



Response of indigenous fruit trees under domestication in West and Central Africa to grafting.

Asaah EK, Tchoundjeu Z, Tsobeng A,
Sado Thaddee, Makueti J

3RD INTERNATIONAL CONFERENCE ON NEGLECTED AND UNDERUTILIZED
CROPS SPECIES ACCRA, GHANA, 24TH TO 27TH SEPTEMBER 2013

[Join us at the 3rd World Congress on Agroforestry 2014,](#)
10-14 February 2014, Delhi, India

Areas covered

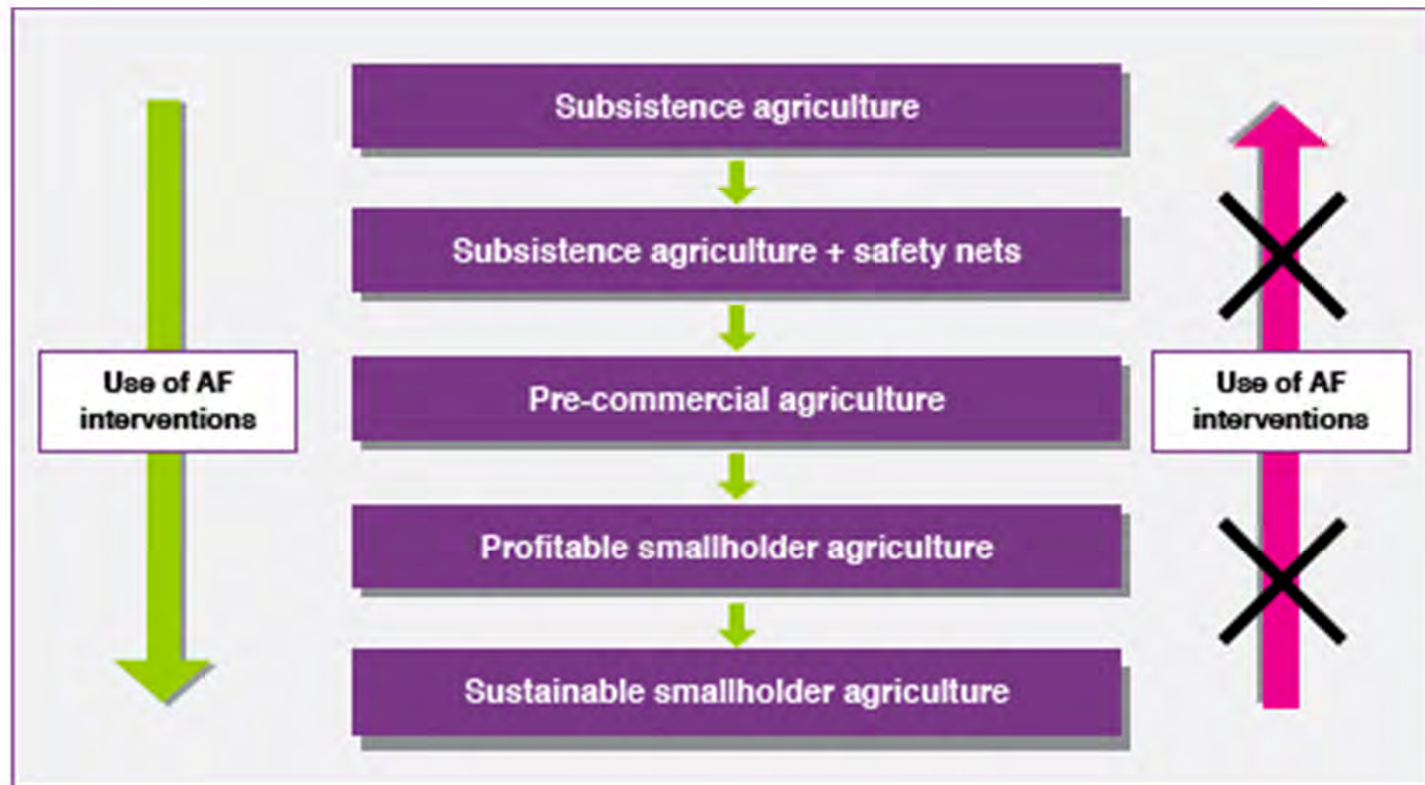
- ❑ About the World Agroforestry Centre (ICRAF)
- ❑ Background
- ❑ Challenges to cultivating Indigenous fruit trees
- ❑ Discussions/Conclusions
- ❑ Key messages



About the World Agroforestry Centre (ICRAF)

Vision is a rural transformation in the developing world as smallholder households increase their use of trees in agricultural landscapes to improve food security, nutrition, income, health, shelter, energy resources and environmental sustainability.

