

Preliminary weed risk assessment for *Khaya senegalensis* in plantations in northern Australia

Mila Bristow^{1 & 2} and David Skelton² (and respondents)

¹ School of Environmental Science and Management, Southern Cross University,
c/o Walkamin Research Station, Walkamin, Queensland.

² Private Forestry North Queensland Assoc. Inc, Kairi, Queensland.

Summary

This paper reports on a preliminary questionnaire about the potential for weediness of *Khaya senegalensis* in the dry tropics of northern Australia. Responses to the questionnaire were received via email recording 55 individual observations from sites in south, central and north Queensland, north and central Northern Territory and northern Western Australia. Larger trees, older than ten years were observed to flower and set fruit, sometimes prolifically. Regeneration was observed under these fruiting trees, although regeneration rarely survived longer than 12 months. A farmer-initiated framework for the management of *K. senegalensis* in plantations is suggested to support the development of a timber industry with this species in the dry tropics.

Introduction

African mahogany, *Khaya senegalensis* (Desr.) A. Juss., is a high-value hardwood species that has been growing in parts of northern Australia for more than 40 years. Its adaptability, resistance to pests, growth and wood properties are promising and currently there are initiatives to domesticate the species for industrial forestry development (Bristow 2004; Dickinson *et al.* 2004; Nikles *et al.* 2004). One of the arguments used by some to question the wisdom of domesticating the species in commercial plantings is that it might become a weed.

This suggestion has not been investigated by documentation of the actual distribution of natural regeneration of the species in relation to parent trees sources. For example, in Queensland *K. senegalensis* is neither a declared weed (i.e. not a pest plant targeted for control under state legislation), nor is it declared in any Queensland local government area as a plant of concern. However, Randall (2002) lists the status of this species in parts of the world as a “weed, sleeper weed, naturalised, environmental weed, [and] cultivation escapee” (Randall 2002). Even though not all of these sources could be traced, it is indicative that a number of sources cited by Randall (2002) regarded it as a weed. To be proactive and precautionary about using this exotic species in plantations, there has been a call for Risk Assessments to be completed in advance (Wilson *et al.* 2004).

Natural habitat and flowering biology

Khaya senegalensis occurs in savannas to humid forests often within the riparian zone, from Senegal to Sudan to Uganda (Arnold 2004). The climatic requirements and suitability of this species for the dry tropics of northern Australia is discussed in Arnold *et al.* (2004). The species has been introduced to a number of countries. Plantations have been established within its area of natural distribution and are well established in Vietnam, India (for example, Maharashtra, Tamil Nadu), Java, Cuba and Guadeloupe, as well as Australia (CAB International 2000; Arnold 2004; Arnold *et al.* 2004).

K. senegalensis is an insect pollinated, monoecious flowering tree (CAB International 2000). There are few records of the tree age when viable seed is produced, but until this study, not recorded at least before 20 years CAB International 2000. The seeds are brown, broadly transversely ellipsoid to flat, paper thin (about 25 x 18 mm) with narrowly-winged margins (Figure 1). Seeds may be dispersed up to 100 m by prevailing winds (Pacific Island Ecosystems at Risk (PIER) 2004). The frequency of

flowering and seeding trees in a population is generally unknown, but these and the long-term fate of natural regeneration are all factors that would influence potential for weediness.

This paper reports on a questionnaire developed by Private Forestry North Queensland Assoc. Inc. (PFNQ) and sent to foresters and forest networks across northern Australia. The questionnaire asked interested persons to document their observations about *Khaya senegalensis* in plantations, street and park trees and field trials. Information was collected about the location, growth, vigour, flowering, fruiting regeneration and the location and vigour of this regeneration.

This survey was not intended as a rigorous weed risk assessment; such an assessment would take considerable resources. Instead we undertook this preliminary survey in the hope that the results would determine whether or not there was a need for a complete weed risk assessment.



Figure 1. *K. senegalensis* seed pods and seed (photo: Geoff Dickinson).

Methods

The questionnaire asked for any information about observations such as:

- Location of tree/s
- Number of trees
- Age of tree/s
- Size (approximately) of tree/s (height in metres & diameter in cm)
- Any regeneration observed? (Y/N)
- Distribution of regeneration (quantity, distance, direction, up/down wind etc) Flowering & fruiting frequency
- Number of trees with pods
- Vigour of regeneration
- Age of regeneration.

