Survival and Growth of Selected Agroforestry Tree Species under Farm Conditions in Western Kenya

Johannes Dietz - World Agroforestry Centre (ICRAF), Nairobi; Contact: j.dietz@cgiar.org

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Rationale

Many projects seek to use agroforestry and other reforestation practices to rehabilitate degraded and abandoned sites. Yet recommendations are often based on species screening trials that are conducted under controlled and hence optimal conditions by researchers. There is good reason to expect that the performance of recommended trees would be inferior under field conditions, leading to project failure.

Similarly, projects often dogmatically promote the use of native species, asserting that they will perform better because they are adapted to local conditions, without verifying their assumptions. There is good reason to doubt the appropriateness of this recommendation, particularly when rehabilitating degraded lands.

This study investigates the survival and growth of tree seedlings of 4 common species under a realistic range of management and edaphic conditions.

Methods

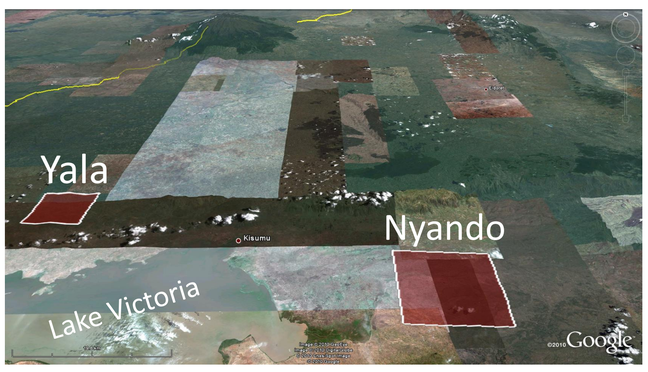

Fig. 1: Both two study blocks in the Nyando and Yala watersheds of Western Kenya at 990-1100m asl. The climate is tropically semi-arid with rainy seasons from in March-April and October-November

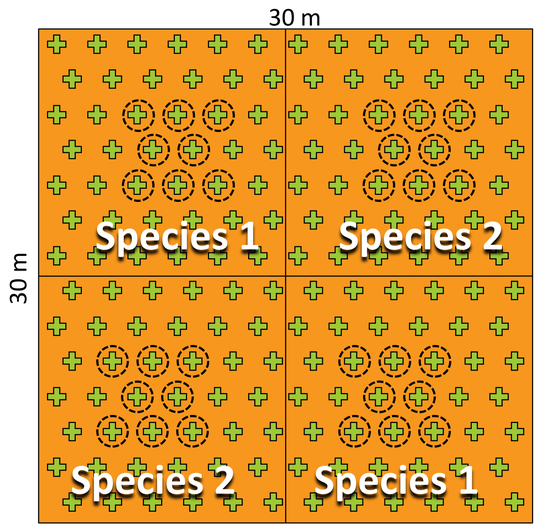

Fig. 2: Sketch of the layout for the trial plot for at total of 144 tree seedlings of two different species at equal spacing within 30x30 m (+). Identical species were allocated diagonal subplots and all trees were monitored for survival. Circled + indicate trees used for growth measurement avoiding edge effects.

Starting in March 2007, seedlings of *Albizia coriaria, Grevillea robusta, Markhamia lutea* and *Senna siamea* were planted according to farmers' choice by farmers at 227 eligible farms in Western Kenya (Fig. 1 & Fig. 2). Although recommendations on management were provided, type and intensity of management of the seedlings was left up to the individual farmer's preference.

The survival and growth of the seedlings was monitored after 3, 6, 12 and 18 months. (Tab. 1).

A. coriaria and *M. lutea* are native species to the region while *S. siamea* is considered an established species and *G. robusta* exotic. All species used are common trees relevant to local agroforestry use and practices.

Tab. 1: Overview of numbers assessed for each species.

Species	Survival				Growth		
	n	% of total planted*	% of this species planted	% with soil data	*n*	% of this species planted	% with soil data
Albizia coriaria	2520	13.3	100.0	15.3	64	2.5	17.4
Grevillea robusta	9000	47.5	100.0	57.6	216	2.4	50.0
Markhamia lutea	3672	19.4	100.0	20.9	88	2.4	23.9
Senna siamea	1152	6.1	100.0	6.2	56	4.9	8.7
Total	**16344**			**100**	**424**		

* = 11 species were planted at a total of 18936 trees

Results & Discussion

Tab. 2 Species listed as per management classes (Management classes are 1 = Well managed, 2 = Improving in management, 3 = With termites but well managed, 4 = Water logged, 5 = Browsed, 6 = Poorly managed or not managed) and survival rates after 3, 6, 12 and 18 months (Differences between species in lowercase letters are significant at $p < 0.05$; One-way ANOVA, Duncan's test)

Species	*n* in Management class						Survival rate (%)			
	1	2	3	4	5	6	3 months	6 months	12 months	18 months
Albizia coriaria	0	504	144	0	0	1872	93.0	81.8^{b}	75.0^{bc}	66.9^{b}
Grevillea robusta	792	1224	1368	288	288	5040	90.6	78.7^{b}	66.3^{c}	57.9^{b}
Markhamia lutea	360	648	792	144	0	1728	94.9	85.2^{ab}	78.1^{b}	69.6^{b}
Senna siamea	72	72	432	0	0	576	94.1	91.2^{a}	89.9^{a}	86.2^{a}
Total	**1224**	**2448**	**2736**	**432**	**288**	**9216**				

Tab. 3 Correlation of soil parameters in the sub-soil (30-60 cm derived from PCA of near-infrared spectra of soils) where significant.