Mission is to generate science-based knowledge about the diverse roles that trees play in agricultural landscapes, and use its research to advance policies and practices, and their implementation that benefit the poor and the environment





Irvingia gabonensis



Garcinia kola



Ricinodendron heudelotii



Cola nitida

Background

- **These species have been categorized as:**
 - **Non Timber Forest Products (NTFPs) by FAO**
 - **Underutilized crops by International Centre for Underutilized Crops (ICUC), and**
 - **Agroforestry Tree Products (AFTPs) by World Agroforestry Centre (ICRAF) if cultivated.**
 - **Neglected and Underutilized Species [NUS]; (Bioversity International)**
- **NTFPs contribute to:**
 - **food security,**
 - **health (nutrition/medicine),**
 - **income generation,**
 - **and environmental services.**
- **Values & Potentials of these species**
 - **rich in lipids, essential oils, vitamins and minerals.**
 - **Can be eaten raw, cooked, roasted and/or grilled.**
 - **highly commercialized with transactions known to occur both at national and international levels.**



E.g. Irvingia gabonensis & Irvingia wombolu

- *Bush mango* is cultivated for its fruit - rich in vit C and the kernel rich in lipids, essential oils, and minerals.
- Fruits are consumed / sold, however, the kernel, fetches prices several folds that of fruits.
- Fruits are highly commercialized with transactions known to occur both at national and international levels.
- In a recent review on non-timber forest products in Cameroon, Ingram and Schure (2010), reported that US\$ 8, 089,580 is generated annually, from the sale of *Irvingia* spp.
- Internationally, the kernels are exported within West and Central Africa and to Europe and America.



Snack of bush mango fruit



Kernels of bush mango



Proximate composition of *I. gabonensis* (% dry weight) and *I. wombolu* (% fresh weight) kernels

	Mean %	
	<i>I. abonensis</i> #	<i>I. wombolu</i> &
Moisture	4.0 ± 0.1	11.9
Ash	7.8 ± 0.3	2.46
Protein	6.5± 0.2	7.42
Fat	58.5 ± 0.4	51.32
Fiber	6.6 ± 0.2	0.86
Carbohydrate	16.6 ± 0.3	26.02

Source: #Oboh and Ekperigin, 2004;
&Ejiofor (1987, cited in Ejiofor 1994)

www.worldagroforestry.org

Nutritional value bush mango

Mineral composition of *I. gabonensis* (ppm dry weight) and *I. wombolu* kernels)

	Mean %
	<i>I. gabonensis</i>
Mg	429.0 ± 0.3
Fe	13.2 ± 0.1
Zn	5.7 ± 0.2
Mn	3.8 ± 0.2
Ca	201.3 ± 0.3
Na	395.1 ± 0.5
K	587.0 ± 0.4 2
P	16.4 ± 0.2

Source: #Oboh and Ekperigin, 2004

Diversity in species

- ❑ Diversity in different fruit and kernel traits provides opportunities for:
 - ❑ Selection, and
 - ❑ development of cultivars and varieties through breeding and/or vegetative propagation techniques.



Irvingia gabonensis



Garcinia kola



Monodora myristica

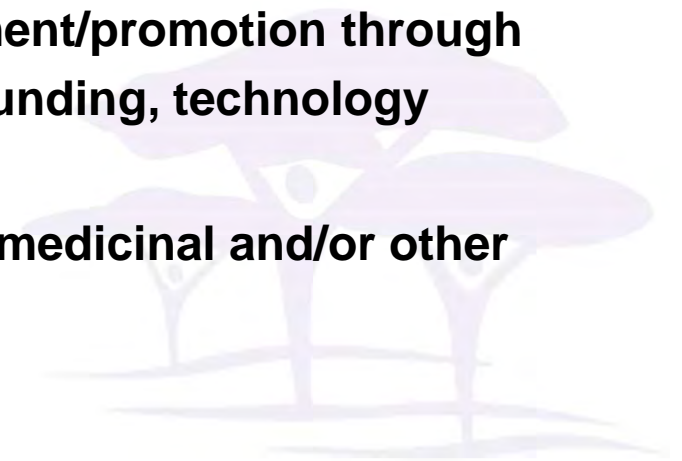
Fruiting calendar of some indigenous fruit trees in West & Central Africa

Tree species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Irvingia wombolu</i>	■	■	■									■
<i>Cola</i> spp.			■	■	■	■	■	■	■			
<i>Dacryodes edulis</i>				■	■	■	■	■	■	■		
<i>Garcina kola</i>						■	■	■	■			
<i>Irvingia gabonensis</i>						■	■	■	■	■	■	■
<i>Ricinodendron heudelotii</i>								■	■	■	■	■