Results and Discussion

There were 13 respondents, recording 55 separate observations on a range of sites, numbers and ages of trees. The respondents' names are listed in the acknowledgements, and original observations are recorded in Appendix A.

Responses from across northern Australia included:

- 6 from Queensland (Bowen to Burdekin, Charters Towers to Townsville, Weipa, Lakeland Downs, Imbil, Gympie, Rockhampton);
- 5 from Northern Territory (Howard Springs, Berry Springs, Berrimah, Gunn Point, Darwin, Katherine);
- 2 from Western Australia (Kununurra, Mitchell Plateau).

There were also several verbal responses received by growers who had very young trees and stands, which were not yet flowering; these were not included in the results.

Growth rate and hardiness

Most responses were about trees older than 10 years, describing vigorously growing street trees or plantation stands of *K. senegalensis*. The first part of the survey asked about size and age of tree and whether there was any regeneration observed. Most responses had observed regeneration, and those that did were from older, larger trees (Table 1).

Table 1. Observed regeneration and approximations for ages and sizes of reproducing *K. senegalensis* trees.

Regeneration observed	Approx. percentage of observations (%)	Age of trees (span of yrs)	Minimum DBHOB (cm)
No	44	3.8 - 30	6.6
Yes	51	15 - 33	19.4

Approximately 4.0% of observations did not answer this question (i.e. 2 out of 55).

Reproduction and hardiness of regeneration

The second series of questions were about the distribution of any regeneration (quantity, distance, direction, up or down wind from parent tree, etc). Those observation with regeneration recorded (51% of responses from older, larger trees) suggest that most of the germinants occur under, or immediately adjacent to the parent tree (Appendix A). There were some comments that germinants occurred in irrigated areas, or drainage lines.

This is consistent with observations on the dissemination of *K. senegalensis* natural regeneration in its natural habitat: *K. senegalensis* occurs in riverine forests and is scattered within the higher-rainfall savannah woodlands (CAB International 2000; Pacific Island Ecosystems at Risk (PIER) 2004).

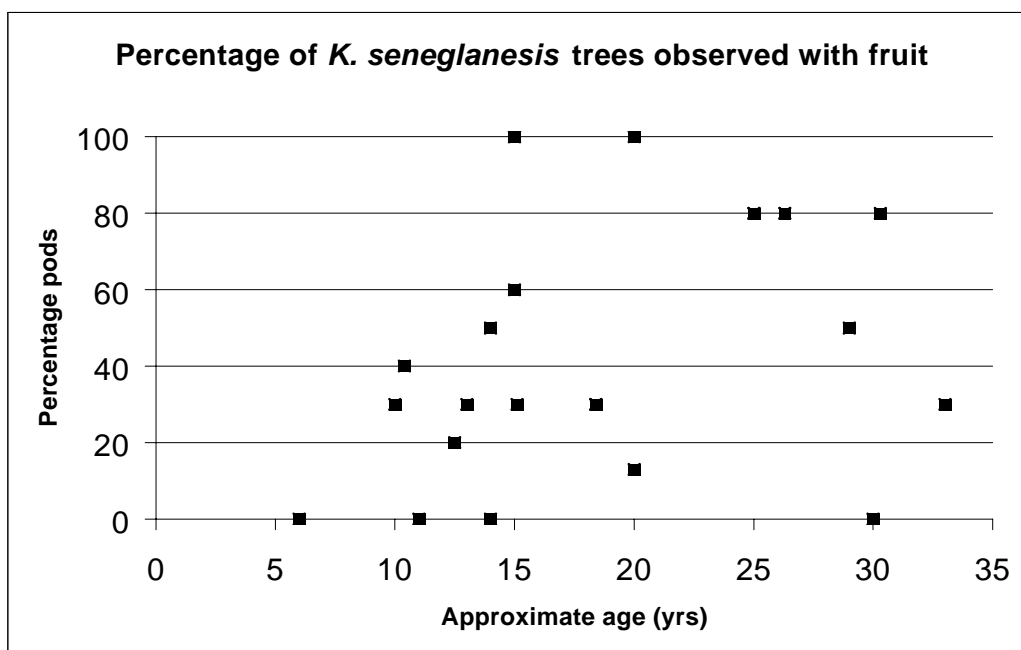
Flowering and seed production

Third, we asked about the flowering and seed production habits of the observed trees. To this section of the survey we had 26 responses. This was probably because in approximately 44% of cases no

regeneration was observed underneath or nearby to the trees; these were the same trees that were not old enough to flower. Therefore respondents only completed the second part of the survey if they had observed older trees (about 47% of observations).

