Test report: Some properties of lesser known timber species from Suriname

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SHR operates according to NEN-EN-ISO/IEC 17025.

Contents

1 Assignment

On September 16th, 2017 the project *Laboratoriumonderzoek t.b.v. Surinaamse Lesser Known Timber Species*, was granted and on March 2nd 2018 a specification was given of the work executed for this project and reported here.

2 Execution of the test

2.1 Identification and description of the samples

On January 25th, 2018, Mr. van Benthem (Probos) and Mr. Klaassen (SHR) inspected the timber just delivered from Suriname on the site of WTP (World Timber Products) at Hardenberg. Eight boards were chosen as material for investigation. Figure 2.1 shows the boules (stickered boards).

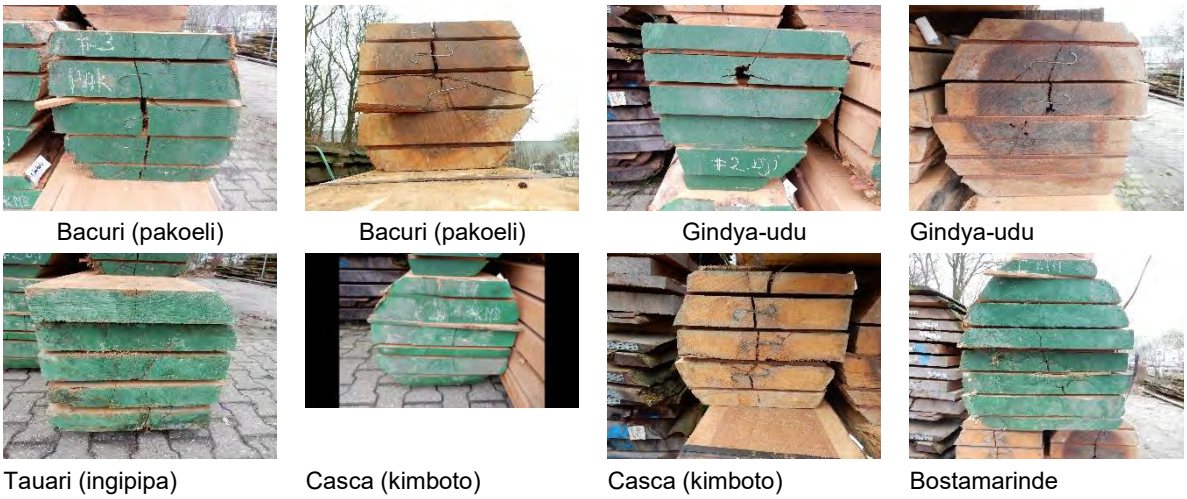


Figure 2.1 The stems on the site of WTP

From each stem the middle plank was selected for the lot assessment. Before transportation to SHR, these unedged boards were sawn into separate beams.
At the SHR laboratory, the beams were stored in the laboratory (at 20°C and 65% RH, appr. 2 months) until the lot assessment. During storage some fungal growth was seen and cracks appeared in some of the beams.
The lot assessment was mainly executed on March 23rd 2018.

For determination of the swelling and shrinkage, quarter sawn blocks (10mm thick in axial direction and 20-45mm wide) were made. All samples were numbered in agreement with the code used at the lot assessment. The number of samples used in the test depended on the wood quality. An overview of the samples is given in table 2.1.

Table 2.1 sample overview

Trade name	Code stem	Number of samples
Ingipipa	1.1	12
Bostamarinde	2.1	12
Gindya-udu	4.1 & 6.1	26
Pakoeli	5.1 & 5.2	14
Kimboto	3.1 & 7.1	10

For the durability tests samples were made according to the description of CEN/TS 15083-1 with dimensions 25 x 15 x 50 mm (w x t x l). Sample preparation started with a lath of each of the selected beams, which would deliver enough samples to use at least one sample on each of the required fungi, and two samples to determine moisture content. After conditioning, the laths were first calibrated (to 15x25 mm) and then crosscut to obtain the samples of 50 mm in length.
Untreated pine sapwood (*Pinus sylvestris*) and beech (*Fagus sylvatica*) samples of the same dimensions were prepared as virulence control samples. Wood for these samples was taken from the SHR stock. The virulence control samples are placed on the fungi without the presence of test samples and are used to check the activity of the fungi in the test.

2.2 Period of the test

The tests were conducted between March and November 2018.

2.3 Procedure

The lot assessment (according to SKH Publication 97-04):
On planed, coded samples, the quality of the timber was assessed, the imperfections found in the timber were described and pictures were taken both from normal wood as well as wood with imperfections. A representative sample was chosen for microscopic research. Based on the cross, radial, and tangential thin sections an anatomical description was made. Furthermore representative samples were chosen for making macroscopic pictures of the cross, flat and quarter sawn surfaces. Only the cross section picture was enlarged and an area of 5x5 mm is shown.

Determination of the radial and tangential swelling (according to SKH Publication 97-04):
Of the quarter sawn samples the mass as well as the radial and tangential dimensions were determined. Half of the samples were climatized to the following climates descending in humidity: 94% RH, 81% RH, 65% RH, 50% RH and 30% RH. The other half of the samples were climatized to another climates sequence with humidity ascending: 30% RH, 50% RH, 65% RH, 81% RH and 94% RH. If the mass of the samples did not change in 24 hours, the samples were regarded as climatized. Finally the samples were water saturated by submerging them in water for 24 hours, followed by oven drying for 24 hours at 103±2°C.
After every climatizing step and after water saturating the tangential and radial dimensions and the mass of the samples were determined. After oven drying, the samples were cooled in an desiccator and again the dimensions and mass were determined.

For determination of the thickness swelling and shrinkage the following formulas were used:

$$K_{x-y} = \frac{b_x - b_y}{b_x} * 100\%$$

$$Z_{x-y} = \frac{b_x - b_y}{b_y} * 100\%$$

Where b_x is the tangential or radial dimension at moisture content x and b_y is the tangential or radial dimension at moisture content y. K_{x-y} means the shrinkage from water saturated (x) to a moisture content of y% and Z_{x-y} means the swelling from ovendry (y) to moisture content of x%.

Determination of the durability (SKH Publication 97-04 / CEN/TS 15083-1):
All samples, including virulence samples were conditioned at 20°C, 65% RH to equilibrium. The dry weight of the test samples was determined using the moisture content of 2 samples of each lath. According to the CEN/TS 15083-1 the initial dry weight of the virulence samples was determined using oven drying at 103 °C for 16-24 hours. The conditioned samples were sterilized with ionized radiation.

The samples were placed in culture vessels, which contained sterilised culture medium (agar) which was inoculated with one of the wood destroying Basidiomycetes (Table 2.2). The choice of the test fungi is based on the recommendations from both the SKH Publication 97-04 and CEN/TS 15083-1.

Table 2.2 Fungi used in the test

Fungus	Common name	Type
Coniophora puteana	Cellar (rot) fungus, wet rot fungus	Brown rot
Poria placenta	Pore fungus	Brown rot
Coriolus versicolor	Turkey tail fungus, Shelf fungus, Many zone polypore	White rot
Donkioporia expansa	Oak polypore	White rot

In each culture vessel, two test samples were placed. The culture vessels were then placed in a culture chamber (22°C, 70% RH) for a period of 16 weeks. The virulence control samples were exposed in the same way.
After the exposure period, the samples were taken from the culture vessels and, after removing adhering fungal tissue, they were weighed before and after drying at 103 °C for 16-24 hours.

The mass loss (ML) of each individual sample due to fungal decay was calculated based on the dry weight before and after the test. The moisture content (mc) of the samples was calculated based on the weight before and after drying.

$$ML = \frac{(m_0 - m_t)}{m_0}$$

with:

ML	*mass loss*	*(%)*
m_0	*dry weight of the sample before the test*	*[g]*
m_t	*dry weight of the sample after the test*	*[g]*

$$mc = \frac{(m_{tw} - m_t)}{m_t}$$

with:

mc	*moisture content*	*(%)*
m_{tw}	*wet weight of the sample before oven drying*	*[g]*
m_t	*dry weight of the sample after oven drying*	*[g]*

Following EN 350:2016 the classification into durability classes would be based on the median percentage of mass loss of the test samples. The criteria of the durability classes as defined in the standard are given in Table 2.3. The fungus resulting in the highest mass loss (in %) determines the durability class.

None off the timber species investigated in this study fulfils the demands with regard to the number of samples required in the standard. Table 2.1 gives an overview of the number of samples used per species. Therefore this durability test can only result in an indication of the durability class.

Table 2.3. Durability classification according to EN 350 for Basidiomycete fungal tests

Durability class	Description	Percentage mass loss (ML)				
1	Very durable			ML	≤	5
2	Durable	5	<	ML	≤	10
3	Moderately durable	10	<	ML	≤	15
4	Slightly durable	15	<	ML	≤	30
5	Not durable	30	<	ML		

2.4 Apparatus

- Electric wood moisture meter (SHR/107 and SHR/187)
- Analytic balance (SHR/648 and SHR/008)
- Thickness gauge (SHR/007)
- Electric furnace (SHR/038 and SHR/200)

3 Results

In this chapter the results are given of the lot assessment, swelling and shrinkage and the durability test. The results are grouped by wood species.

In general the wood available was of poor quality: of 4 stems it is suspected that they have been too long in the forest after felling, based on the rot, blue stain and bore holes present in the wood. This makes the available test material partly unusable for further research. As the wood was delivered at SHR undried, two months of drying (at 20°C and 65% RH) with some air movement, was too short to reach moisture contents below 20%. The much smaller samples for shrinkage & swelling and durability tests were therefore dried in a climate chamber at 65%RH and 20°C. After they reached their equilibrium moisture content, further investigation was started. As some of the samples needed more time for climatization, the durability test was executed in two parts.

Regarding the durability test, the CEN/TS 15083-1 fungal test requires the determination of the virulence of the fungi. Sufficient virulence is present when the mass loss of the untreated pine sapwood and / or beech test samples is more than the minimum percentage specified in the CEN/TS 15083-1 (column 'ML required' in Table 3.1).
In this test beech virulence samples were used for all fungi according to the CEN/TS 15083-1.
For some samples it took a long time to reach their equilibrium moisture content. Therefore the test (charge 1) was started without theses samples and the test (charge 2) with these samples was started several weeks later. For charge 1 virulence samples of softwood and hardwood were included for all fungal species. For charge 2 virulence samples were used as required but as *Poria placenta* has a preference for softwood, we used for this species softwood only. Table 3.1 shows the required mass loss and the mass loss (ML) found for all virulence control specimens in this test. Since the test is executed in two parts there are two columns for ML found.