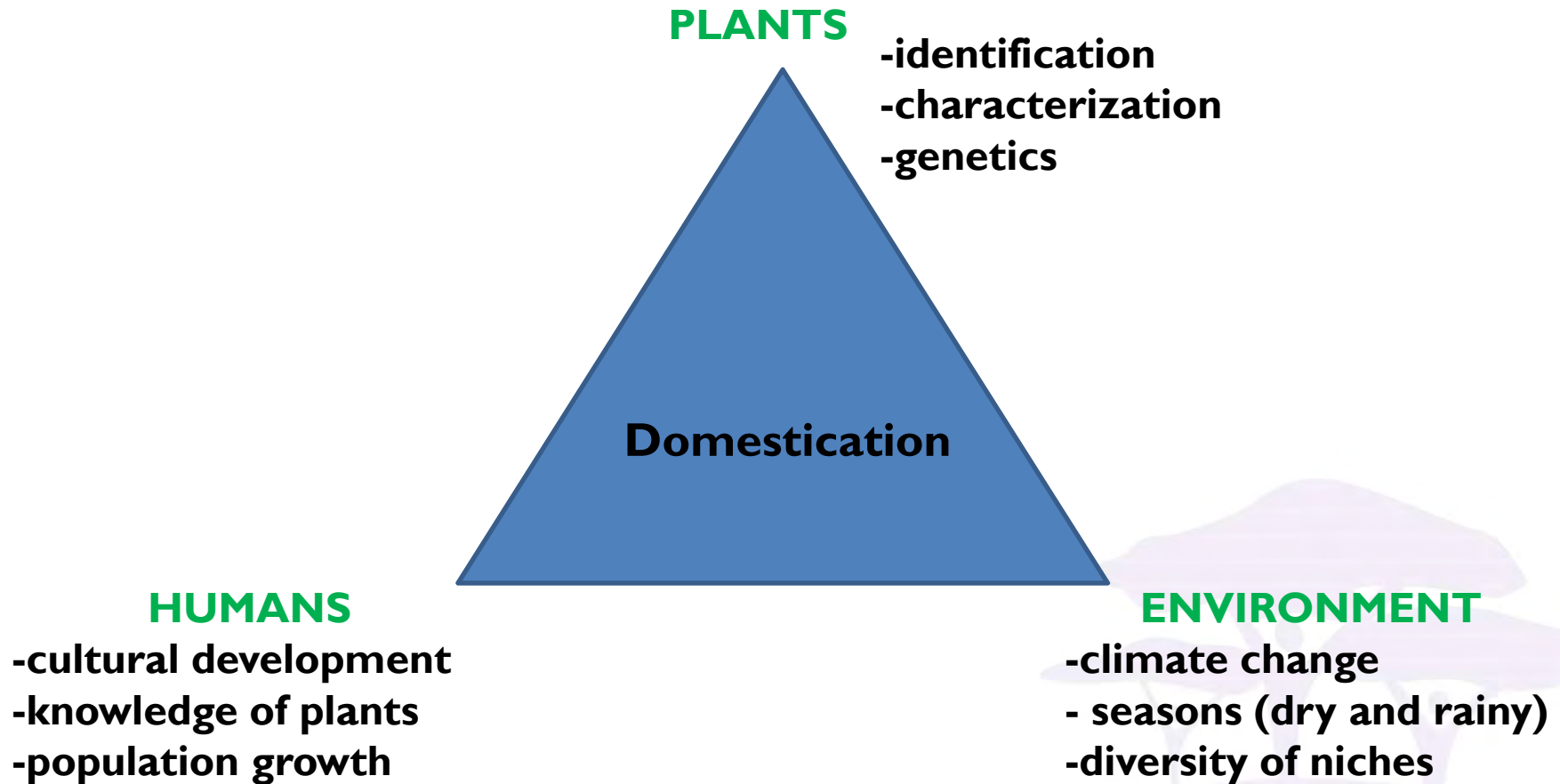
Seasonal variations: Early, Normal, late maturing

Underutilized species commonly are/have:

- ▶ **High agrobiodiversity, capable of combating food and nutritional security especially micronutrient (vitamins and minerals) deficiencies,**
- ▶ **Traditional foods and have strong socio-cultural linkages to places of origin,**
- ▶ **Collected from the wild with limited attempts to cultivate or manage systematically,**
- ▶ **Weak seed or improved seedling supply systems,**
- ▶ **Little attention given towards species improvement/promotion through research efforts, extension services, policies, funding, technology providers etc.,**
- ▶ **Meanwhile these species are high in nutritious, medicinal and/or other properties.**



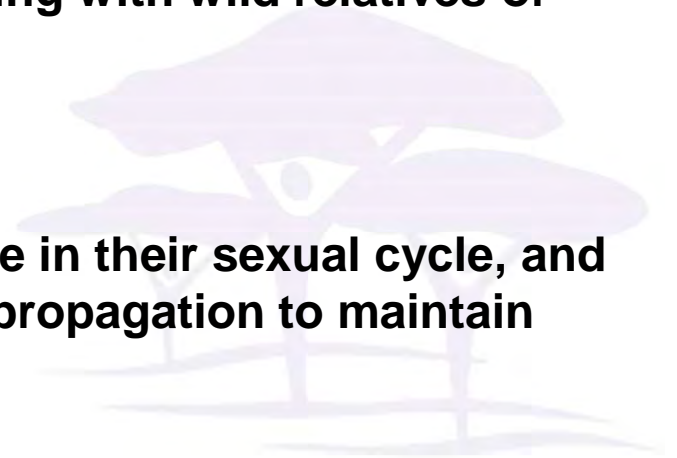
Participatory domestication of indigenous species



