3D architecture representation of date palm (*Phoenix dactylifera* L.) using Xplo tools.

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The date palm is an arborescent monocotyledon belonging to the family of *Arecaceae*. Its areal topology is easy to describe: one robust stem surmounted by crown of fronds. Each frond composed by nerve which bears on either side the pinnae (spines and leaflets). The first architectural models proposed by Hallé and Oldeman (1970) and Hallé et al (1978) classified the date palm in the model of Tomlinson . This model is qualitative and has importance in botany, but could be not virtually presented (3D). In order to simulate architecture of date palm with better accuracy and realize mockup similar to real palms in field, the palm tree must be described and analyzed at frond scale.

Botanical and architectural parameters of date palm used in model *of Principes*

Biological material

- Moroccan date palm: 'Asian' and 'Boufeggous'
- Tunisian date palm : 'Barhi ' and 'Rochdi'

Botanical elements and parameters considered in simulation

The geometrical parameters were mesured in field according to MOCAF's protocol [Lecoustre & al., 2012]:

- On the stem : internodes length, circumference , the number of stumps and living fronds and phyllotaxis.
- On the fronds : geometrical parameters of frondnervure and pinnae (spines and leaflets) (fig.1)

Modelling and simulation tools:

AMAPstudio (Griffon and de Coligny, 2014) :

- Features for plant architecture modeling . It contains interactive tool to handle the topology , the geometry and dynamics of plant at individual or scene scale.
- Is based on multi-scale tree graph (MTG) data structure.
- Hosts *Xplo* software which also hosts the model ***Principes*** developed by Rey et al [2012] thanks to MOCAF and PHC Maghreb networks (fig.2).

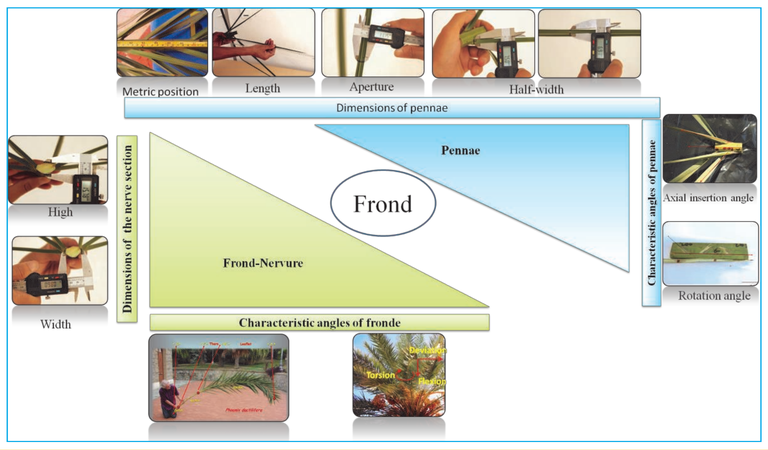

Fig.1. Botanical elements and parameters measured on the frond of date palm.

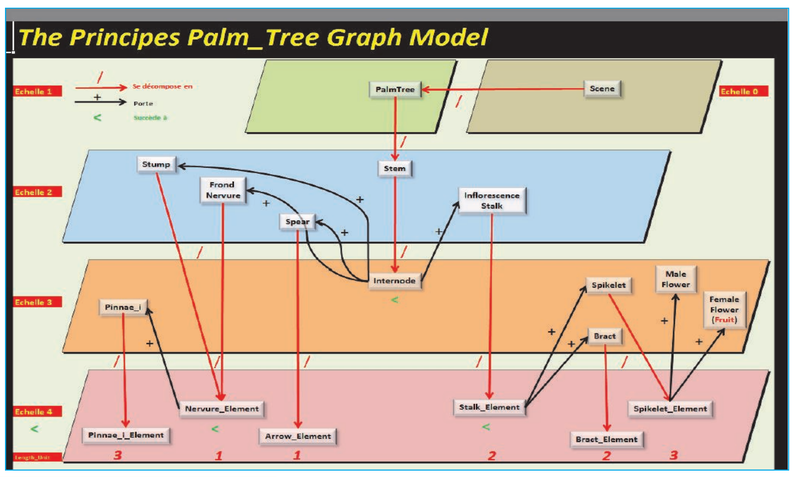

Fig.2. Principes model

Architecture simulation

'Boufeggous' 'Asian' 'Rochdi' 'Barhi'

- The virtual crown shape of date palm is a result of geometrical arrangements of all its part and depends on measured field values of the parameters .
- The Virtual plants are similar to actual plants, as pictures show (fig.3).
- The model, Principes, simulates with accuracy the date palm architecture.

Fig.3. 3D mockup simulated by *Xplo* and real palms.

Conclusion and perspectives

After achieving structural model, our purposes and perspectives view to develop functional-structural model : radiative balance, photosynthesis, transpiration, production (fig.4)

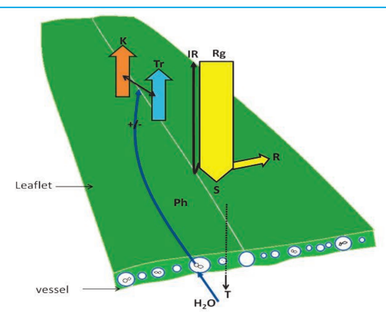

Fig.4. Example of radiative balance for canopy. Part of global radiation (Rg) reaching leaflet reflected (R), part reradiated (IR), small part used in photosynthesis (Ph). S is the part lost by leaflet in transpiration (Tr), convective heat loss (K) and very small part is transmitted (T) depending on water status of plant.

References

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