PLAN COMPARISON PROTOCOL: TREE PLANTING IN BURKINA FASO

WP1. Compare survival, growth and production of in situ-grafted natural regenerated plants, nursery propagated plants and air layering of *Balanites aegyptiaca*

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Rationale

Balanites aegyptiaca is a native tree species in the West African Sahel and provide food, fodder, medicine, wood for fuel, construction and other essential products (Orwa 2009, Arbonnier 2000). It belongs to the family Balanitaceae. *B. aegyptiaca* has wide ecological distribution, expanding from Senegal to the Sudan. In Mali, the species is common in the Sahelo-Sudanian climatic zone. The population is abundant in the Sahelian zone, especially in the arid lands. The density gradually declines towards the south in the Sudanian area. The species is among those chosen for the restoration of Sahelian ecosystems in the context of the pan-African reforestation project, the Great Green Wall for the Sahara and Sahel Initiative (Sagna et al. 2014).

The fleshy pulp of both unripe and ripe fruit is edible and eaten dried or fresh. The fruit is processed into a drink and sweetmeats. Young leaves and tender shoots are used as a vegetable, which is boiled, pounded, then fried or fat added to prepare it. The flowers are a supplementary food in West Africa. The fresh and dried leaves, fruit and sprouts are all eaten by livestock. The wood is good firewood, producing considerable heat (Sotelo Montes 2011) and very little smoke, making it particularly suitable for indoor use. It produces high-quality charcoal, and it has been suggested that the nutshell is suitable for industrial activated charcoal. The kernels produce edible oil used for cooking. The oil remains stable when heated and has a high smoking point, and therefore its free fatty acid content is low. *B. aegyptiaca* is important for medicine in Mali, especially the northern regions of the country. Decoction of root is used to treat malaria. Roots boiled in soup are used against oedema and stomach pains. Roots are used as an emetic; bark infusion is used to treat heartburn. Wood gum mixed with maize meal porridge is used to treat chest pains. The trees that are able to fix nitrogen, are managed through agroforestry parklands and pasture areas in the Sahel region (Orwa 2009).

B. aegyptiaca trees are excellent multipurpose tree species so that the communities from DryDev project area have identified as priority tree species. In the discussion, they have defined the use of vegetative propagation technique such grafting for improving the growth and production of *B. aegyptiaca*. As it can be propagated by layering, the research team has suggested layering and in-situ grafting as alternative option to seedling grafting.

Planned comparison on tree planting approach

This planned comparison is defined to help farmers identifying suitable vegetative propagation practices to ensure sustainable biomass and fruit production of *B. aegyptiaca*. Volunteer farmers will be selected from at least 10 villages cover by the DryDev project in Mali. Each volunteer farmer may chose the land use type (farmland or fallow) where *B. aegyptiaca* plants are naturally growing.

Sahel Eco, the lead organization of DryDev project in Mali will help selecting the villages and volunteer farmers preferably including some women.

The objective is to compare three vegetative propagation options for improving biomass and fruit production of *B. aegyptiaca* on farm and fallow lands in Mali. Watering will be a facultative option. Results from farmers who would have watered their plants will be compared to those who have not watered. The watering mode (quantity and frequencies) will be discussed with farmers for more consistency. Grafted plants could be provided by ICRAF as their propagation requires knowledge and skills. Farmers will be trained later to propagate further their own plants. This PC will need at least two years to be completed.

Table1: Sites for DryDev implementation in Mali

Communes/districts	Villages
Koumbia	*Barena,Tèbèrè, Koumbia, Sindé, Bagadina, Dorosso, Ouyasso*
Kiffosso1	*Kiffosso1; Kiffosso2; Lopégué; Makoungo*
Menamba	Menamba 1, Menamba 2*, Dionkhouna*]
Fambougou	*Cinzana Gare, Sanogola*
Mouina	*Boumboro, Bokuy*
Kondala	*Sadian, Tayo,Minso*
Soroly	*Mandoli, Garou dow, Gani*
Mandoli,	Mandoli, Gani
Kogo	Thy, Kobolagado, Doundé, Gulié dogon, Domé, Kogo
Sadia	Endé Toro, Endé Ogodengou, Bagourou, Oualia

Table2: Components of planned comparison

Question or objectives	**What is the question for the learning priority?**	**WP1. Compare survival, growth and production of in situ-grafted natural regenerated plants, nursery propagated plants and air layering plants (marcots) of *Balanites aegyptiaca***
Hypothesis	What is the premise?	Grafting natural regenerated plants and nursery propagated seedlings is an efficient vegetative propagation technique as layering for *Balanites aegyptiaca* in Mali
Options to compare	What are the alternative ways of implementing the option in order to answer the question?	Three vegetative propagation practices - grafting natural regenerated plants in situ (on plants growing naturally on fields or fallows) - grafting plant propagated in nursery before planting - air layering of mature trees growing on farm or fallow Farmer may choose two of the three options to compare.
Contexts to compare	Under what conditions will the options be undertaken?	- Land use types (field vs. fallows) Dominant soil types
Study units	Where will the measurements be taken	- Plots (fields or fallows) where nursery grafted plants and marcots are planted, and in-situ grafting is made - Individual vegetative propagated plants (nursery seedlings grafts, in-situ grafted plants and marcots)