Redrawn and modified from Gepts, 2004

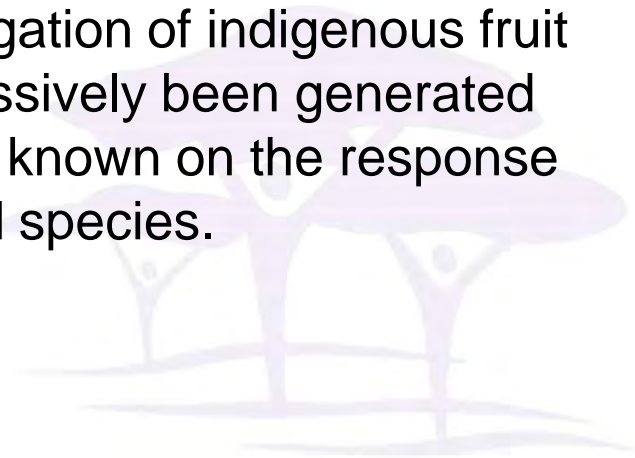
Some facts.....

- **Less than 200 of estimated 400,000 flowering plants species, have been domesticated as food and feed plants.**
- **About 75% of domesticated fruit trees are primarily vegetatively propagated through stems cuttings, layering, grafting and *in vitro* techniques (Gross and Miller, 2011).**
- **Vegetative propagation assure three goals in fruit tree domestication:**
 - (re)production even under unfavorable conditions,
 - trueness to type in the presence of out crossing with wild relatives of other domesticated types, and
 - more appetizing fruits.
- **Selection of trees with superior traits occurs once in their sexual cycle, and subsequent multiplication is through vegetative propagation to maintain the favoured traits.**



Challenges to cultivating Indigenous fruit trees

- To date the majority of indigenous fruits and nuts are gathered from natural occurring trees which pose concerns to sustainable fruit/nut supply as well as biodiversity issues.
- Attempts to cultivate the species have been constrained by the lack of improved planting material that is true-to-type and early fruiting.
- Considerable information on vegetative propagation of indigenous fruit trees using stem cuttings, layering has progressively been generated over the last decade in Africa but much less is known on the response to grafting of most neglected and underutilized species.



Research questions objectives

Research questions

Are the candidate indigenous species (*Irvingia gabonensis*, *Garcinia kola*, *Cola nitida*, *Ricinodendron heudelotii* and *Monodora myristica*) amenable to grafting?

Can grafted result in fruit earlier than reported in literature?

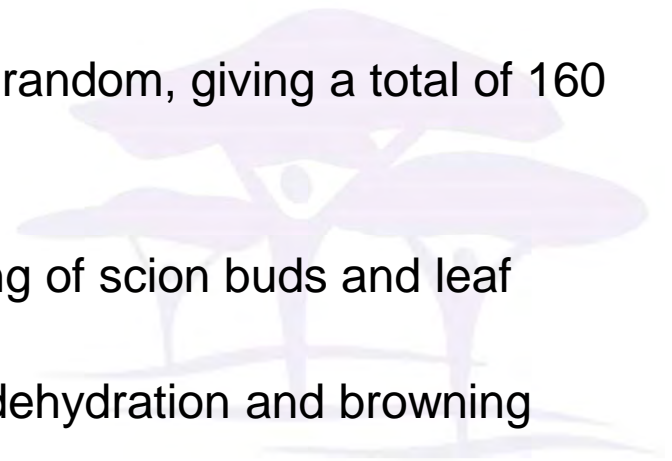
Objectives

- To determine the amenability of *Irvingia gabonensis*, *Garcinia kola*, *Cola nitida*, *Ricinodendron heudelotii* and *Monodora myristica* to grafting.