Table 3.1 Required and found mass loss (ML) of virulence samples for the fungi used in the test

Fungus	Type	Wood species	Virulence control samples		
			ML required (%)	ML found (%) charge 1	ML found (%) charge 2
Coniophora puteana	Brown rot	Pine sapwood	> 30	28.0	34.0
		Beech	> 30	38.8	41.6
Poria placenta	Brown rot	Pine sapwood	> 20	16.7	17.5
		Beech	no requirement	14.1	-
Coriolus versicolor	White rot	Pine sapwood	no requirement	18.6	-
		Beech	> 20	36.6	31.0
Donkioporia expansa	White rot	Pine sapwood	no requirement	15.4	-
		Beech	no requirement	19.7	23.5

3.1 Ingipipa

Lot assessment

Below a summary of the lot assessment is given (for further details see appendix 1).

Colour:	light brown with light streaks.
Sapwood:	not clearly demarked: width: 1-10cm
Grain:	straight
Interlocked grain:	not present
Knots:	not present
Checks:	some radial checks, increasing towards the pit. Bark pocket over a length of 30 cm.
Decay:	mainly in the outer side of the sapwood: white rot; numerous boreholes (in the sapwood, as well as in the heartwood).
Remark:	the decay intensity gives the impression that the stem laid in the forest for a long time after felling.

Figure 3.1.1 sawn and planed ingipipa

Anatomical description

Hardwood, diffuse porous, vessel distribution diffuse, vessels solitary and in radial groups of 2 (-5), tangential diameter appr. 150 µm, appr. 5/mm², pits alternate, 6-7 µm in diameter, vessel-ray pits similar but smaller. Fibres average thick walled, non-septate. Parenchyma in apotracheal 1(-2) wide bands, reticulate, 5-8 cells per strand. Rays (1-)2-3-seriate, homogeneous to heterogeneous with one row of marginal cells.

Density, moisture content, shrinkage and swelling

The density at a climatized moisture content (20°C, 65% RH) is given in table 3.1.1. In table 3.1.2 and 3.1.3 the wood moisture contents at respectively descending and ascending relative humidity are given. In table 3.1.4 and 3.1.5 the shrinkage and swelling values are given. Individual data are given in appendix 4.

Table 3.1.1 Density for moisture content as started at 20°C and 65% RH

N=12	Density [kg/m³]	Moisture content (%)
mean (min-max)	744 (723-781)	14.0 (13.5-14.4)
std	20.6	0.3

Table 3.1.2. The equilibrium moisture content for different relative humidities at desorption. And the moisture content at water saturation

N=6	Wood moisture content (%) at descending relative humidity and water saturation					
	94%	**81%**	**65%**	**50%**	**30%**	**Water saturated**
Mean	21.94	19.07	14.12	11.27	6.82	89.74
Std	0.36	0.16	0.11	0.11	0.09	3.78
Min	21.57	18.87	13.96	11.10	6.66	84.87
Max	22.50	19.31	14.30	11.39	6.90	93.51

Table 3.1.3. The equilibrium moisture content for different relative humidities at absorption and moisture content at water saturation

N=6	Wood moisture content (%) at ascending relative humidity and water saturation					
	30%	**50%**	**65%**	**81%**	**94%**	**Water saturated**
Mean	7.15	9.66	11.53	15.48	21.03	89.09
Std	0.13	0.12	0.14	0.17	0.29	5.37
Min	6.96	9.45	11.34	15.29	20.76	80.27
Max	7.29	9.76	11.73	15.75	21.56	94.52

Table 3.1.4. Radial (rad) and tangential (tan) swelling relative to the dimensions of oven dry wood the samples conditioned to 5 different relative humidities and as started ('al')

Swelling	$Z_{0\text{-}30\%}$		$Z_{0\text{-}50\%}$		$Z_{0\text{-}65\%}$		$Z_{0\text{-}al}$		$Z_{0\text{-}81\%}$		$Z_{0\text{-}94\%}$		$Z_{0\text{-}ws}$	
N=6	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**
Mean	1.5	2.2	2.2	2.8	2.7	3.6	3.5	4.7	3.8	5.1	5.2	7.2	6.0	8.8
Std	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.4	0.4
Min	1.4	2.1	2.1	2.2	2.6	3.5	3.2	4.4	3.6	4.9	4.9	6.9	5.6	8.3
Max	1.7	2.3	2.3	3.0	2.8	3.7	3.6	4.9	4.0	5.2	5.7	7.5	6.7	9.3

Table 3.1.5. Radial (rad) and tangential (tan) shrinkage for the samples conditioned to 5 different relative humidities and as started ('al') relative to the dimensions of water saturated wood.

Shrinkage	$K_{ws\text{-}94\%}$		$K_{ws\text{-}81\%}$		$K_{ws\text{-}65\%}$		$K_{ws\text{-}al}$		$K_{ws\text{-}50\%}$		$K_{ws\text{-}30\%}$		$K_{ws\text{-}0\%}$	
N=6	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**
Mean	0.5	1.2	1.1	2.0	2.1	3.6	2.3	3.7	2.9	4.6	4.2	6.2	5.6	8.1
Std	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3
Min	0.3	1.0	0.9	1.8	1.9	3.3	1.9	3.3	2.6	4.3	3.8	5.8	5.2	7.7
Max	0.7	1.4	1.3	2.4	2.5	4.0	2.8	4.2	3.3	5.0	4.7	6.6	6.1	8.6

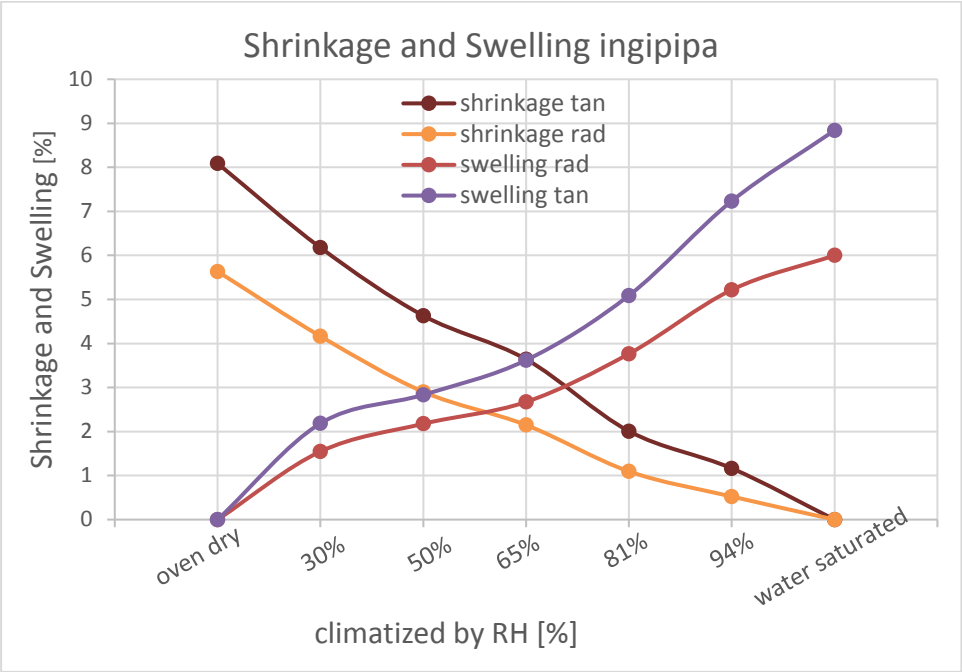


Figure 3.1.2 Shrinkage and swelling of ingipipa climatized at various humidities

The swelling from 50% RH to 95% RH is respectively 3.0% and 4.4% for radial and tangential. The standard deviation is 0.3% and 0.4% respectively.

Durability

The median mass loss of the samples as a result of the exposition to each of the four fungi is given in Table 3.1.6. Also a provisional classification is indicated per fungus based on that single value. All individual sample values are given in Appendix 3.

Table 3.1.6 mass loss and provisional durability class for the different fungi

Fungus	*Coniophora puteana*		*Poria placenta*		*Coriolus versicolor*		*Donkioporia expansa*	
Wood species	**ML (%)**	**DC**	**ML (%)**	**DC**	**ML (%)**	**DC**	**ML (%)**	**DC**
Ingipipa	-0.1	1	-0.1	1	0.7	1	0.2	1

In table 3.1.7 the spread of the individual mass losses are shown, together with the indicative durability class for *Coriolus versicolor*, since *Coriolus versicolor* led to the highest mass loss.

Table 3.1.7 Spread (in %) of individual mass loss values (n = 7) over the durability classes (DC) for *Coriolus versicolor*

Group DC	samples [no.]	(%)
1	4	57
2	1	14
3	0	0
4	2	29
5	0	0

3.2 Bostamarinde

Lot assessment

Below a summary of the lot assessment is given (for further details see appendix 1).

Colour:	yellow, in a wengé-like pattern (alternating light and dark zones), little pinkish around the heart.
Sapwood:	not clearly demarked, almost no colour difference: width possibly 3-4.5 cm. locally blue, possibly as reaction to environment
Grain:	straight
Interlocked grain:	distinct and regular
Knots:	in the heart plank two larger knots (Ø 3cm, with bark pocket one knot with some brown rot) also some pin knots
Checks:	Only present in the heart plank
Decay:	white rot in outer side and locally some deep worm holes
Remarks:	some thin canals with extractives present, clear reaction wood; the decay intensity gives the impression that the stem, laid for longer time in the forest after felling

Figure 3.2.1 Bostamarinde heartwood, reaction wood and sapwood

Anatomical description:

Hardwood, diffuse porous, vessel distribution diffuse, solitary and in radial groups of 2-3, tangential diameter 250-350 µm, appr. 10/mm², pits alternate, 4-5 µm in diameter, vessel-rays pits similar but smaller. Fibres average thick walled, non-septate. Parenchyma wavy wide bands (>50% of total structure), 2-4 cells per strand. Rays 2-seriate, homogeneous to heterogeneous with one row of marginal cells.