Responses to measure	What will be measured	1. Measurable by farmers - Narrative feedback from farmers - Recovery time (qualitative evaluation) - Success rates - Cost benefit ratio (effort, labor required): farmer assessment of the benefit, trade-off (ranking) 2. If student available - Survival rates, rate of establishment - Recovery time (rooting for layering or budding of scions in the case of grafting) - Plant growth increment: height, collar diameter, canopy - Flowering and fruit production
Roles of farmers	What will the farmers do to implement the PC??	- Choice of locations for in-situ grafting, plantation and layering - Nursery plant production or/and grafting, in-situ grafting and layering - Peer training on grafting and layering - Planting and maintenance of the stands - Farmer keeping record (document their own measurable response variables)
Roles of other actors	What will the other actor do to implement the PC?	1. Implementation partners (grassroots organization) - Information and awareness raising - Selecting volunteers producers - Participatory site selection - Monitoring and capitalization of the lessons 2. Lead organization (Sahel Eco and partners) - Provides logistics, coordination and funding - Sharing the results (lessons learnt, gaps ...) Researchers (ICRAF, EIR focal persons) - Contribute to the development of protocols, set up of planned comparisons, data collection and analysis - Contribute to train farmers on nursery plant propagation and grafting, in-situ grafting, air layering, plantation - Supervision of students 3. Students: - Monitor survival rates, rate of establishment - Plant growth increment: height, diameter, crown - Flowering and fruiting of all types of plants
Study/experimental design	How will the PC get laid / rolled out? How are the farmers going be selected How many treatments, how many farmers, how	- Number of sites, treatment per farm (still need to be defined; ideally consider large number of sites covering different contexts to be compared): minimum 10 - Number of treatment: minimum 2 out of 3 options - in situ plant grafts - nursery plant grafts

	many sites combine de sites?	- marcots (plants produced from air layering of mature trees) - watering is a facultative option - Number of farmers: minimum 10 per village based on the volunteer - Selection of volunteer farmers considering the geographic diversity within the same village - Set up: implementation by grassroots organizations of other actors
Suggested timing (start and end)	When will the PC start and end	Start November 2016 – End December 2018
Data collection sheets	Annex the data collection sheets for farmers and any additional for more rigorous data	Data collection sheets to be develop in from July 2016

Monitoring and evaluation

From the outset farmers will be required to indicate willingness to participate in the PC and their choice of options (2 or 3). Information on chosen options will be recorded in order to define a given context. Implementing agents or student will facilitate lead farmers and participating farmers to record data once a month using simple data collection sheets covering:

- Tree survival counts,
- Recovery time (qualitative evaluation)
- Success rates
- Tree flowering and fruiting (starting)

Farmers will be encouraged to keep records on the 3 options for vegetative propagation of *B. aegyptiaca* Data collection tools are included in the Annex section. Data collected by will be keyed into electronic devices in the field by the field monitoring team or a student. Implementing agents or student will monitored once a month the phenology and pest incidence (leafing, flowering and fruiting) of all types of plants their growth and survival (every 3 month). Data collection tools are suggested in the annex section.

Annex 1: IP staff record sheet on the farm profile (adapted from Tree planting / Kenya)

Farmer ID
Farmer's name:
Farmer's gender:
Village:
Province:
Site:
GPS Coordinates:
Slope (degrees):
Soil texture (also indicate if varying within the farm):
Distance to water source:
Choice of species:
Choice of accession:

Manure source
Date of plantation:

Description of the land use/ cultivation history:
Area cultivated (ha)
Number of trees already on the farm and species:
Time since the land was opened to cultivation,
Time since the land was fallowed
Crops commonly planted
Management practices (burning, inorganic fertilizer)
Does the farmer burn trash/ crop residue?
Does farmer apply fertilizers/ herbicides /Pesticides?
Erosion status (gully, sheet, rill, none):
Has the farmer ever employed a Soil Water Conservation practice before?
Which one?
Grazing animals on farm?

Crops and cropping history:
Land size (acres)
Land tenure type
Distance from farm to main road (km)
Distance from farm to nearest main market (km)

Any other observations

Annex 2: Farmer record sheet for monitoring plant survival, flowering and fruiting (once a month)

FARMER ID: VILLAGE: DATE OF OBSERVATION:
FARMER NAME: PROVINCE:

Species	In situ grafts	No. plant	Flowering (yes/no)	Fruiting (yes/no)	Observation (Utilizations made of fruit collected: consume, sold...)
		1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			
Species	Seedling grafts	No.	Flowering	Fruiting	Observation
		1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			
Species	Marcots	No.	Flowering	Fruiting	Observation
		1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			

Annex 3: Technician or student's record sheet for monitoring and evaluation of tree phenology (once a month)

FARMER ID: VILLAGE: NAME OF OBSERVER:

FARMER NAME: PROVINCE: DATE OF OBSERVATION:

Species	In-situ grafts	No. plant	Stage leafing	Stage flowering	Stage fruiting	Pest incidence (fungi/insect)	Observations
		1					
		2					
		3					
		4					
		5					
		6					
		7					
		8					
		9					
		10					
Species	Seedling grafts	No. plant	Stage leafing	Stage flowering	Stage fruiting	Pest incidence (fungi/insect)	Observations
		1					
		2					
		3					
		4					
		5					
		6					
		7					
		8					
		9					
		10					
Species	Marcots	No. plant	Stage leafing	Stage flowering	Stage fruiting	Pest incidence (fungi/insect)	Observations
		1					
		2					
		3					
		4					
		5					
		6					
		7					
		8					
		9					
		10					