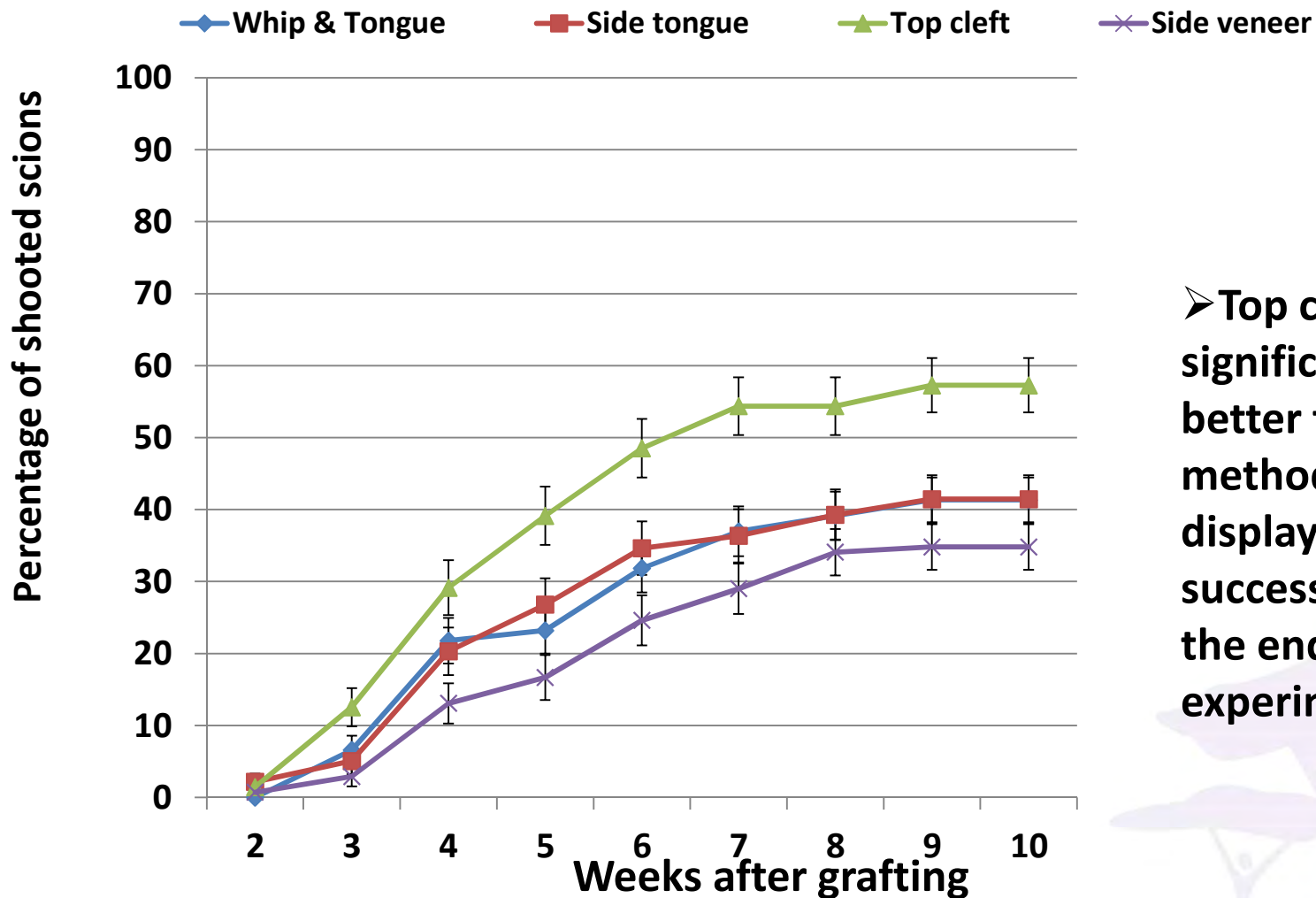


Material and methods

- Experiments were setup to determine the most suitable grafting method for *Irvingia gabonensis*, *Garcinia kola*, *Cola nitida*, *Ricinodendron heudelotii* and *Monodora myristica*
- Scions were harvested from mature fruiting *A. floribunda* trees and grafted on pencil size stem diameter root stocks at the vegetative growth phase under nursery conditions.
- 4 grafting methods (side tongue, side veneer, top cleft and whip-and-tongue) were tested in a completely randomized design in the nursery experiment.
- Each method was applied to 40 plants selected at random, giving a total of 160 plants per experiment.
- Graft success = healing of the graft union, sprouting of scion buds and leaf formation.
- Mortality = lack of sprouting from green scions or dehydration and browning



