PLANT & ANIMAL GENOME

P0632

Avocado (*Persea americana* Mill.) and cherimoya (*Annona cherimola* Mill.) crop ontologies facilitate data interoperability among different descriptors in biological databases

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Introduction

Subtropical fruits, like avocado (*Persea americana* Mill.) and cherimoya (*Annona cherimola* Mill.), are key crops for food security in a wide range of countries, with an increasing commercial importance worldwide. Even though their importance is starting to be recognized and high throughput sequencing approaches are currently being used to characterize genome-wide patterns of natural diversity in different populations and breeding stocks, currently available ontological information for these subtropical fruits crops is scarce and often not stored in internationally standardized formats. With the aim to facilitate future analyses we present **ontologies for these crops.**

Objective

Develop standardized ontologies for the annotation of phenotypic and genomic data for cherimoya and avocado.

Method

These ontologies have been developed using **OBOEdit** software version 2.3, grouping traits commonly used as descriptors for variety characterization mainly established by Biodiversity International and the International Union for Protection of New Varieties of Plants (UPOV) but also newly developed ad hoc descriptors.

Results

Based on different formats, we have generated ontologies for avocado and cherimoya for traits not currently present in reference ontologies for plants [1]. Those formats include source specific ontologies such as **Biodiversity International** [2,3], with 755 terms for avocado and 618 for cherimoya, **UPOV** [4,5], with 426 terms for avocado and 350 for cherimoya and **unpublished formats**, including 295 terms for avocado and 189 for cherimoya. The integrated ontology for each species represents **77%** and **64% of new trait definitions** for **avocado** and **cherimoya,** respectively, not present in available reference ontologies for plants [1]. All files are available from the following repository:

https://github.com/IHSMFruitCrops/Ontologies

Table 1: Example of variables from the avocado ontology.

Trait	Variables	Method	Scale	Source
SO2:0000197 A fruit anatomy and morphology trait which is associated with fibers in flesh.	**SO2:0000216** Fibers in flesh	**SO2:0000220** Sensory assessment of fiber in flesh. Scored as: 3: Low, 5: Intermediate and 7: High.	**SO2:0000414** 3pt	Bioversity International
	SO2:0000219 Ripe fruit conspicuousness of fibers in flesh	**SO2:0000223** Visual observation of ripe fruit conspicuousness of fibers in flesh scored as: 1: inconspicuous(e.g. 'Fuerte', 'Santana'), 2: conspicuous (e.g. 'Edranol', 'Ettinger', 'Ryan').	**SO2:0000233** 2pt	UPOV
	SO2:0000218 Black fibers in flesh	**SO2:0000222** Visual observation of black fibers in flesh. Scored as: 13:present and 0:absent.	**SO2:0000230** 2pt	IHSM CSIC
	SO2:0000217 Red fibers in flesh	**SO2:0000221** Visual observation of red fibers in flesh. Scored as: 17: present and 0: absent.	**SO2:0000227** 2pt	IHSM CSIC

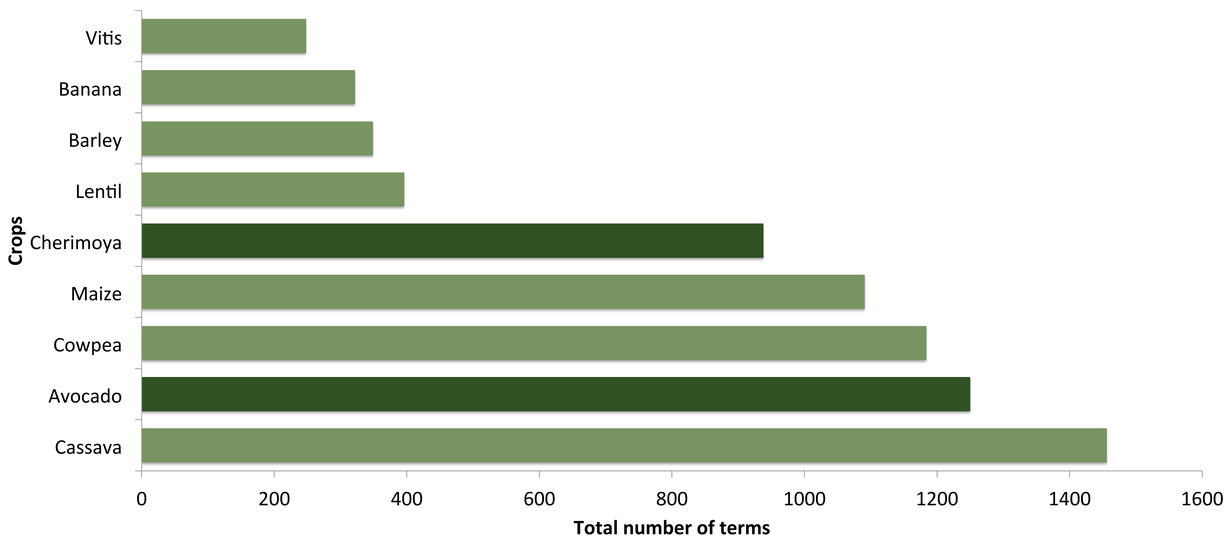
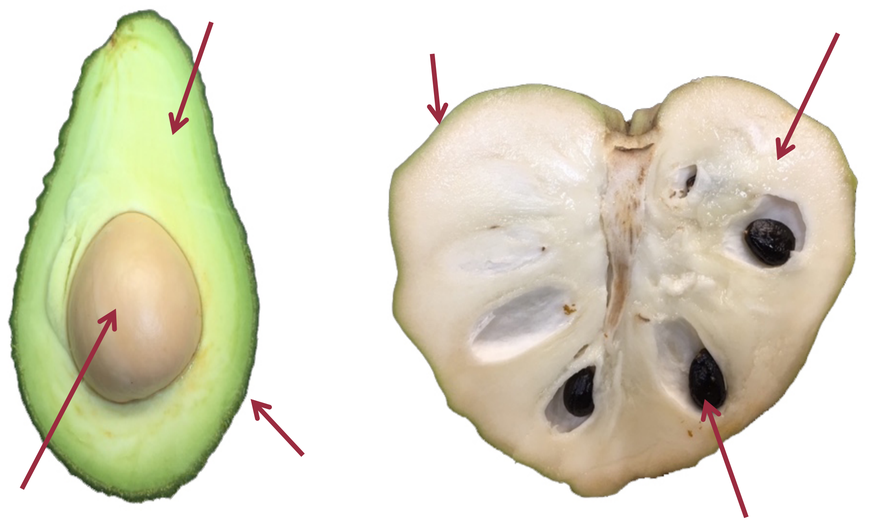