Density, moisture content, shrinkage and swelling

The density at a moisture content (20°C, 65% RH) is given in table 3.2.1. In table 3.2.2 and 3.2.3 the wood moisture contents at respectively descending and ascending relative humidity are given. In table 3.2.4 and 3.2.5 the shrinkage and swelling values are given. Individual data are given in appendix 4.

Table 3.2.1. Density for moisture content as started at 20°C and 65% RH

N=12	density [kg/m³]	Moisture content (%)
Mean (min-max)	573 (457-697)	15.55 (14.15-18.11)
Std	102.3	1.3

Table 3.2.2. The equilibrium moisture content for different relative humidities at desorption. And the moisture content at water saturation

N=6	Wood moisture content (%) at descending relative humidity and water saturation					
	94%	**81%**	**65%**	**50%**	**30%**	**Water saturated**
Mean	24.3	20.5	15.4	12.6	8.8	126.9
Std	1.3	1.0	1.2	1.2	1.2	45.3
Min	22.7	19.5	14.1	11.3	7.5	80.8
Max	26.3	22.2	17.1	14.5	10.6	175

Table 3.2.3. The equilibrium moisture content for different relative humidities at absorption and moisture content at water saturation

N=6	Wood moisture content (%) at ascending relative humidity and water saturation					
	30%	**50%**	**65%**	**81%**	**94%**	**Water saturated**
Mean	9.3	11.7	13.7	17.8	24.2	124.5
Std	1.5	1.5	1.5	1.6	1.8	45.1
Min	7.7	10.1	12.1	16.1	22.3	80.1
Max	11.5	14.1	16.1	20.6	27.4	176.2

Table 3.2.4. Radial (rad) and tangential (tan) swelling relative to the dimensions of oven dry wood for the samples conditioned to 5 different relative humidities and as started ('al')

Swelling	$Z_{0\text{-}30\%}$		$Z_{0\text{-}50\%}$		$Z_{0\text{-}65\%}$		$Z_{0\text{-}al}$		$Z_{0\text{-}81\%}$		$Z_{0\text{-}94\%}$		$Z_{0\text{-}ws}$	
	rad	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**	**rad**	**tan**
Mean	0.7	2.1	1.1	2.8	1.4	3.5	1.8	4.3	2.1	4.9	3.0	7.0	3.4	8.1
Std	0.4	0.2	0.5	0.4	0.6	0.5	0.7	0.6	0.8	0.8	1.1	1.6	1.2	2.3
Min	0.0	1.8	0.4	2.4	0.6	2.8	0.7	3.4	1.0	3.8	1.6	5.0	1.9	5.5
Max	1.1	2.4	1.6	3.3	2.0	4.1	2.6	5.1	2.9	5.8	4.1	8.6	4.7	10.7
N	6	6	6	5	6	6	6	6	6	6	6	6	6	6

Table 3.2.5. Radial (rad) and tangential (tan) shrinkage for the samples conditioned to 5 different relative humidities and as started ('al') relative to the dimensions of water saturated wood

Shrinkage	$K_{ws-94\%}$		$K_{ws-81\%}$		$K_{ws-65\%}$		K_{ws-al}		$K_{ws-50\%}$		$K_{ws-30\%}$		$K_{ws-0\%}$	
N=6	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan
Mean	0.3	0.8	0.7	1.7	1.3	3.2	1.6	3.5	1.7	4.0	2.3	5.2	3.2	7.3
Std	0.2	0.6	0.3	0.9	0.5	1.3	0.5	1.4	0.7	1.5	0.8	1.8	1.1	2.0
Min	0.1	0.4	0.4	0.9	0.7	1.9	1.0	2.1	1.0	2.5	1.5	3.5	1.9	5.1
Max	0.6	1.8	1.0	3.0	1.9	4.9	2.1	5.4	2.5	5.9	3.3	7.3	4.5	9.4

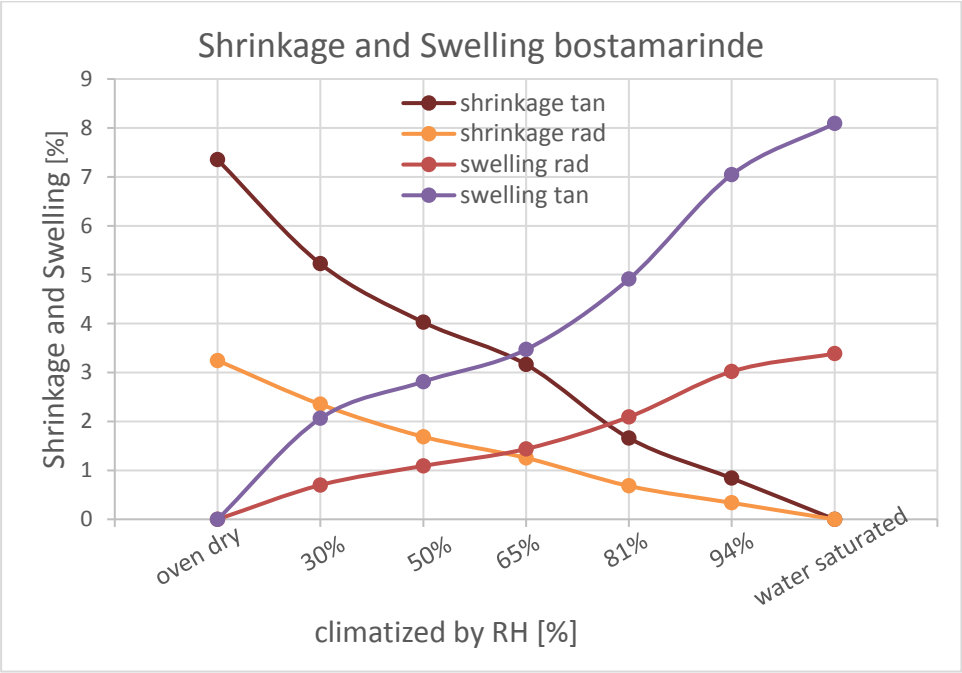


Figure 3.2.2 Shrinkage and swelling of bostamarinde climatized at various humidities

The swelling from 50% RH to 95% RH is respectively 1,9% and 4,4% for radial and tangential. The standard deviation is 0,6% and 1,5% respectively.

Durability

The median mass loss of the samples as a result of the exposition to each of the four fungi is given in Table 3.2.6. Also a provisional classification is indicated per fungus and test group based on that single value. All individual sample values are given in Appendix 3.

Table 3.2.6 mass loss and provisional durability class for the different fungi

Fungus	*Coniophora puteana*		*Poria placenta*		*Coriolus versicolor*		*Donkioporia expansa*	
Wood species	**ML**	**DC**	**ML**	**DC**	**ML**	**DC**	**ML**	**DC**
	(%)		**(%)**		**(%)**		**(%)**	
Bostamarinde	0.3	1	0.4	1	0.3	1	0.5	1

The spread in the results is shown in table 3.2.7, for this species *Poria placenta* is the fungus resulting in the highest mass loss.

Table 3.2.7 Spread (in %) of individual mass loss values (n = 11) over the durability classes (DC) for *Poria placenta*

Group DC	samples [no.]	(%)
1	9	82
2	1	9
3	0	0
4	1	9
5	0	0

3.3 Gindya-udu

Lot assessment

Below a summary of the lot assessment is given (for further details see appendix 1).

Colour:	red-brown, light striped by lighter streaks, sapwood yellowish, sometimes the outsides of the heartwood lighter (red-yellow streaks) pinkish discolouration around the heart
Sapwood:	3-9cm wide, clearly demarked from heartwood
Grain:	straight
Interlocked grain:	hardly, some reaction wood
Knots:	one knot of 3cm Ø, one knot with Ø 4cm and one heart knot
Checks:	little
Decay:	stem 4: in heartwood places of brown rot and white rot, on one place a bore hole (Ø around 7 mm) in the heartwood with a discolouration reaction around it. Smaller boreholes (Ø around 1mm) in sapwood, as well as blue stain and white rot; stem 6 has some (mainly white) rot in the outside layers
Remarks:	the decay intensity gives the impression that the stems, especially stem 4, laid for longer time in the forest after felling.

Figure 3.3.1 Gindya-udu, sawn and planed

Wood anatomical description

Hardwood, diffuse porous, vessel distribution diffuse, solitary and in radial groups of 2-3, tangential diameter appr. 150 µm, appr. 7/mm², pits alternate, appr. 10 µm in diameter, vestured, vessel-rays pits similar but smaller. Fibres thick walled, non-septate. Parenchyma aliform with long thin to thick wings, 2-4 cells per strand, crystals in chambered cells. Rays uni-seriate, homogeneous.

Density, moisture content, shrinkage and swelling

The density of gindya-udu and moisture content are given in table 3.3.1. In table 3.3.2 and 3.3.3 the wood moisture contents at respectively descending and ascending relative humidity given. In table 3.3.4 and 3.3.5 are the shrinkage and swelling values given. Individual data are given in appendix 4.