Survey results show that all trees over 10 years old were flowering and setting seeds, and probably annually, and that no flowering was observed on trees less than 10 years old (Figure 2). This is much younger than the suggested 20 – 25 years by CAB International (2000). The survey did not, however, collect enough information to determine site or regional differences in flowering or seed production, nor did it question the viability of this first-produced seed.

Figure 2. Percentage of *K. senegalensis* trees, and/or stands of trees, observed with fruit (seed pods). NB. Number of observations = 26.



Lastly we asked about the survival of the regeneration that was observed – was it vigorous, and did it grow on to maturity. Mostly the responses were that regeneration was not vigorous, or that germinant vigour was “poor less than 15cm tall, less than 1 yr old” (see Figure 3). With comments like: “In almost every example I have seen, 98% annual mortality from drought, parent/weed competition or plantation management occurs every year.”

There were a couple of answers from Northern Territory respondents that vigour of the regeneration “depends on timing of dispersal”, and that it can be “very persistent”, and another that said regeneration was “vigorous on edge of the stand, and surviving perhaps 1-6 years”.

Control of regeneration or germinants

K. senegalensis will not tolerate fire (CAB International 2000; Pacific Island Ecosystems at Risk (PIER) 2004), and fire appears the main cause of death in most Queensland plantings, although vigorous weed competition or extreme dry over the first 12 months will also cause mortality (Collins and Dickinson 2004).

One respondent summarised regeneration and germinants with the following statement:

“In most cases, the *Khaya senegalensis* regeneration seen was less than a year old and consisted of seedlings with only the cotyledons or less than 6 leaves present. It would appear that the regenerated seedlings almost entirely die-out over the dry Winter/Spring/early Summer period. Fires, inter-row slashing or weed/parent competition take(s) out the rest.”



Figure 3. Germinants, generally with 2 cotyledons, in leaf litter under a *K. senegalensis* age 15 yrs, Burdekin Agricultural College, north Queensland. (photo: Geoff Dickinson)

Conclusions

The performance of *Khaya senegalensis*, and the status awarded it at this workshop as currently the most promising high-value hardwood species for the dry tropics, will promote further planting of this species in northern Australia. Many of the attributes that make good plantation timber species for the dry tropics (drought resistance, fast growth, and persistence) also contribute to what is commonly known as ‘weediness’. Weediness is made up of a suite of characteristics including the fecundity, vigour and persistence, and adaptability to different environmental conditions. This preliminary questionnaire could be seen as a first step in investigating the weediness of *K. senegalensis* in northern Australia.

Conclusions from the observation survey are that:

- *K. senegalensis* is flowering and fruiting from age 10 years in northern Australia.
- Regeneration is seen under older, larger trees, and this regeneration is generally restricted to close proximity of the parent tree.
- Regeneration mostly perishes within 12 months.

Surviving germinants are in a few niche microclimates, especially wetter areas such as drainage lines. In these situations there are some suggestions that seedlings may have an opportunity to survive and continue to grow (at least up to age 6 years from one observation).

In plantation situations, each of these features can and should be managed through careful site selection when planting a *Khaya senegalensis* plantation, management of drainage lines and fence lines, and proficient plantation silviculture.

The emergent *K. senegalensis* plantation industry could learn from other exotic plant based industries, such as Queensland's leucaena growers, and consider a self-regulating and government-supported code of practice, based on precautionary principle of ecologically sustainable development as one way to be proactive about weediness (The Leucaena Network 2004).

The main cause for concern with *K. senegalensis* is its high annual production of viable seed, however even this is generally restricted to close proximity of the parent tree and seed, and most regeneration from this seed, perishes within 12 months probably due to resource competition with the parent trees. Other papers presented at this workshop show that the growth of this species is somewhat determined by silvicultural inputs, and irrigation is commonly used to improve the early growth of *K. senegalensis* (Collins *et al* 2004; Dickinson *et al.* 2004). This survey emphasizes a risk associated with planting *K. senegalensis* in close proximity to wetter areas. If seed is transported away from the planting site by overland flow into a riparian area or irrigation drainage lines, it could develop unnoticed. However, as it takes at least 10 years to set viable seed, its propensity for further spread is greatly curtailed. A better understanding of water use and requirements is necessary to not only optimise growth (per unit of silvicultural input), but also to avoid excess water on the site. Observations of regeneration suggest avoiding riparian zones and assiduous monitoring of irrigation drainage lines.