Figure 2: Total number of terms of different crop ontologies.

SO2:0000192 (General taste of flesh)

SO1:0000012 (Exocarp type)

SO1:0000852 (Pulp fibre content)



SO2:0000361 (Seed position in fruit)

SO2: 0000349 (Fruit skin surface)

SO1: 0000028 (Seed coat colour)

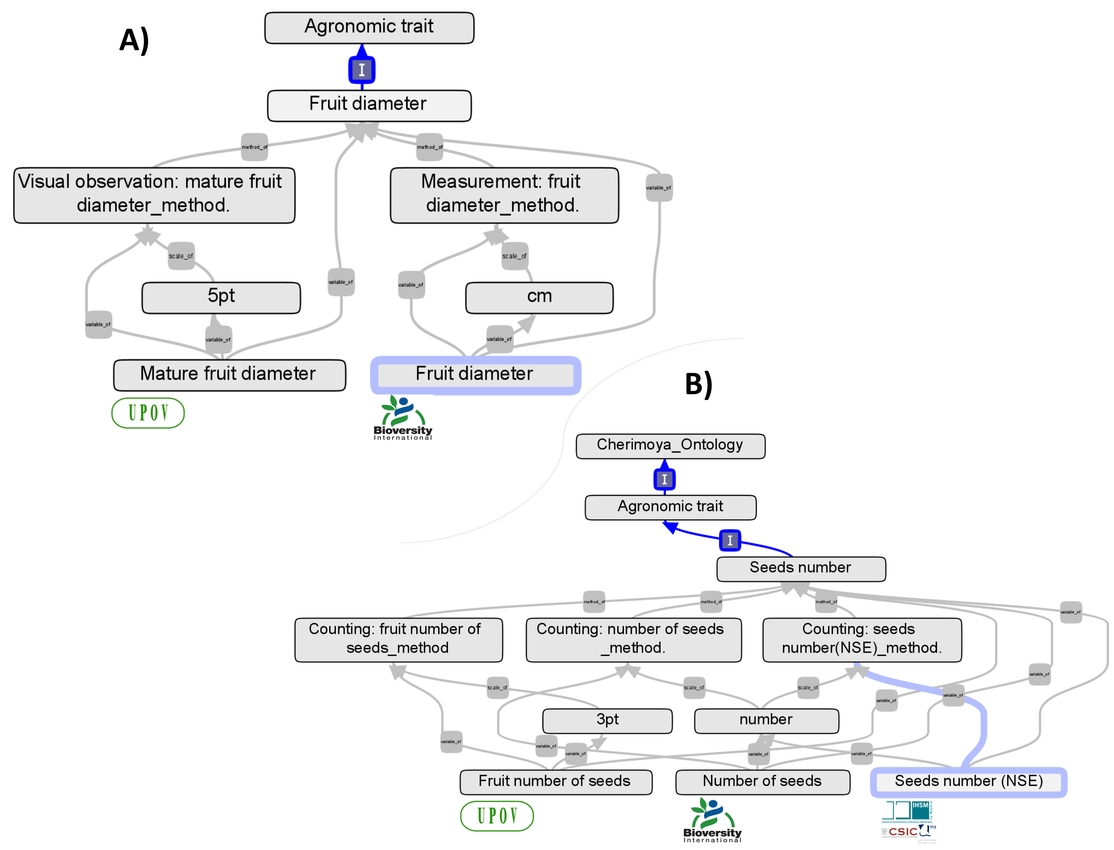


Figure 1:Alternative ways to measure the same trait in avocado (A) and cherimoya (B) according to different sources.

Next steps

- **Complete, improve the quality and update these ontologies.**
- **Integrate avocado and cherimoya ontologies in a database of subtropical fruit crops.**
- **Include additional crops: mango, litchi, longan…**

Acknowledgements

This work is supported by MINECO (AGL2013-43732- R and AGL2016-77267-R) to Iñaki Hormaza, (RYC-2011-08839) to Antonio Matas and (BES-2014-068832) to Alicia Talavera Júdez.

References

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