Table 3.3.1. Density for moisture content as started at 20°C and 65% RH

N=26	density [kg/m³]	Moisture content (%)
mean (min-max)	1026.6 (959-1081)	14.93 (14.2-15.8)
std	39.8	0.33

Table 3.3.2. The equilibrium moisture content for different relative humidities at desorption. And the moisture content at water saturation

N=13	Wood moisture content (%) at descending relative humidity and water saturation					
	94%	**81%**	**65%**	**50%**	**30%**	**Water saturated**
Mean	20.2	18.5	14.8	11.8	7.5	40.4
Std	0.4	0.3	0.3	0.2	0.1	6.1
Min	19.7	18.1	14.4	11.4	7.1	34.6
Max	21	19.3	15.5	12.1	7.6	56.7

Table 3.3.3. The equilibrium moisture content for different relative humidities at absorption and moisture content at water saturation

N=13	Wood moisture content (%) at ascending relative humidity and water saturation					
	30%	50%	65%	81%	94%	Water saturated
Mean	7.8	10.1	11.9	15.3	19.6	37.7
Std	0.2	0.2	0.1	0.2	0.4	5.1
Min	7.5	9.8	11.7	15.2	19.2	33.3
Max	8.0	10.4	12.1	15.9	20.4	52.8

Table 3.3.4. Radial (rad) and tangential (tan) swelling relative to the dimensions of oven dry wood for the samples conditioned to 5 different relative humidities and as started ('al')

Swelling	$Z_{0\text{-}30\%}$		$Z_{0\text{-}50\%}$		$Z_{0\text{-}65\%}$		$Z_{0\text{-}al}$		$Z_{0\text{-}81\%}$		$Z_{0\text{-}94\%}$		$Z_{0\text{-}ws}$	
N=13	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan
Mean	1.6	2.6	2.2	3.5	2.8	4.3	3.9	5.9	3.9	5.9	5.2	8.0	5.7	8.8
Std	0.2	0.1	0.3	0.2	0.3	0.2	0.4	0.4	0.4	0.4	0.5	0.6	0.5	0.6
Min	1.3	2.4	1.9	3.1	2.4	3.9	3.3	5.4	3.4	5.4	4.6	7.2	5.1	7.8
Max	2.0	3.0	2.7	3.9	3.3	4.9	4.8	6.7	4.6	6.8	6.1	9.2	6.5	10.1

Table 3.3.5. Radial (rad) and tangential (tan) shrinkage for the samples conditioned to 5 different relative humidities and as started ('al') relative to the dimensions of water saturated wood

Shrinkage	$K_{ws\text{-}94\%}$		$K_{ws\text{-}81\%}$		$K_{ws\text{-}65\%}$		$K_{ws\text{-}al}$		$K_{ws\text{-}50\%}$		$K_{ws\text{-}30\%}$		$K_{ws\text{-}0\%}$	
N=13	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan
Mean	0.3	0.6	0.7	1.2	1.7	2.7	1.7	2.7	2.7	4.1	4.0	5.9	5.4	7.8
Std	0.0	0.1	0.1	0.2	0.2	0.4	0.2	0.4	0.2	0.4	0.3	0.5	0.4	0.5
Min	0.2	0.5	0.6	1.1	1.5	2.2	1.5	2.3	2.4	3.5	3.7	5.2	4.8	7.0
Max	0.4	0.8	0.9	1.7	2.0	3.6	2.1	3.6	3.0	4.9	4.5	6.8	6.1	8.7

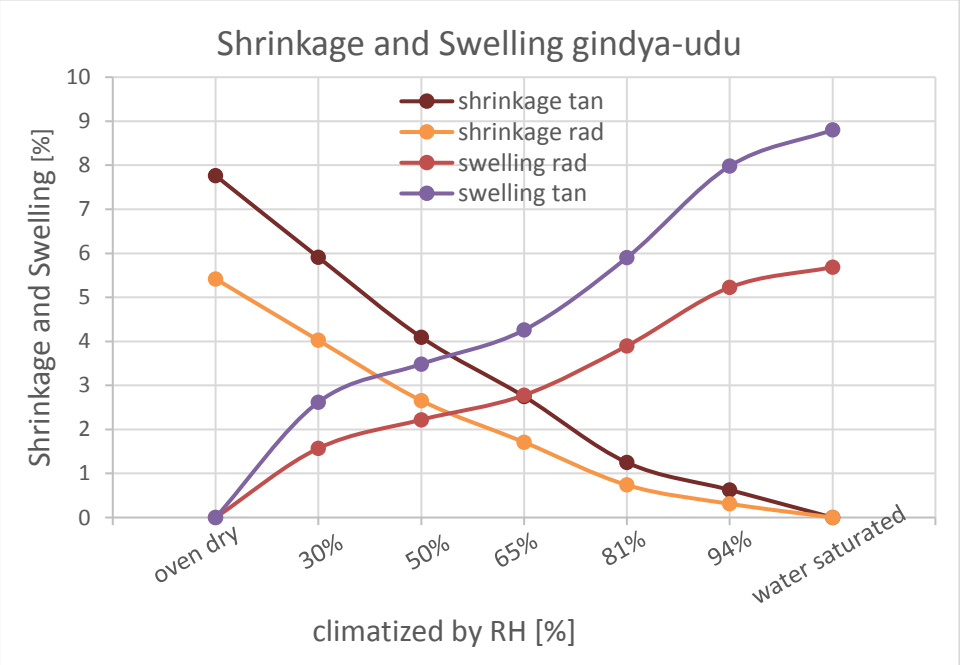


Figure 3.3.2 Shrinkage and swelling of gindya-udu climatized at various humidities

The swelling from 50% RH to 95% RH is respectively 3.0% and 4.5% for radial and tangential. The standard deviation is 0.2% and 0.4% respectively.

Durability

The median mass loss of the samples as a result of the exposition to each of the four fungi is given in Table 3.3.6. Also a provisional classification is indicated per fungus and test group based on that single value. All individual sample values are given in Appendix 3.

Table 3.3.6 mass loss and provisional durability class for the different fungi

Fungus	*Coniophora puteana*		*Poria placenta*		*Coriolus versicolor*		*Donkioporia expansa*	
Wood species	**ML (%)**	**DC**	**ML (%)**	**DC**	**ML (%)**	**DC**	**ML (%)**	**DC**
Gindya-udu	-0.3	1	-0.1	1	0.2	1	0.0	1

In table 3.3.7 the spread of the individual mass loss values are shown. For this species *Coriolus versicolor* is the fungus resulting in the highest mass loss.

Table 3.3.7 Spread (in %) of individual mass loss values (n = 18) over the durability classes (DC) for *Coriolus versicolor*

Group	samples	
DC	**[no.]**	**(%)**
1	15	83
2	0	0
3	2	11
4	1	6
5	0	0

3.4 Pakoeli

Lot assessment

Below a summary of the lot assessment is given (for further details see appendix 1).

Colour:	brown, light striped , yellow sapwood, in 5.2.2.1 transitional wood is visible, dark streaks
Sapwood:	4.5-8 cm wide clearly demarked from heartwood
Grain:	straight
Interlocked grain:	not present
Knots:	little, one heart plank has 7 little knots (Ø 2,5cm)
Checks:	a number of large radial checks, filled with yellow extractives
Decay:	in the sapwood is locally blue stain and white rot present
Remarks:	the decay intensity gives the impression that the stem, laid for longer time in the forest after felling.

Figure 3.4.1 Pakoeli planks, sawn and planed

Wood anatomical description

Hardwood, diffuse porous, vessel distribution diffuse, solitary and in radial groups of 2-10, in long radial groups the middle vessels sometimes smaller, tangential diameter wider vessels 50-200 µm, appr. 10/mm², pits alternate, appr. 10 µm in diameter, vessel-rays pits similar but smaller. Fibres thick walled, non-septate. Parenchyma in 3-5 cells wide bands, 5-8 cells per strand, with yellow extractives in individual cells. Rays 2-3-seriate, homogeneous to heterogeneous with one row of marginal cells.

Density, moisture content, shrinkage and swelling

The density of pakoeli with the moisture content are given in table 3.4.1. In table 3.4.2 and 3.4.3 the wood moisture contents at respectively descending and ascending relative humidity given. In table 3.4.4 and 3.4.5 are the shrinkage and swelling values given. Individual data are given in appendix 4.

Table 3.4.1. Density for moisture content as started at 20°C and 65% RH

N=14	density [kg/m³]	Moisture content (%)
Mean (min-max)	855 (790-937)	13.9 (13.6-14.2)
Std	55.2	0.18

Table 3.4.2. The equilibrium moisture content for different relative humidities at desorption. And the moisture content at water saturation

N=7	Wood moisture content (%) at descending relative humidity and water saturation					
	94%	**81%**	**65%**	**50%**	**30%**	**Water saturated**
Mean	19.8	17.8	13.9	11.1	7.1	28.5
Std	0.2	0.2	0.2	0.1	0.1	2.5
Min	19.5	17.6	13.6	10.9	7.0	26.4
Max	20.2	18.1	14.0	11.3	7.3	33.2

Table 3.4.3. The equilibrium moisture content for different relative humidities at absorption and moisture content at water saturation

N=7	Wood moisture content (%) at ascending relative humidity and water saturation					
	30%	50%	65%	81%	94%	Water saturated
Mean	7.5	9.5	11.2	14.4	19.1	31.0
Std	0.1	0.1	0.1	0.1	0.2	1.5
Min	7.3	9.4	11.1	14.3	18.8	28.6
Max	7.5	9.6	11.3	14.6	19.4	32.5

Table 3.4.4. Radial (rad) and tangential (tan) swelling relative to the dimensions of oven dry wood for the samples conditioned to 5 different relative humidities and as started ('al')

Swelling	$Z_{0\text{-}30\%}$		$Z_{0\text{-}50\%}$		$Z_{0\text{-}65\%}$		$Z_{0\text{-}al}$		$Z_{0\text{-}81\%}$		$Z_{0\text{-}94\%}$		$Z_{0\text{-}ws}$	
N=7	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan
Mean	1.3	2.4	1.8	3.2	2.3	4.0	3.1	5.5	3.1	5.7	4.3	8.1	4.9	9.4
Std	0.2	0.3	0.2	0.3	0.2	0.4	0.2	0.6	0.2	0.5	0.3	0.9	0.3	1.0
Min	1.1	2.1	1.6	2.9	1.9	3.7	2.7	5.0	2.7	5.1	3.9	7.2	4.4	8.2
Max	1.5	2.9	2.0	3.7	2.4	4.6	3.4	6.3	3.3	6.5	4.6	9.4	5.3	11.0

Table 3.4.5. Radial (rad) and tangential (tan) shrinkage for the samples conditioned to 5 different relative humidities and as started ('al') relative to the dimensions of water saturated wood

Shrinkage	$K_{ws\text{-}94\%}$		$K_{ws\text{-}81\%}$		$K_{ws\text{-}65\%}$		$K_{ws\text{-}al}$		$K_{ws\text{-}50\%}$		$K_{ws\text{-}30\%}$		$K_{ws\text{-}0\%}$	
N=7	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan
Mean	0.2	0.5	0.6	1.4	1.4	3.3	1.5	3.3	2.2	4.5	3.2	6.2	4.5	7.9
Std	0.1	0.2	0.1	0.2	0.2	0.4	0.2	0.4	0.2	0.5	0.3	0.6	0.2	0.6
Min	0.0	0.3	0.4	1.0	1.3	2.6	1.4	2.7	2.0	3.8	3.0	5.3	4.2	7.0
Max	0.4	0.8	0.8	1.6	1.8	3.7	1.8	3.7	2.6	5.1	3.7	7.0	4.8	8.6