From the leucaena growers example we know that the majority of weed leucaena does not originate from the grazing properties where it is planted as a commercial fodder species (Responsible Use and Management of Plants (RUMP) 2004; The Leucaena Network 2004). Similar suggestions have been made for *K. senegalensis*; that *K. senegalensis* street and park trees with their inherent proximity to drains, along with plantings in higher rainfall, coastal, urban areas pose the greatest weed threat for this species (D. Reilly, pers. comms). Monitoring and management is essential, and possibly there is less risk associated with managed plantations than with unsupervised amenity plantings where seed might be washed into watercourses and become invasive in riparian strips, the natural habitat of this species.

This preliminary survey highlights some interesting features of *K. senegalensis* growing in northern Australia, and illustrates the need for a detailed weed risk assessment. Results also strengthen the need for promotion of *K. senegalensis* to be on the proviso of judicious silvicultural management, and perhaps restricted to plantation situations. These recommendations could be further developed into a farmer and industry-based framework, or code of practice, for growing this species in the dry tropics of northern Australia.

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References

Arnold, R. 2004. *Khaya senegalensis* - current use from its natural range and its potential in Sri Lanka and elsewhere in Asia. Working paper in 'Prospect for high-value hardwood timber plantations in the 'dry' tropics of northern Australia'. (Eds) Bevege, D.I., Bristow, M., Nikles, D.G. and Skelton, D. 19-21 October, 2004, Mareeba, Queensland. Published as a CD ROM by Private Forestry North Queensland.

Arnold, R., Reilly, D., Dickinson, G. and Jovanovic, T. 2004. Determining the climatic suitability of *Khaya senegalensis* for plantations in Australia. Working paper in 'Prospect for high-value hardwood timber plantations in the 'dry' tropics of northern Australia'. (Eds) Bevege, D.I., Bristow, M., Nikles, D.G. and Skelton, D. 19-21 October, 2004, Mareeba, Queensland. Published as a CD ROM by Private Forestry North Queensland, Kairi, Queensland.

Bristow, M. 2004. Review of Agroforestry in Tropical Savanna Regions of Northern Australia. Joint Venture Agroforestry Program, RIRDC, RIRDC Publication, 04/025, Canberra.

CAB International 2000. Forestry Compendium - a silvicultural reference. CAB International: Wallingford, UK CD ROM.

Collins, R., Dickinson, G. and Skelton, D. 2004. Plantation Forestry Management Principles for the Dry Tropics of northern Australia. Working paper in 'Prospect for high-value hardwood timber plantations in the 'dry' tropics of northern Australia'. (Eds) Bevege, D.I., Bristow, M., Nikles, D.G. and Skelton, D. 19-21 October, 2004, Mareeba, Queensland. Published as a CD ROM by Private Forestry North Queensland, Kairi, Queensland.

Dickinson, G., Bristow, M. and Kelly, N.I. 2004. Promising high-value hardwood plantation tree species for the dry tropics of Queensland. Working paper in 'Prospect for high-value hardwood timber plantations in the 'dry' tropics of northern Australia'. (Eds) Bevege, D.I., Bristow, M., Nikles, D.G. and Skelton, D. 19-21 October, 2004, Mareeba, Queensland. Published as a CD ROM by Private Forestry North Queensland, Kairi, Queensland.

Nikles, D.G., Reilly, D. and Robertson, R.M. 2004. Conservation and genetic improvement in the Northern Territory (Australia) of *Khaya senegalensis* (African mahogany) - a valuable tree species endangered in parts of its homelands. Working paper in 'Prospect for high-value hardwood timber plantations in the 'dry' tropics of northern Australia'. (Eds) Bevege, D.I., Bristow, M., Nikles, D.G. and Skelton, D. 19-21 October, 2004, Mareeba, Queensland. Published as a CD ROM by Private Forestry North Queensland, Kairi, Queensland.