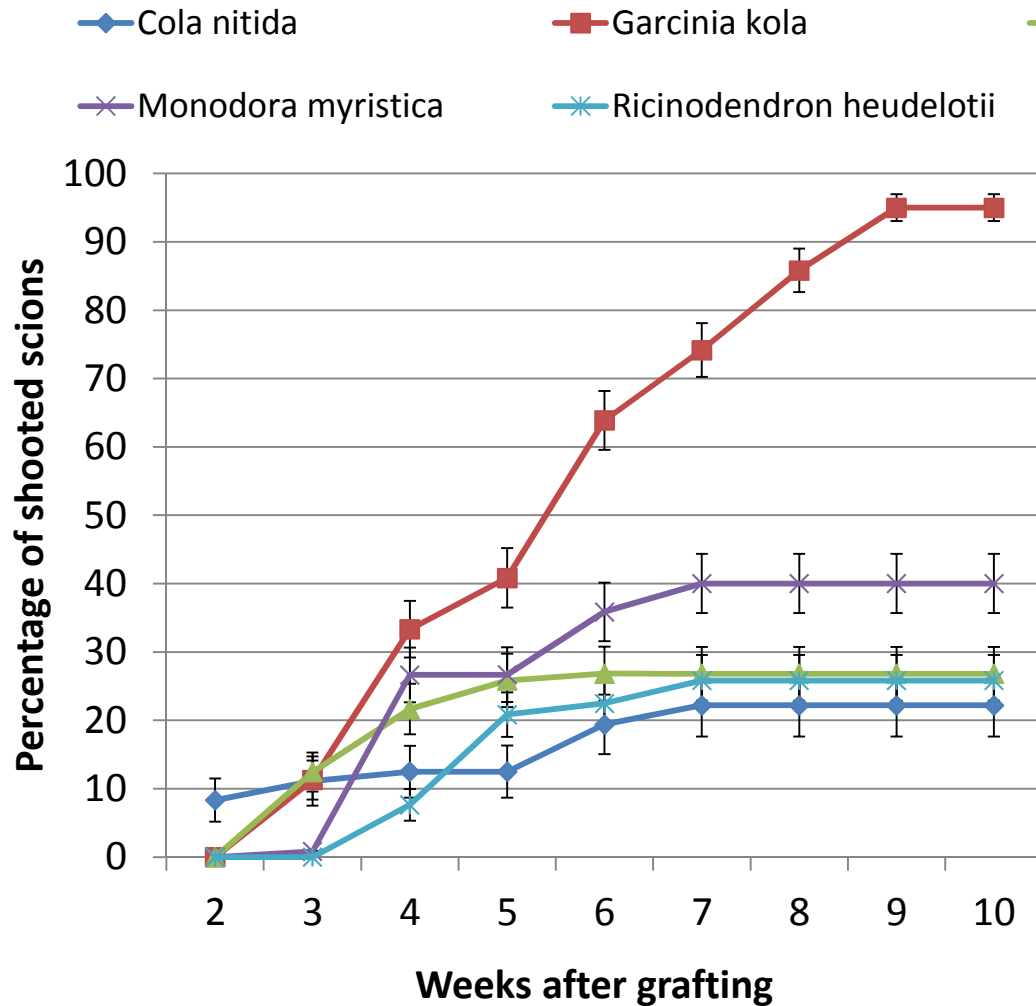
Results



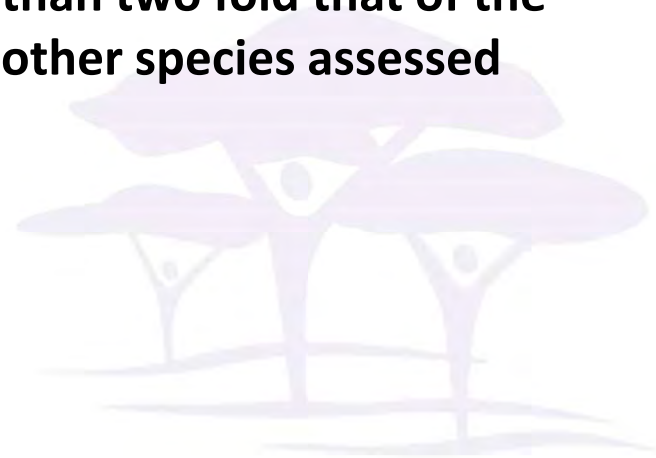
➤ Top cleft method was significantly ($P < 0.001$) better than the other methods tested and displayed 57% graft success averagely by the end of the experiment.

Grafting success (%) in four grafting methods tested on nursery grown indigenous fruit trees

Results...cont'