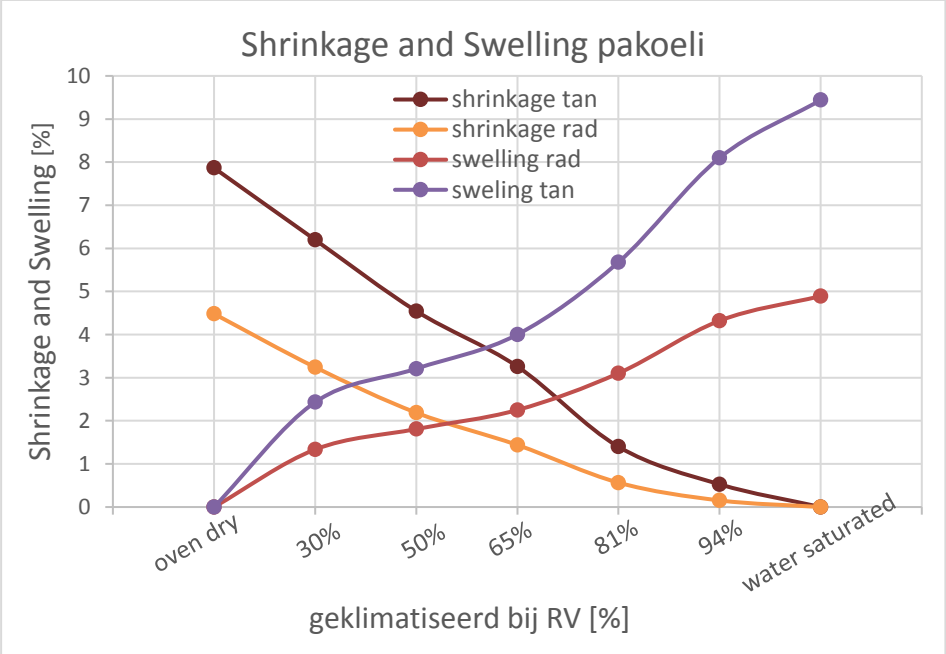


Figure 3.4.2 Shrinkage and swelling of pakoeli climatized at various humidities

The swelling from 50% RH to 95% RH is respectively 2.5% and 4.9% for radial and tangential. The standard deviation is 0.2% and 0.6% respectively.

Durability

The median mass loss of the samples as a result of the exposition to each of the four fungi is given in Table 3.4.6. Also a provisional classification is indicated per fungus based on that single value. All individual sample values are given in Appendix 3.

Table 3.4.6 mass loss and provisional durability class for the different fungi

Fungus	*Coniophora puteana*		*Poria placenta*		*Coriolus versicolor*		*Donkioporia expansa*	
Wood species	**ML**	**DC**	**ML**	**DC**	**ML**	**DC**	**ML**	**DC**
	(%)		**(%)**		**(%)**		**(%)**	
Pakoeli	-2.1	1	-2.0	1	-1.6	1	-2.1	1

In table 3.4.7 the spread of the individual mass loss values are shown. For this species *Coriolus versicolor* is the fungus resulting in the highest mass loss.

Table 3.4.7 Spread (in %) of individual mass loss values (n = 10) over the durability classes (DC) for *Coriolus versicolor*

Group	samples	
DC	**[no.]**	**(%)**
1	10	100
2	0	0
3	0	0
4	0	0
5	0	0

3.5 Kimboto

Lot assessment

Below a summary of the lot assessment is given (for further details see appendix 1).

Colour:	homogeneous yellow, brighter areas visible, outside the brighter areas all the wood is more or less blue stained
Sapwood:	indistinct
Grain:	straight
Interlocked grain:	not present
Knots:	not present
Checks:	many, large radial and heart checks
Decay:	stem 7 with boreholes (Ø around 3 mm) surrounded with discoloration / rot; stem 3 with boreholes (Ø around 1 mm, up to 14mm deep in the wood) sometimes with blue stain/ rot surrounding the boreholes. White rot around the heart and diffuse present in the wood
Remarks:	the decay intensity gives the impression that, especially stem 3, laid for longer time in the forest after felling.

Figure 3.5.1 Kimboto planks sawn and planed, blue stain and wane

Wood anatomical description

Hardwood, diffuse porous, vessel distribution diffuse to a radial alignment or dendritic pattern, solitary and in radial groups of 2-10, tangential diameter 50-100 µm, >20/mm², pits alternate, 2-3 µm in diameter, vessel-rays pits simple or similar to intervessel pits but smaller. Fibres thick walled, non-septate. Parenchyma in unregular wavy 1(-2) cells wide bands, 5-9 cells per strand. Rays 2(-3)seriate, appr. 800 µm high, combined rays higher, heterogeneous with one of more rows of marginal cells.

Density, moisture content, shrinkage and swelling

The density of kimboto with the specific moisture content is given in table 3.5.1. In table 3.5.2 and 3.5.3 the wood moisture contents at respectively descending and ascending relative humidity given. In table 3.5.4 and 3.5.5 are the shrinkage and swelling values given. Individual data are given in appendix 4.

Table 3.5.1. Density for moisture content (20°C 65% RH)

N=10	density [kg/m³]	Moisture content (%)
Mean (min-max)	872.4 (815-969)	15.8 (14.9-17.1)
Std	57.9	0.9

Table 3.5.2. The equilibrium moisture content for different relative humidities at desorption. And the moisture content at water saturation

N=5	Wood moisture content (%) at descending relative humidity and water saturation					
	94%	81%	65%	50%	30%	Water saturation
Mean	25.5	21.3	15.6	12.7	8.6	77.9
Std	1.4	1.2	1.0	1.0	1.0	10.4
Min	24.2	20.2	14.7	11.8	7.6	61.8
Max	27.1	22.6	16.9	13.9	9.8	88.3

Table 3.5.3. The equilibrium moisture content for different relative humidities at absorption and moisture content at water saturation

N=5	Wood moisture content (%) at ascending relative humidity and water saturation					
	30%	50%	65%	81%	94%	Water saturation
Mean	8.8	11.4	13.6	18.0	25.1	78.0
Std	1.0	1.0	1.1	1.2	1.5	10.4
Min	8.0	10.5	12.6	16.8	23.6	61.9
Max	9.9	12.6	14.8	19.3	26.9	87.7

Table 3.5.4. Radial (rad) and tangential (tan) swelling relative to the dimensions of oven dry wood for the samples conditioned to 5 different relative humidities and as started ('al')

Swelling	$Z_{0\text{-}30\%}$		$Z_{0\text{-}50\%}$		$Z_{0\text{-}65\%}$		$Z_{0\text{-}al}$		$Z_{0\text{-}81\%}$		$Z_{0\text{-}94\%}$		$Z_{0\text{-}ws}$	
N=5	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan
Mean	1.8	3.0	2.5	4.1	3.1	5.0	3.8	6.3	4.2	7.2	5.9	10.9	6.6	13.6
Std	0.4	0.2	0.4	0.1	0.5	0.1	0.5	0.1	0.6	0.2	0.9	0.4	1.0	1.1
Min	1.4	2.8	2.0	3.9	2.5	4.8	3.3	6.0	3.5	7.0	4.8	10.6	5.5	12.0
Max	2.2	3.3	2.9	4.2	3.5	5.2	4.4	6.4	4.9	7.5	6.9	11.4	7.8	15.0

Table 3.5.5. Radial (rad) and tangential (tan) shrinkage for the samples conditioned to 5 different relative humidities and as started ('al') relative to the dimensions of water saturated wood

Shrinkage	$K_{ws\text{-}94\%}$		$K_{ws\text{-}81\%}$		$K_{ws\text{-}65\%}$		$K_{ws\text{-}al}$		$K_{ws\text{-}50\%}$		$K_{ws\text{-}30\%}$		$K_{ws\text{-}0\%}$	
N=5	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan	rad	tan
Mean	0.5	2.0	1.3	3.7	2.5	6.2	2.5	6.4	3.3	7.5	4.4	9.1	6.2	11.5
Std	0.2	0.6	0.2	0.7	0.4	0.8	0.3	0.8	0.5	0.8	0.6	0.9	0.8	0.9
Min	0.2	1.1	1.1	2.5	2.2	4.9	2.2	5.0	2.9	6.1	3.9	7.7	5.3	10.1
Max	0.6	2.7	1.5	4.3	3.0	6.9	3.0	6.8	3.9	8.1	5.2	9.9	7.2	12.4

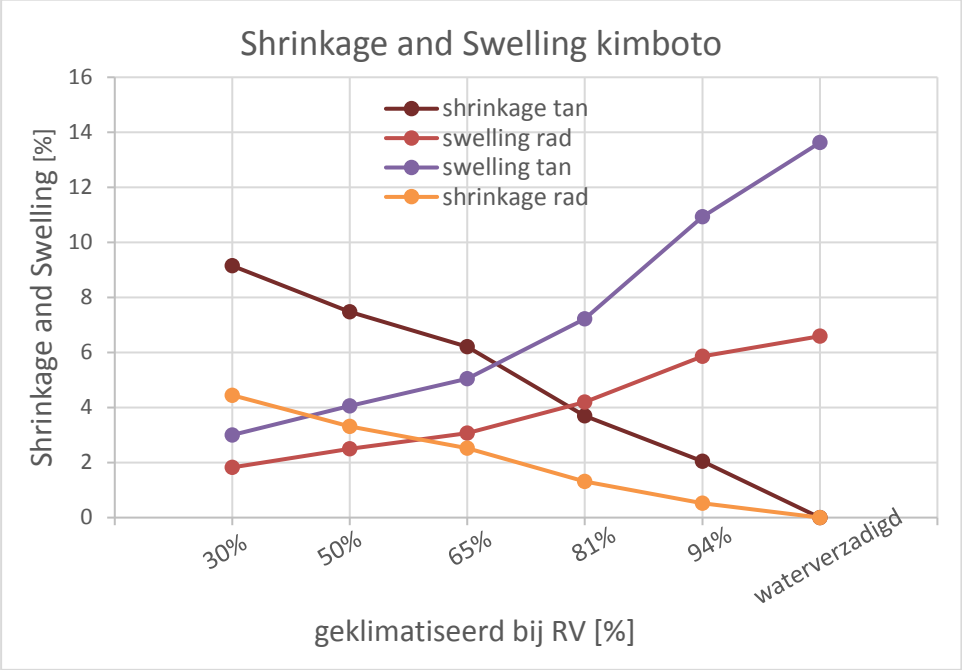


Figure 3.5.2 Shrinkage and swelling of kimboto climatized at various humidities

The swelling from 50% RH to 95% RH is respectively 3.4% and 6.9% for radial and tangential. The standard deviation is 0.5% and 0.3% respectively.