Preliminary weed risk assessment for *Khaya senegalensis* in plantations in northern Australia - Mila Bristow, David Skelton (and respondents)

Pacific Island Ecosystems at Risk (PIER). 2004. *Khaya senegalensis*. Online Website.

Randall, R.P. 2002. A Global Compendium of Weeds. Online Website.

Responsible Use and Management of Plants (RUMP). 2004. Policy to reduce the weed threat of *Leucaena*. Department of Primary Industries & Fisheries, Environmental Protection Agency, Department of Natural Resources and Mines, Queensland.

The *Leucaena* Network 2004. A code of practice for the sustainable use of *Leucaena*-based pasture in Queensland. Yeppoon, Queensland.

Wilson, G.W., Waterhouse, B.M. and Werren, G.L. 2004. The use of exotic species in dry tropics forestry: assessments, potential conflicts of interests and the application of The Precautionary Principle. Working paper in 'Prospect for high-value hardwood timber plantations in the 'dry' tropics of northern Australia'. (Eds) Bevege, D.I., Bristow, M. and Nikles, D.G. and Skelton, D. 19-21 October, 2004, Mareeba, Queensland. Published as a CD ROM by Private Forestry North Queensland, Kairi, Queensland.

Appendix A

Tables 2 and 3, observational data recorded.

Table 2. Location, number, age and size of trees of *Khaya senegalensis* in northern Australia, plus whether or not regeneration was observed.

Observer	Location of tree/s	No. of trees	Age of tree/s	Size (approx) of tree/s (ht-m; dia-cm)	Regeneration observed	Distribution of regeneration (quantity, distance, direction, up/down wind etc)
G. Dickinson	Lakeland Downs	5	10.4	12.7m / 32.3cm	N	
G. Dickinson	Lakeland Downs	50	10.4	7.0m / 16.5cm	N	
G. Dickinson	Weipa (Lions park)	300	25	14.4m / 21.0cm	Y	>50 tree. Mainly under, but within 10m radius of canopy
G. Dickinson	Weipa (Lions park)	300	25	11.9m / 19.4cm	Y	>50 tree. Mainly under, but within 5m radius of canopy
G. Dickinson	Weipa (regen centre)	50	30.3	14.2m / 26.2cm	Y	<20/tree. Under canopy only
G. Dickinson	Weipa (Andoom mine)	500	26.3	14.4m / 20.8cm	Y	20-50/tree. Mainly under, but within 10m radius of canopy
G. Dickinson	Weipa (Andoom mine)	500	26.3	13.6m / 19.9cm	Y	20-50/tree. Mainly under, but within 10m radius of canopy
G. Dickinson	Sudley Station	30	18.4	12.3m / 36.5cm	N	
G. Dickinson	Sudley Station	24	18.4	13.4m / 40.4cm	N	
G. Dickinson	G.N. Caravan Park, T'vile	4	15.1	66.7cm / 21.0m	Y	<20/tree. Mainly under, but within 5m radius of canopy
G. Dickinson	Alligator Ck (Hicks)	85	6.6	9.4m / 15.3cm	N	
G. Dickinson	Alligator Ck (Mills)	80	5	6.6m / 11.1cm	N	
G. Dickinson	Ayr (Rossiter)	63	5.3	7.1m / 12.6cm	N	
G. Dickinson	Home Hill (Walters)	63	6.6	8.2m / 17.1cm	N	
G. Dickinson	Merinda (Jones)	58	5.5	8.4m / 13.6cm	N	
G. Dickinson	Merinda (Dyson)	60	6	6.3m / 10.2cm	N	

Prospects for high-value hardwood timber plantations in the 'dry' tropics of northern Australia, Mareeba, 19th – 21st October 2004.

