corozal of the University of Puerto Rico.
- Application used to collect absolute location of points: GPS Essential.
- Additional tools for collecting points: Sky Pro and Google Earth.
- The information was collected and passed to Excel to be evaluated and filtered.
- First, it was determined which trees were not present before the hurricanes and this data was removed so as not to be calculated and decrease the error percentage.
- The data analysis was mostly in Excel (for tables, calculations and graphs).
- The spatial analysis was performed using satellite images of NOAA and Arc GIS.
- For the representation of absolute location of the points ArcGIS was used.
- The wind analysis was carried out with the report of the "National Hurricane Center: Tropical Cyclone Report on Hurricane María".



Fig. 1 Agricultural Experimental Station of the University of Puerto Rico in the Municipality of Corozal before Hurricane María.

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Study area

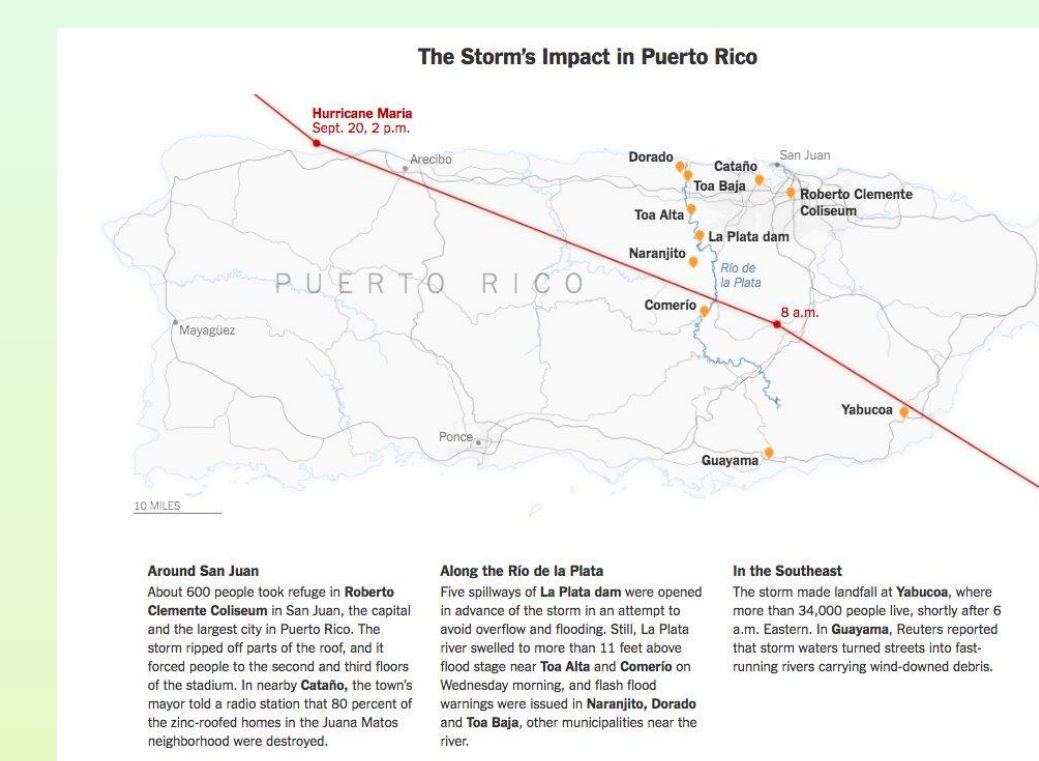
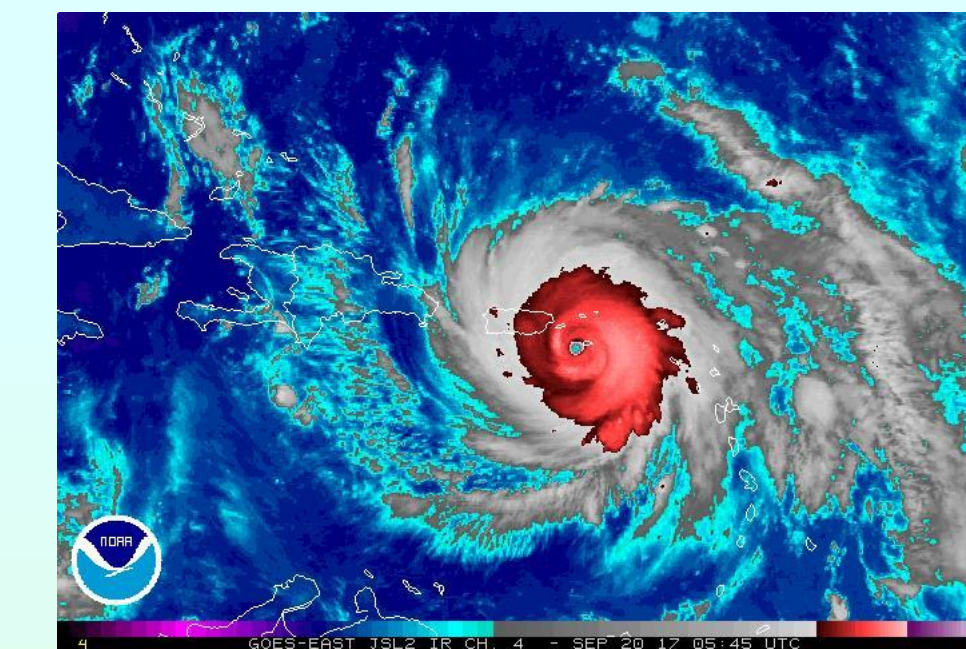
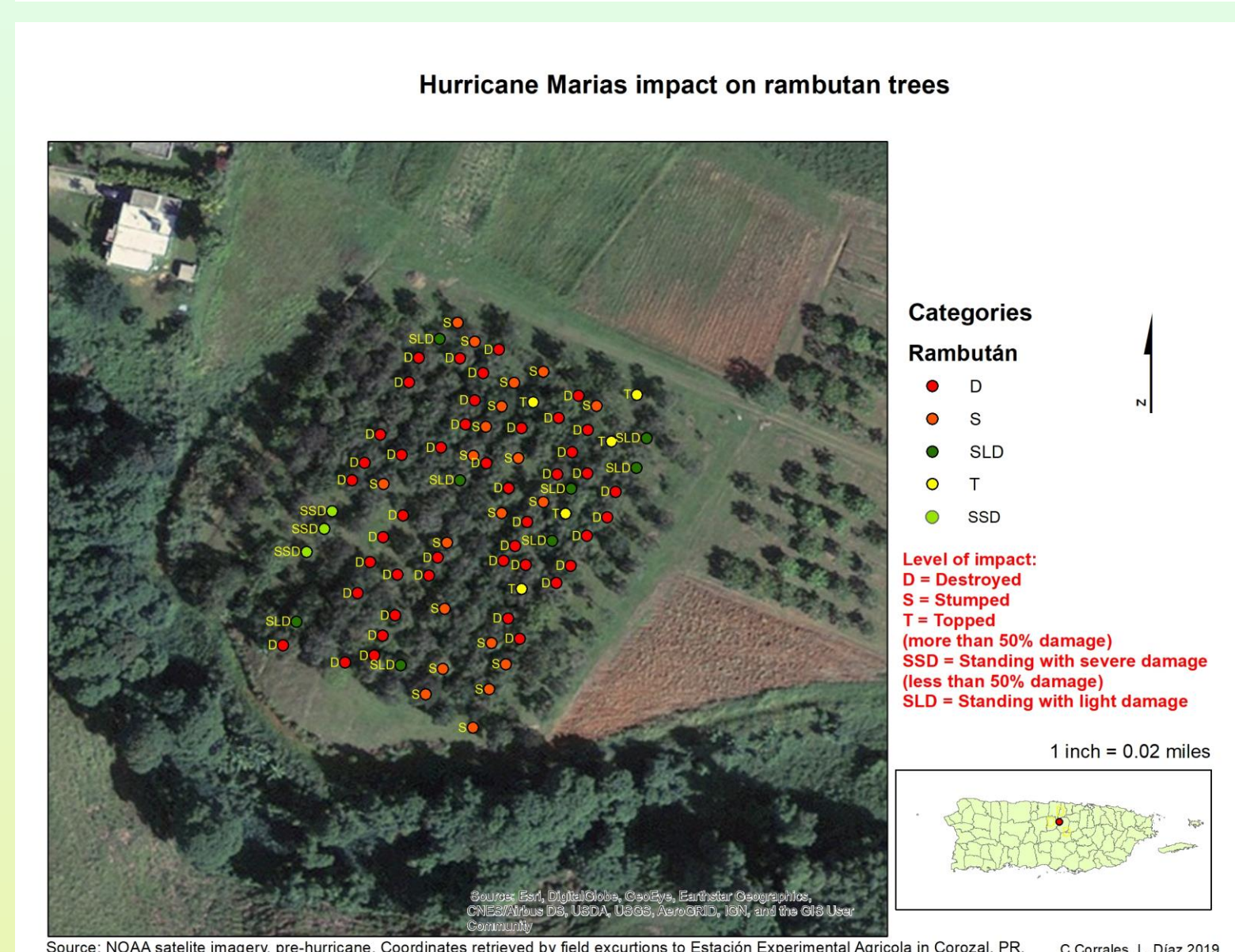
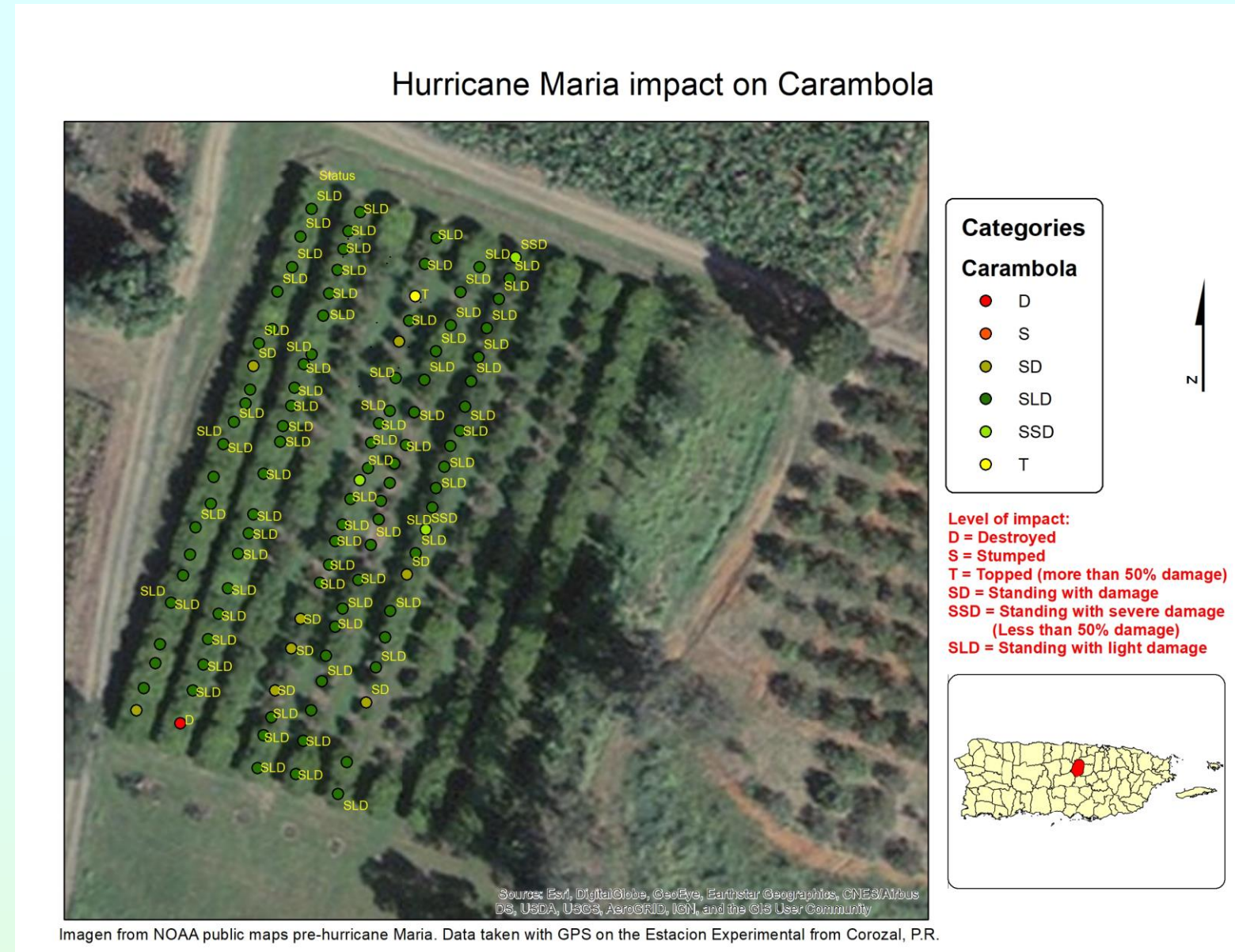
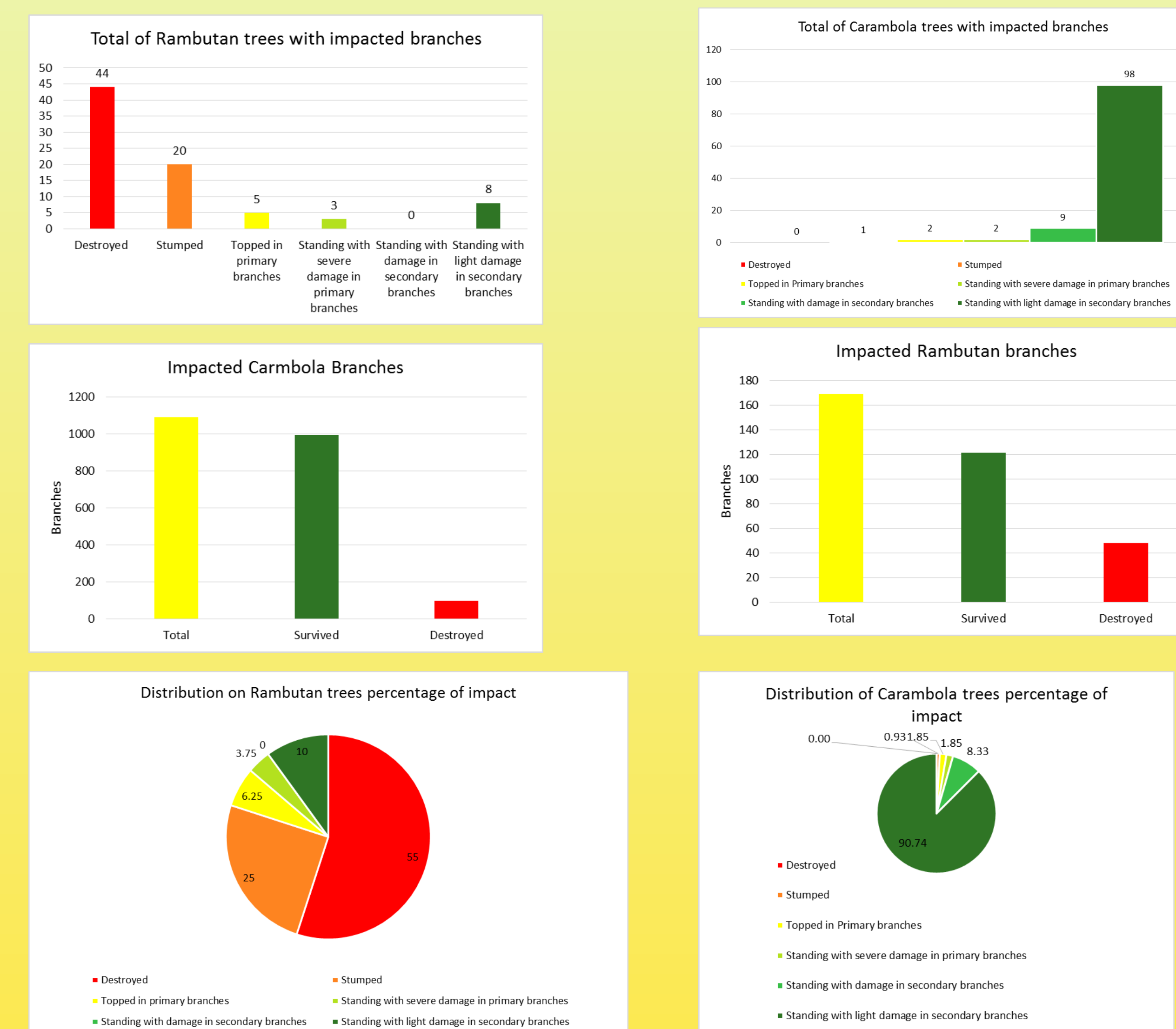