Durability

The median mass loss of the samples as a result of the exposition to each of the four fungi is given in Table 3.5.6. Also a provisional classification is indicated per fungus based on that single value. All individual sample values are given in Appendix 3.

Table 3.5.6 mass loss and provisional durability class for the different fungi.

Fungus	***Coniophora puteana***		***Poria placenta***		***Coriolus versicolor***		***Donkioporia expansa***	
Wood species	**ML**	**DC**	**ML**	**DC**	**ML**	**DC**	**ML**	**DC**
	(%)		**(%)**		**(%)**		**(%)**	
Kimboto	-2.1	1	-2.0	1	-1.6	1	-2.1	1

In table 3.5.7 the spread of the individual mass loss values are shown. For this species *Coriolus versicolor* is the fungus resulting in the highest mass loss.

Table 3.5.7 Spread (in %) of individual mass loss values (n = 5) over the durability classes (DC) for *Coriolus versicolor*

Group	samples	
DC	[no.]	(%)
1	3	60
2	0	0
3	1	20
4	1	20
5	0	0

4 Discussion

4.1 Ingipipa

Summary of the results originated from 4 plates of one stem:
Wood quality: light brown in colour, light colour variations, sapwood indistinct, almost failure free timber, but decay in outermost layer (stems probably remained long time in forest)
Density at 14% is 744 kg/m³ and variation is low.
Shrinkage radial / tangential is total 5.6% and 8.1%; wet to moisture content of 11.3%, 2.9% and 4.6%.
Durability is variable (57% of samples in class 1, 29% in class 4).

Quarter sawn (scale in cm's)

Flat sawn (scale in cm's)

Cross section, height 5 mm

Compared to the data from literature of tauari (*Couratari spp.)*, our material has the same wood colour and structure and it can be regarded as heavy tauari with similar shrinkage behaviour (literature: total 5.8% and 7.8% and from wet to 12% moisture content of 2.8% and 4.5%). The variability showed by the durability tests is also comparable with the information from the literature. Wood with decay (probably less durable parts of the stem) was excluded from the test and therefore we think that the durability tests show an overestimation over the behaviour of ingipipa against fungal attack.

Additional information from literature: The workability is variable, like the resistance to shipworm since the silica content varies between the different species. The durability varies class 5, and class 4 are reported as well as class 2 for *Tauari branco* with density ≥600 kg/m³ (moisture content 12%); bending related to density (for small clear specimen 50 - 130N/mm^2).

Compared to tauari, our material is homogeneous in density and colour, it also lacks false heart (brown-red in colour) and resin canals filled with black extractives. Tests on additional stems (at least two) provide further support for its homogeneity.
The use of ingipipa is not different from that of tauari but the supposed homogeneity is in favour of ingipipa.

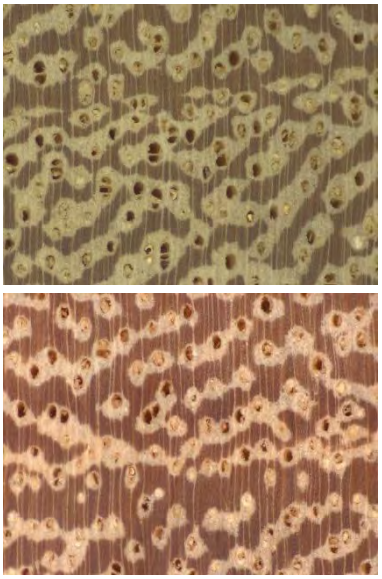
References used: Japing & Japing 1960, Klaassen 2018.

4.2 Bostamarinde

Summary of the results originated from 3 plates of one stem:
Wood quality: yellow in colour, light pinkish around the heart, with darker lines, sapwood indistinct, grain straight, some knots, distinct and regular interlocked grain. Decay in outermost layer and borer holes (stems probably remained long time in forest).
Density at 16% is 573 kg/m³ but variable (450-700 kg/m³).
Shrinkage radial / tangential is total 3.2% and 7.3%; wet to moisture content of 12.6%, 1.7% and 4.0%.
Durability is high with some variation (82% of samples in class 1, 9% in class 2 and 9% in class 4).

Quarter sawn (scale in cm's)

Flat sawn (scale in cm's)



Cross section, height 5 mm

The name bostamarinde is used in Suriname for the genera: *Hydrochorea corymbosa* (synonyms: *Pithecellobium corymbosum, Arthosamanea corymbosa*), *Parkia oppostifolia, Stryphnodendron* and *Martiodendron parviflorum.* The anatomy of first thee species is different from the wood studied. The structure of the last one, also called pintolocus, is similar but it has less clear storied ray arrangement and its heartwood is red-brown in contrast to the pinkish colour we found. In Suriname also the name white pintolocus is used probably referring to whitish heartwood. Additional stems should give more information on the identity of the wood (especially with regard to heartwood formation).

The durability tests show a high resistance against fungi. But we should be careful with conclusions because wood with decay (probably less durable parts of the stem) was excluded from the test and therefore we think that the durability tests show an overestimation over the behaviour of bostamarinde against fungal attack.

If the durability is confirmed with material from additional non-degraded stems, than there are many possibilities for outside use, taking into account the larger difference in radial and tangential shrinkage and the interlocked grain.

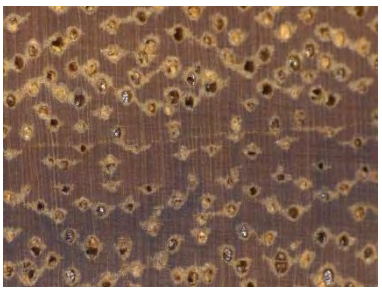
References used: Bhikhi et al 2016, Klaassen 2018.

4.3 Gindya-udu

Summary of the results originated from 2 stem with 3 plates each.
Wood quality: red-brown in colour, colour variations between stems (light and darker), red-yellow streaks and pinkish around the heart, sapwood distinct, some knots, straight grain, some reaction wood, some decay in sapwood and discoloration around bore holes (one stem probably remained long time in the forest).
Density at 15% is 1027 kg/m³ and variation is low.
Shrinkage radial / tangential is total 5.4% and 7.8%; wet to moisture content of 12%, 2.7% and 4.1%.
Durability is high with some variation (83% of samples in class 1, 11% in class 3 and 6% in class 4, lowest values in stem 6).

Quarter sawn (scale in cm's)

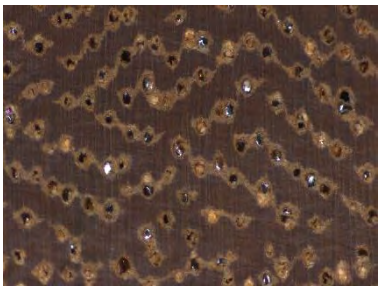
Flat sawn (scale in cm's)



Cross section yellow coloured, height 5 mm

Quarter sawn (scale in cm's)

Flat sawn (scale in cm's)



Cross section brown coloured, height 5 mm

Compared to the data from literature of gindya-udu (*Buchenavia* spp.) our material has the same wood colour and colour variance and structure. The shrinkage behaviour as described in the literature is variable (found values for total radial and tangential of 8% and 12% and for wet to 12% moisture content of 5.5% and 8%, other sources refer to a total shrinkage of 2.8% and 5.6%). Our values are just in between the variation. The durability found in our tests is somewhat higher than found in literature (class 2-3). Wood with decay (probably less durable parts of the stem) was excluded from the test and therefore we think that the durability tests show an overestimation over the resistance of gindya-udu against fungal attack. We suppose also a relationship between durability and colour. Lighter coloured wood seems to be less durable (figure 4.3.1).

References used: Comvalius 2001, Gerard et al. 1996, Klaassen 2018.

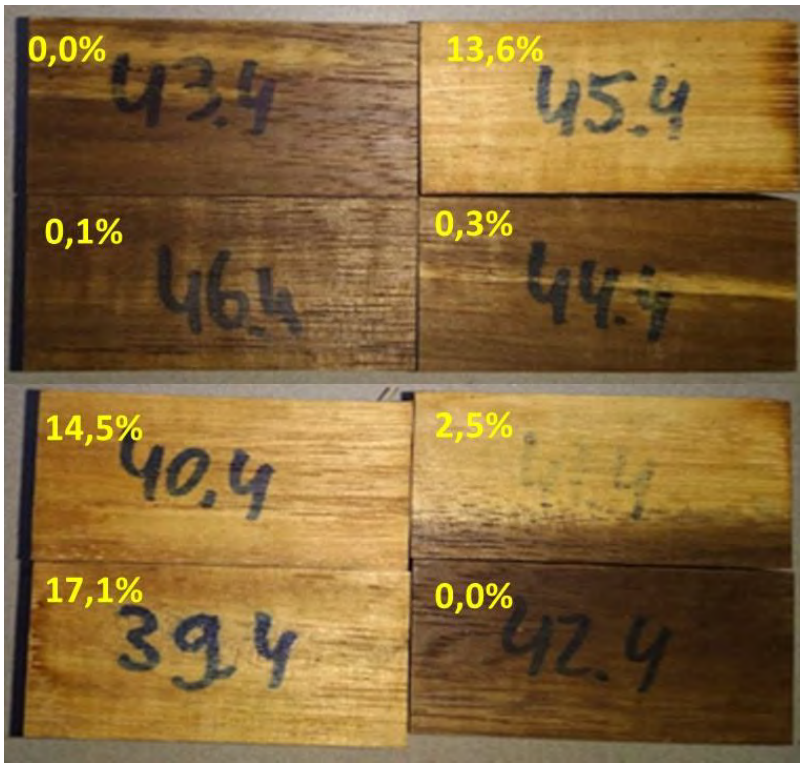


Figure 4.3.1 Mass loss in per percentage because of *Coriolus versicolor* (see Appendix 3 for) and wood colour

4.4 Pakoeli

Summary of the results originated from 2 stems with two plates each.
Wood quality: brown in colour, intermediary wood, sapwood distinct, large cracks (often filled with yellow extractives), small knots, local decay
Density at 14% is 855 kg/m³ and variation is low.
Shrinkage radial / tangential is total 4.5% and 7.9%; wet to moisture content of 11.1%, 2.2% and 4.5%.
Durability is high (100% of samples in class 1).