Observer	Location of tree/s	No. of trees	Age of tree/s	Size (approx) of tree/s (ht-m; dia-cm)	Regeneration observed	Distribution of regeneration (quantity, distance, direction, up/down wind etc)
G. Dickinson	Bowen (Baxter)	60	5.7	6.3m / 11.1cm	N	
G. Dickinson	Clare (B. Ag. College)	59	15	10.8m / 27.4cm	Y	>100/tree. Mainly under, but within 5m radius of canopy
G. Dickinson	Clare (B. Ag. College)	66	13	9.4m / 24.8cm	Y	<20/tree. Mainly under, but within 5m radius of canopy
G. Dickinson	Clare (B. Ag. College)	30	12.5	10.5m / 22.4cm	Y	1-2/tree. Under canopy only
G. Dickinson	Charters Twrs (Walker)	46	5.8	6.6m / 8.7cm	N	
G. Dickinson	Charters Twrs (Rowes)	58	4.8	4.9m / 6.6cm	N	
G. Dickinson	Charters Twrs (Rowes)	52	3.8	4.9m / 6.9cm	N	
G. Dickinson	Ingham (Vitalis)	15	10	50cm / 22.0m	Y	<20/tree. Mainly under, but within 5m radius of canopy
G. Sankowsky	Howard Springs, NT	Numerous	Various	Seedlings to small trees	Y	Throughout the small rainforest area
G. Sankowsky	Berry Berry Springs NT	Thousands	Various	Seedlings to small trees	Y	Throughout the small rainforest area
R. Collins	Weipa	Plots	30		Y	Under parent trees
R. Collins	Gunn Point NT	Plots	30		Y	Under parent trees
R. Collins	Burdekin Agricultural College	Plots	12		Y	Under parent trees
F. Bebawi	Charters Towers	About 20 in addition to 2 small plantations	10	15m / 70 cm	N	
K. Gould	Kairi Research Station, NQ	4+	30		N	Nil
K. Gould	Weipa streets & parks	Dozens	30		N	None obvious
K. Gould	Weipa Rehabilitation plantations	Thousands	29		Y	Some, but not a problem
J. Stuart	McMinns Lagoon area, Darwin	1	26	15m / 130 cm	Y	Via wind up to 20m

Prospects for high-value hardwood timber plantations in the 'dry' tropics of northern Australia, Mareeba, 19th – 21st October 2004.

Observer	Location of tree/s	No. of trees	Age of tree/s	Size (approx) of tree/s (ht-m; dia-cm)	Regeneration observed	Distribution of regeneration (quantity, distance, direction, up/down wind etc)
J. Stuart	Around Darwin	Many	12 to 30	10m / 70cm +	Y	Generally heavy under canopy or within 10 - 20m of tree
E. Rider	Rockhampton	several		doing well		
E. Rider	Old railway Stn, Gympie	1			N	
E. Rider	Krasnozern soil, Imbil	Plots				
D. & N. Higgins	House yard, Katherine NT	11	15	15m / 60cm	Y	Immediate vicinity of parent tree
D. & N. Higgins	Shed area, Katherine NT	3	18	15 / 80	Y	Under parent trees
T. Walker	Windrock, Charters Towers	120	6	5m / 15cm	N	
T. Walker	Windrock, Charters Towers	20	14	50cm DBH	N	
J. Brennan	Beagle Bay Nursery (old plant nursery), West Kimberley	4	15		N	Nil
J. Brennan	Beagle Bay Nursery (old plant nursery), West Kimberley	10	20		N	Nil
J. Brennan	Ornamental plantings on pastoral land north and west Kimberley	10	15-20		N	Nil
C. Done	Mitchell Plateau, Kandiwal, Kimberley WA	< 20	25	>15m / approx 70 cm	Y	Locally, all directions
C. Done	Mitchell Plateau regeneration plot, Kimberley WA	Few	25	Probably < 10	Y	Downslope on disturbed fill area
D. Reilly	Noonamah, NT	20	15	15 -20m / 30cm	Y	Within 30m of parent tree, upwind in irrigated paddock
D. Reilly	Home, NT	4	12	15m / 20-30cm	N	
D. Reilly	Howard Springs, NT	Hundreds	29	15m / 70 cm	Y	Usually downwind, within a short distance of parent trees
D. Reilly	Gunn Point NT	Hundreds	29	20m / 70 cm	Y	Usually downwind, within a short distance of parent trees

Prospects for high-value hardwood timber plantations in the 'dry' tropics of northern Australia, Mareeba, 19th – 21st October 2004.