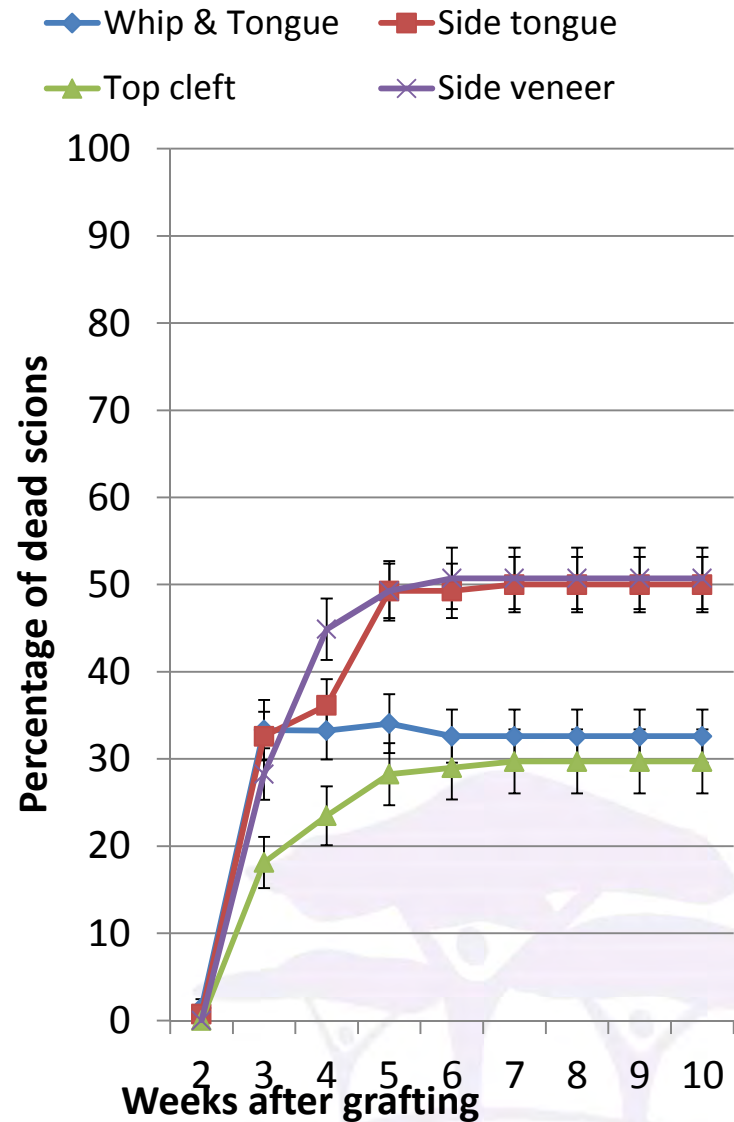
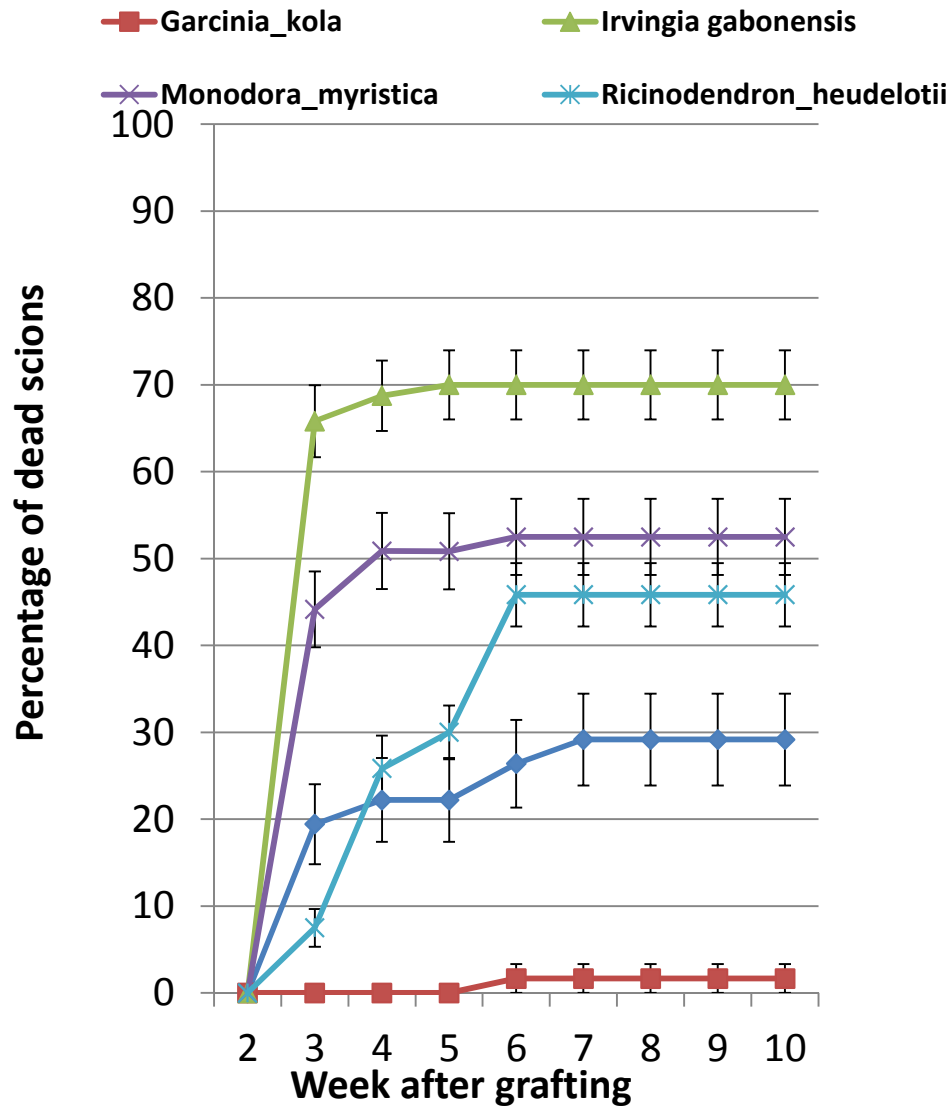


➤ *Garcinia kola* is highly amenable to grafting and was significantly ($P < 0.001$). Its graft success was more than two fold that of the other species assessed