Fig. 4 and 5 Satellite image from the NOAA and map of Puerto Rico of the trajectory of Hurricane María.

Results



Conclusion

The reason for the majority detachment of the exotic fruit tree of rambutan is mainly due to its circumference or small thickness of the trunks and branches, which varied from 3 to 6 centimeters. This species was also in the production stage, which is considered a vulnerable stage during harvest. Unlike the fruit species of carambola, whose circumference is greater than 9 cm, therefore it develops thicker roots and in greater quantity; which makes them resilient to strong winds.

However, another vulnerability factor of the study area was the soil. Both species require a sandy, well drained and moist soil. Upon receiving high amounts of rainfall, in an extremely short period, these trees became more vulnerable to shedding due to the change in terrain.

The last factor that relates to the destruction of these species was the strong wind currents they received from northeast to southwest. These winds, from 100 to 155 km / h, were received directly by the rambutan trees, since they had no barrier to the north. However, carambola trees, having thicker roots, were more resistant than rambutan trees. Research of this type seeks to communicate to the people of Puerto Rico the urgency of restructuring the country's agriculture with species more resilient to the impact of hurricanes to minimize economic damage in the country's agriculture.

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Acknowledgments

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Fig. 2 Satellite image from the NOAA of the Experimental Agricultural Station of the University of Puerto Rico in the Municipality of Corozal; lot of rambutan trees on September 20, 2017 after Hurricane María.



Fig. 3 Satellite image from the NOAA of the Experimental Agricultural Station of the University of Puerto Rico in the Municipality of Corozal; Lot of carambola trees on September 20, 2017 after Hurricane María.