Observer	Location of tree/s	No. of trees	Age of tree/s	Size (approx) of tree/s (ht-m; dia-cm)	Regeneration observed	Distribution of regeneration (quantity, distance, direction, up/down wind etc)
R. M (B) Robertson	DBIRD Berrimah, NT	1	30	25m / 100cm	Y	Under canopy of trees, approx 100 seedlings
R. M (B) Robertson	Howard Springs Forest Reserve, NT	2500 (2.5 ha)	33	20 - 25m / 35 - 60cm	Y	Regeneration on eastern side of trial, regeneration distrib no further than height of trees
R. M (B) Robertson	Virginia, 30km south Darwin	About 15	15 - 25	15 - 20m / 50 - 70cm	Y	Regeneration in road drain outside fence line

Table 3. Observations of flowering, fruiting, seed production and vigour and age of regeneration of *Khaya senegalensis* in northern Australia.

Observer	Location of tree/s	No. of trees	Age of tree/s	Flowing & fruiting frequency	No. trees with pods	Percentage of trees with seed pods	Vigour of regeneration	Age of regeneration
G. Dickinson	Lakeland Downs	5	10.4	Just started?	40%	40	None	None
G. Dickinson	Weipa (Lions park)	300	25	Annual for 15+ years (?)	80%	80	Poor (few trees to 3m)	Possible up to 5yrs of age?
G. Dickinson	Weipa (Lions park)	300	25	Annual for 15+ years (?)	80%	80	Poor (few trees to 3m)	Possible up to 5yrs of age?
G. Dickinson	Weipa (regen centre)	50	30.3	Annual for 15+ years (?)	80%	80	Poor (<15cm)	< 1 year old
G. Dickinson	Weipa (Andoom mine)	500	26.3	Annual for 15+ years (?)	80%	80	Poor (few trees to 1m)	Possible up to 3yrs of age?
G. Dickinson	Weipa (Andoom mine)	500	26.3	Annual for 15+ years (?)	80%	80	Poor (few trees to 1m)	Possible up to 3yrs of age?
G. Dickinson	Sudley Station	30	18.4	Annual for last few years?	30%	30	None	None
G. Dickinson	Sudley Station	24	18.4	Annual for last few years?	30%	30	None	None
G. Dickinson	G.N. Caravan Park, T'ville	4	15.1	Annual for last few years?	30%	30	Poor (<15cm)	< 1 year old
G. Dickinson	Clare (B. Ag. College)	59	15	Annual for last few years?	60%	60	Poor (<15cm)	< 1 year old
G. Dickinson	Clare (B. Ag. College)	66	13	Annual for last few years?	30%	30	Poor (<15cm)	< 1 year old
G. Dickinson	Clare (B. Ag. College)	30	12.5	Just started?	20%	20	Poor (<15cm)	< 1 year old
G. Dickinson	Ingham (Vitales)	15	10	Annual for last few years?	30%	30	Poor (<15cm)	< 1 year old
F. Bebawi	Charters Towers	About 20, plus 2 small plantations	10	Produces heaps of seed				
J. Stuart	Around Darwin	up to 100	20	Spasmodically 1 - 2 year	Irregular		Depends on timing of dispersal	Very persistent
D. & N. Higgins	House yard, Katherine NT	11	15	Yearly	11	100	Unknown	

Prospects for high-value hardwood timber plantations in the 'dry' tropics of northern Australia, Mareeba, 19th – 21st October 2004.

Observer	Location of tree/s	No. of trees	Age of tree/s	Flowing & fruiting frequency	No. trees with pods	Percentage of trees with seed pods	Vigour of regeneration	Age of regeneration
T. Walker	Windrock, Charters Towers	120	6	None	0	0	None	
T. Walker	Windrock, Charters Towers	20	14	Yearly	0	0	None	
J. Brennan	Beagle Bay Nursery (old plant nursery), West Kimberley	4	15	Yearly	4	100		
J. Brennan	Beagle Bay Nursery (old plant nursery), West Kimberley	10	20	Yearly	10	100		
D. Reilly	Noonamah, NT	20	14	Some every year	50	50	Poor	Some > 5 yrs
D. Reilly	Home, NT	4	11	None	0	0		
D. Reilly	Howard Springs, NT	Hundreds	29	Some every year	50	50	Good	> 5 yrs
B. Robertson	DBIRD Berrimah, NT	100	30	None	0	0	Vigorous healthy	2-3 yrs
B. Robertson	Howard Springs Forest Reserve, NT	2500	33	Some edge trees	10	30	Vigorous on edge	1-6 years
B. Robertson	Virginia, 30km south Darwin	About 15	20	Some fruiting	2	13	Vigorous	7 years