Graft success (%) of diverse IFT species to grafting

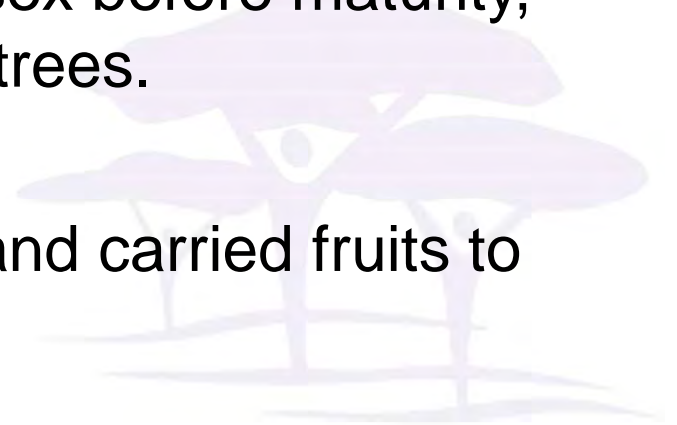
Results...cont'



Grafting mortality (%) on nursery grown plants of diverse IFTs

Discussion/conclusion

- ▶ *Irvingia gabonensis*, *Garcinia kola*, *Cola nitida*, *Ricinodendron heudelotii* and *Monodora myristica* are amendable to grafting.
- ▶ This suggests that *In situ* graft grafting is possible and so too could be topworking which can be used to regenerate the ageing trees with reduced productivity.
- ▶ In addition, many wildings of unknown sex before maturity, could be transformed to fruit producing trees.
- ▶ A graft transplanted in the field, fruited and carried fruits to maturity under 5 years.



Key messages



Scion from *A. floribunda* plus tree



4 years, smaller fruiting *A. floribunda* tree

Uniform *A. floribunda* fruits

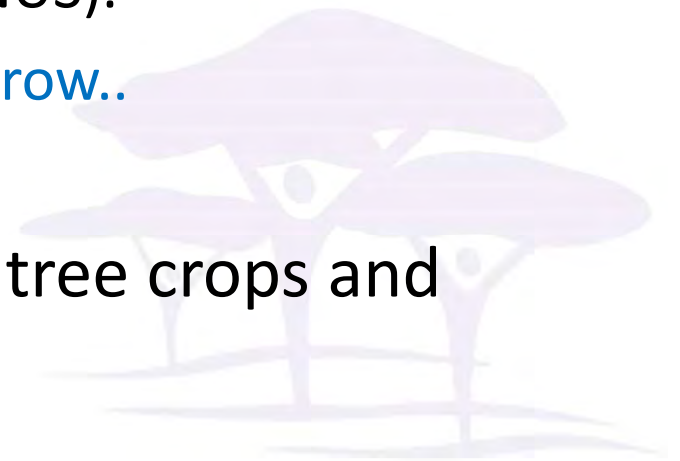


Shorten juvenile phase to fruiting to 4 years via grafting in *A. floribunda*, Cameroon.



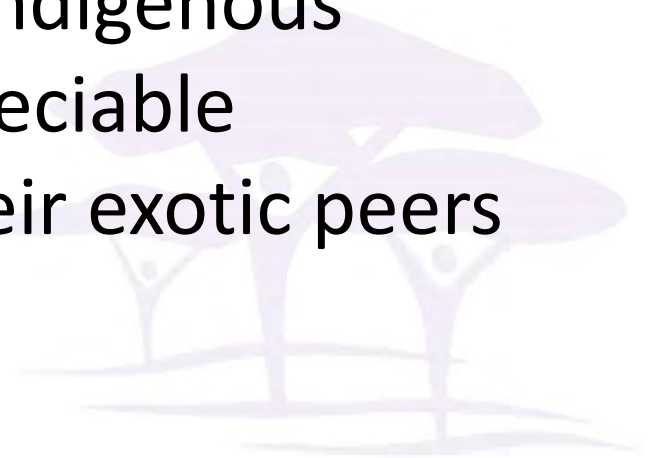
Key messages cont'

- Harmonize names used to address these species.
 - Indigenous Fruit Trees (IFTs),
 - Non Timber Forest Products (NTFPs),
 - Non Wood Forest Products (NWFPs),
 - Under Utilize Crops (UUCs),
 - Agroforestry Tree Products (AFTPs),
 - Neglected and Underutilized Species (NUS).
 - Notable and Utilize Species ...[for tomorrow..](#)
- Look at the continuum from food to tree crops and bring all actors on board.



Key messages cont'

- African governments should fund the development of indigenous species to the level of cultivars with known **nutritional profile** and **agronomic requirement**.
- Promote the consumptions of indigenous fruits which are equally of appreciable nutrient status compared to their exotic peers in conferences and other fora.



**THIS WORK WAS
SUPPORTED BY THE
FOLLOWING
ORGANIZATIONS**



Join is at the 3rd
World Congress on Agroforestry 2014,
10-14 February 2014, Delhi, India