Quarter sawn (scale in cm's)

Flat sawn (scale in cm's)

Cross section, height 5 mm

Compared to the data from literature of pakoeli (bacuri, *Platonia* spp.*)*, our material has the same wood colour, extractives, structure and shrinkage behaviour (literature: total 4.5% and 9% and from wet to 12% moisture content of 3.0% and 4.5%). The high durability is confirmed by literature.

Additional information from literature: pakoeli has a tendency to distort and check, therefore it should be carefully dried, the workability is good but the variable silica content and hardness has to be taken in consideration.

References used: Comvalius 2001, Gerard et al. 1996, Japing & Japing 1960, Klaassen 2018.

4.5 Kimboto

Summary of the results originated from 4 plates of one stem:
Wood quality: yellow in colour with brighter areas, sapwood indistinct, texture homogeneous, cracks, straight grain, outside the bright area, all the timber is degraded or blue stained. (stems remained long time in forest).
Density at 16% is 872 kg/m³ and some variation.
Shrinkage is large: radial / tangential is total 6.2% and 11.5%; wet to moisture content of 12.7%, 3.3% and 7.5%.
Durability is variable (60% of samples in class 1, 20% in class 3, 20% in class 4).

Quarter sawn (scale in cm's)

Flat sawn (scale in cm's)

Cross section, height 5 mm

Compared to the data from literature of kimboto (casca, *Pradosia* spp.*)*, our material has the same wood colour, structure, shrinkage behaviour (literature: total 6.9% and 11.3% and from wet to 12% moisture content of 3.5% and 6.5%) and sensitivity to blue stain The high or moderate durability is not confirmed by literature (probably due to forest exposition of our material).

Additional information from literature: workability is not easy due to the silica content and hardness. It is recorded that the timber is suitable for inside heavy constructions, house framing, floors and furniture.

References used: Comvalius 2001, Gerard et al. 1996, Japing & Japing 1960, Klaassen 2018.

5 Conclusion

The five timber species from Suriname were investigated according to Dutch standard (SKH Publication 97-04) in order to get an idea of their properties and use potential. This standard is developed to get a first impression of the use potential of lesser and unknown timber species specific for joinery but also for timber use in general.

For all applications it is important to know the botanical identity of the timbers as properties are species related. Therefore descriptions of the structure and pictures of the three main wood surfaces have to be available in order to make sure that clear recognition is possible. For all five species these descriptions and pictures were made and compared with literature. The identity of four species was confirmed and the data on their properties were collected. Descriptions of bostamarinde in literature are contradicting and limited and therefore it was impossible to make a clear identification of this species .

The available wood quality of each species is an important item to determine its use potential. Failure free large and thick boards have a large potential whereas the potential is very limited for small boards with many failures (e.g. knots, sapwood, deviant grain, cracks) although its properties could be excellent. In order to get a good idea of the wood quality at least 27 boards originating from at least 3 different trees are required. In this study one stem only was available for pakoeli, bostamarinde, and ingipipa. Two stems only were available for gindya-udu and kimboto. Therefore the wood quality determined of each of the species should be regarded as a first impression of the potential quality to be expected on the Dutch and other foreign markets. The wood quality of all five investigated species is promising but large checks appeared in ingipipa, kimboto, and pakoeli and these should be avoided by a more careful handling avoiding too fast drying.

The first impression of the wood quality, density and dimension stability shows that the Surinam ingipipa compared to its South American relatives is more homogeneous, the Surinam gindya-udu is more variable, and the Surinam kimboto and pakoeli are similar to the information found in the literature. For gindya-udu selection on quality could improve the homogeneity.
Although bostamarinde could not be identified as such, the material investigated shows reaction wood, interlocked grain, and decay, suggesting specific use with requirement of careful handling and selection on quality.

The resistance against fungal decay of a wood species is difficult to describe because it varies with how the timber is used and with different locations of the wood in the tree. In soil contact other wood degrading fungi are active than in timber use above the ground. Therefore there are different standards to test the resistance against fungal decay, accelerated tests with and without soil contact and field tests. The Dutch standard used here, (focussing on joinery), demands an accelerated test without soil contact. All stems in at least some parts, of the species tested here, show some decay. Presence of decay in wood samples for the durability test is not allowed in these tests and therefore only sound timber was selected. The samples used in the durability test therefore give an overestimation of the resistance against fungal decay and do not represent the full variation of the species. The results of the test therefore only give an idea of the durability of the species. In this conclusion no classification can be mentioned because the number of samples did not fulfil the requirements of the standard.

The information of the wood quality and durability is too limited for a clear statement of use potential.

Summary per species

The summary below gives a preliminary estimation of the use potential per species, based on the available data (this project and literature) and the expectation based on the quality of more and representative sample material:

- Surinam ingipipa: if a lower tangential shrinkage and a higher durability can be proven, then the species could be suitable for outside joinery, if a higher durability cannot be proven then only inside use is possible.
- Surinam bostamarinde: if the identity of the species is known and a quality selection can provide timber without reaction wood, it has potential for inside use.
- Surinam gindya-udu: the species could have potential for ground and water constructions.
- Surinam pakoeli: the species could have potential for ground and water constructions.
- Surinam kimboto: the species has potential for inside use but only in decay/blue stain free qualities.
-

Recommendations

Research on eight additional stems (so for every species in total 3 stems are tested) should be done and the results should be included in the data already available. With this extension clear scientifically sound statements on durability and use potential of each of the Surinam timber species can be made and the identity of bostamarinde can be confirmed.

Literature

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Appendix 1 Lot assessment

Ingipipa (stem 1)
Below the available ingipipa is described based on the lot assessment.

Stem 1	plate 1: 3 beams 13x7cm, 16,5x7cm and 17x7.5cm (1 with wane)	
	plate 2: 3 beams 18x7cm, 17x7cm and 17x7cm	
	plate 3: 2 beams 17.5x8cm and 17.5x8cm (1 with wane)	
	plate 4: 3 beams 16x8cm, 17.5x8cm and 18.5x8cm	
Colour:		light brown with light streaks
Sapwood:		not clearly demarked: width: 1.1.1.1 (8cm); 1.1.1.2 (10cm); 1.1.2.1 (1,5 cm); 1.1.3.1 (4 cm to wane); 1.1.4.2 (1 cm)
Grain:		straight
Interlocked grain:		not present
texture:		light striped
Knots:		not present
Checks:		Some radial checks, increasing towards the pit. Bark pocket over a length of 30cm
Decay:		Mainly in the outer side of the sapwood, a lot of white rot in the sapwood, numerous boreholes in the sapwood, but as well in the heartwood 1.1.1 and 1.1.3 are not suitable for further research (white rot and bore holes) partially useable is 1.1.4 (parts decayed by white rot)
Remarks:		Possible stem 1 has been too long in the forest after felling.

Plate 3

Plate 1 side

Plate 3

Plate 4

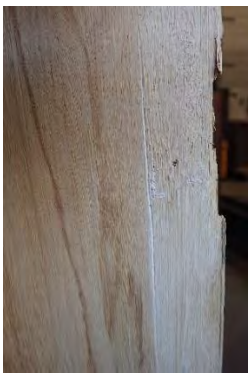
Plate 4

Bostamarinde (stem 2)

Below the available bostamarinde is described based on the lot assessment.

Stem 2.1	plate 1: 2 beams 23x7.7cm and 21x7.5cm (1 with wane, 1 with boxed heart) plate 2: 3 beams 24x7cm, 18x7cm and 24x7 cm plate 3: 3 beams 22x7.5cm, 23x7.5cm and 24x7.5 cm (2 with wane)
Colour:	yellow, little pinkish around the heart
Sapwood:	not clearly demarked no colour difference: width possible 3-4.5cm. locally blue, possibly as reaction to environment (present in 2.1.3.2, 2.1.3.1 and 2.1.1.1)
Grain:	straight
Interlocked grain:	distinct and regular
Texture:	besides interlocked grain also a wengé-like pattern (alternating light and dark zones)
Knots:	in the heart plank two larger knots (Ø 3cm, with bark pocket one knot with some brown rot) also some pin knots
Checks:	Only present in the heart plank
Decay:	white rot in outer side (sapwood) and locally deeper (2.1.3.2, 2.1.3.1 and 2.1.1.1). only deeper in 2.1.2.1 and 2.1.2.2. worm only (little) present in sapwood
Remarks:	At the transition from sapwood to heartwood is a thin canal with extractives present. Possibly a lot of reaction wood.

Sapwood with worm

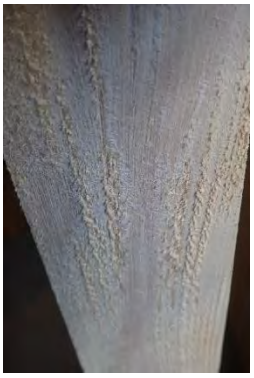


Narrow line with extractives between heart- and sapwood

Striped texture

Heart plank with check

Reaction wood



Reaction wood detail

Gindya-udu (stem 4 and 6)

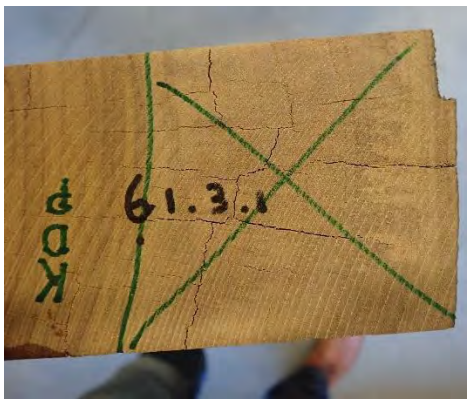
Stem 4.1	plate 1: 4 beams 11x4cm, 7.5x4cm, 12.5x4cm and 7x4cm (2 with wane, 2 with sapwood) plate 2: 3 beams 12x7cm, 14.5x7cm and 15x7cm (1 with wane, 2 with sapwood) plate 3: 3 beams 14.5x5cm, 15.5x5.5cm and 11.5x5.5cm (1 with wane, 2 with sapwood)
Stem 6.1	plate 1: 3 beams 10x4.57cm and 12x9.5cm (2 met wane and sapwood) plate 2: 2 beams 14.5x3.5cm and 15.5x3.5cm (1 with sapwood) plate 3: 3 beams 17.5x7.5cm, 17.5x7.5cm and 17.5x7.5 cm (1 met wane, 1 with heart, 2 with sapwood)
Colour:	red-brown, sapwood yellowish, sometimes the outsides of the heartwood lighter (red-yellow streaks) pinkish discolouration around the heart
Sapwood:	3-9cm wide, clearly demarked from heartwood
Grain:	straight
Interlocked grain:	hardly, some reaction wood
Texture:	light striped by lighter streaks
Knots:	one knot of 3cm Ø, one knot with Ø 4cm and one heart knot
Checks:	little
Decay:	stem 4: in heartwood places of brown rot and white rot, on one place a bore hole (Ø around 7 mm) in the heartwood with a colouration reaction around it. Smaller boreholes (Ø around 1mm) in sapwood, as well as blue stain and white rot. For stem 6 it is mainly (white)rot in the outside
Remarks:	possible stem 4 has been too long in the forest after felling.