Species	Parameter	Months	Soil Cluster	Cumulative r^2	*p*	*n*
A. coriaria	Survival	3	C, N (Yala)	0.48	0.035	8
G. robusta	Survival	3	Ca, Mg, pH	0.29	0.005	23
All	Survival	3	K, P	0.17	0.003	46

- While initial survival rates were similar only *S. siamea* showed significantly superior survival after 18 months, although not present across all management classes Tab 2).
- Lowest average survival rate is shown by the preferred species *G. robusta* which features highest in the poorest management class. This indicates that farmers tend to choose this popular species irrespective of their sub-sequent management efforts.
- Soil characteristics only of the subsoil had significant effects on the initial survival after 3 months. Under some management regimes, however, the planting using manure as fertilizer was promoted which may have obscured true soil effects (Tab. 3).

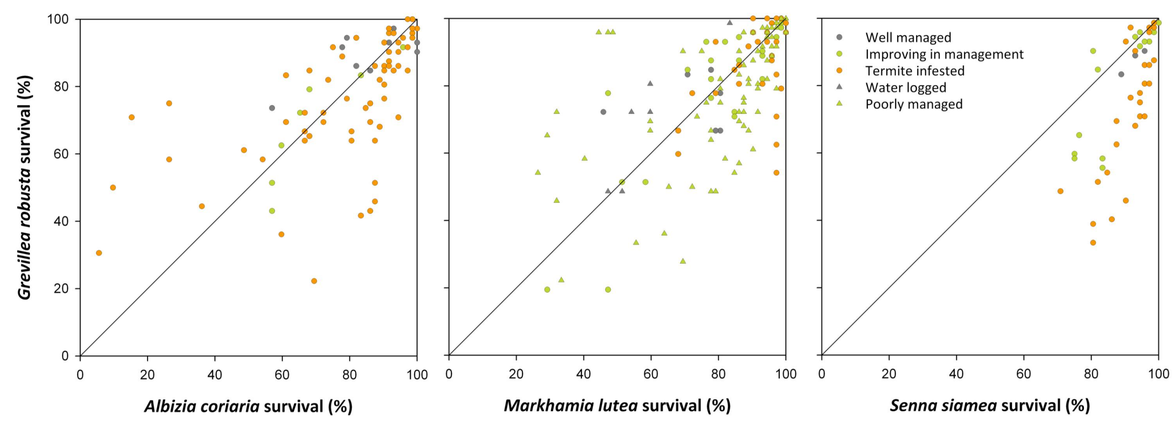

Fig. 1 Survival rate of *G. robusta* (exotic) compared to the remaining species according to the management type observed, where they were featured on identical plots.

- During the first 18 months, survival rates of *G. robusta* was below *S. siamea* and in most cases also below *A. coriaria* and *M. lutea*, across all management classes (Fig. 1).
- On plots where al monitored *G. robusta* and reference species survived 18 months, *G. robusta* showed superior growth throughout (Fig. 2). However, the bias in only monitoring sites of apparently favorable growth conditions must be taken in to account.

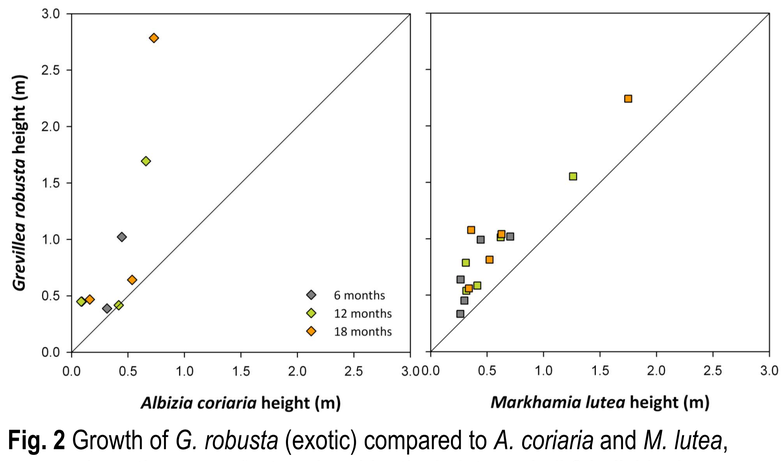

Fig. 2 Growth of *G. robusta* (exotic) compared to *A. coriaria* and *M. lutea*, where they were featured on identical plots and all 8 individuals sampled of each species survived 18 months leading to a bias by limiting sites to favorable survival/growth conditions.

Conclusions

- *Grevillea robusta*, a species introduced from its native Australia has by far been the favorite choice by farmers in Western Kenya and can be observed throughout the landscape due to its alleged rapid growth.
- Although no general conclusions for exotic species can be drawn, *G. robusta* showed lowest survival rates, especially compared to the (least favored) *Senna siamea*.
- Under conditions allowing high survival rates for *G. robusta* its growth rates are superior to all other sampled native species.
- Most significant constraints for survival were waterlogged soils and browsing by livestock, which is important as in practice constantly optimal growth conditions across all farms cannot be assured for reforestation projects.

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