Stem 4

Borehole

White rot in heartwood

Stem 6



Cross section, wane, sapwood, drying checks, decay



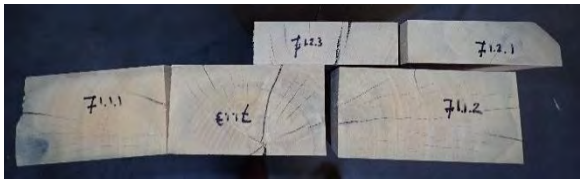



Overgrown injury


Overgrown injury detail

Kimboto (stem 3 and 7)

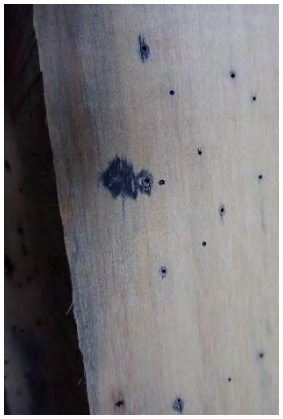
Stem 3.1	plate 1: 3 beams 14x4cm, 14x4cm and 14x4cm (2 with wane)
Stem 3.2	plate 2: 2 beams 17.5x7,5cm and 17.5x7.5cm (1 with boxed heart)
Stem 7.1	plate 1: 2 beams 15x4.5cm and 14.5x4.5cm (1 with wane) plate 2: 3 beams 17.5x8.5cm, 15x8.5cm, 15x8.5cm (1 with boxed heart, 1 with wane)
Colour:	yellow, brighter areas visible, sapwood invisible, outside the brighter areas al the wood is more or less blue stained.
Sapwood:	invisible
Grain:	straight
Interlocked grain:	not present
Texture:	homogeneous
Knots:	not present
Checks:	many, large radial and heart checks
Decay:	stem 7 with boreholes (Ø around 3 mm) surrounded with colouration / rot; stem 3 with boreholes (Ø around 1 mm, up to 14mm deep in the wood) sometimes with bleu stain/ rot surrounding the boreholes. White rot around the heart and diffuse present in the wood
Remarks:	possible stem 3 has been too long in the forest after felling.





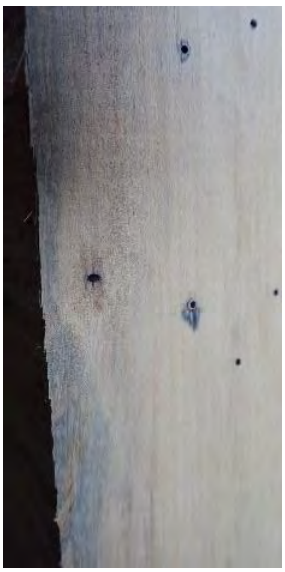

Checks and blue stain

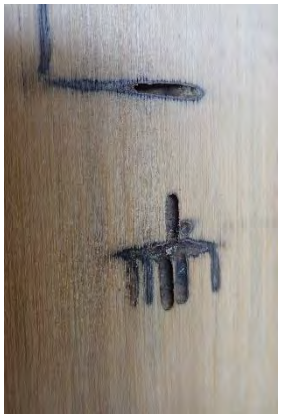
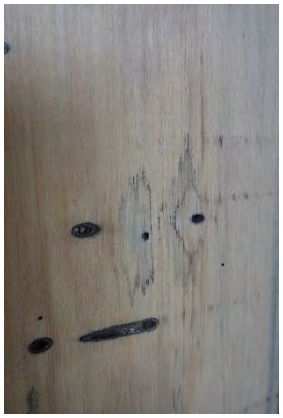


Boreholes with blue stain (rot)



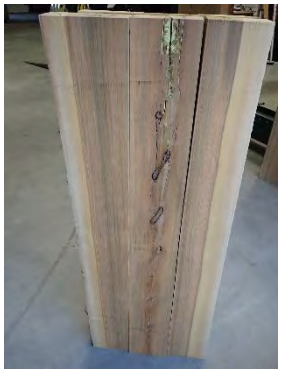
Boreholes

Pakoeli (stem 5)

Stem 5.1	plate 1: 3 beams 14x4.5cm, 12.5x4.5cm and 11x4.5cm (1 with wane, 2 with sapwood) plate 2: 3 beams 19x8.5cm, 15x8.5cm and 13x8.5cm (1 with wane, 2 with sapwood, 1 with boxed heart)
Stem 5.2	plate 1: 3 beams 15.5x7.5cm, 15.5x7.5cm and 16x7.5cm (1 with wane, 2 with sapwood, 1 with boxed heart) plate 2: 3 beams 12x4.5cm, 13x4.5cm and 14x7.5cm (2 with wane, 2 with sapwood)

Colour:	brown, yellow sapwood, in 5.2.2.1 transitional wood is visible, dark streaks
Sapwood:	4.5-8cm wide clearly demarked from heartwood
Grain:	straight
Interlocked grain:	not present
Texture:	light striped
Knots:	little, one heart plank 7 little knots (Ø 2.5cm)
Checks:	a number of large radial checks, filled with yellow extractives
Decay:	the sapwood is locally bleu stained and/or rot
Remarks:	possible the stem has been too long in the forest after felling.



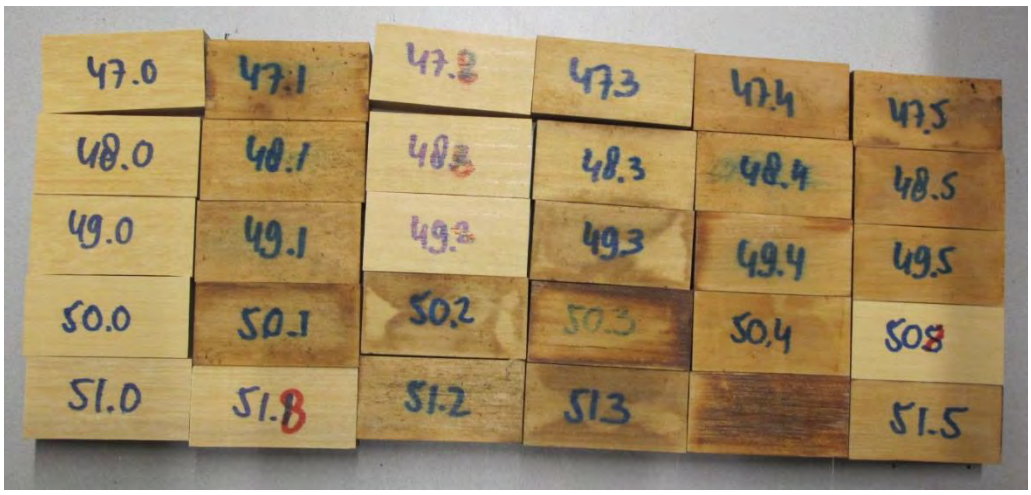

Appendix 2 Samples for durability tests

Samples of ingipipa

Samples of gindya-udu

Samples of pakoeli

Samples of bostamarinde



Samples of kimboto

Appendix 3 Data of durability tests

In the durability test the samples got a new (shorter) code. The connection between the new and original codes is given below

Codes	
Original	Durability test
1,1,2,1A	1
1,1,2,1B	2
1,1,2,2A	3
1,1,2,2B	4
1,1,2,3	5
1,1,4,2A	6
1,1,4,2B	7
2,1,1,1A	8
2,1,1,1B	9
2,1,1,3A	10
2,1,1,3B	11
2,1,2,1	12
2,1,2,2	13
2,1,2,3	14
2,1,3,1	15
2,1,3,2A	16
2,1,3,2B	17
2,1,3,3	18
4,1,1,3	19
4,1,2,1A1	20
4,1,2,1A0	21
4,1,2,1A2	22
4,1,2,1B	23
4,1,2,2	24
4,1,2,3	25
4,1,3,2	26
4,1,3,3	27
4,1,3,1	28
5,1,1,3A	29
5,1,1,3B	30
5,2,1,1	31
5,2,1,2	32
5,2,1,3	33
5,2,2,1A	34
5,2,2,1B	35
5,2,2,2A	36
5,2,2,2B	37
5,2,2,3	38

Codes	
Original	Durability test
6,1,1,1	39
6,1,1,2	40
6,1,1,3	41
6,1,2,1	42
6,1,3,1A	43
6,1,3,1B	44
6,1,3,2A	45
6,1,3,2B	46
7,1,1,1A	47
7,1,1,1B	48
7,1,1,2	49
7,1,2,1	50
7,1,2,3	51

extra code	plank	nr	fungus		Weight 22 C / 65%RH (g)	Calculated dry weight (g)	dry matter moisture control [g]	ds% [%]	Weight after 16 weeks (g)	Dry weight after 16 weeks (g)	Moisture after 16 weeks (%)	Mass loss (%)	DK	median mass loss (%)
Coniophora puteana														
1.1	1	1	1		14,935	13,039826			22,5971	12,9601	74,4%	0,6%	1	
2.1	2	1	1		13,234	11,523375			19,0502	11,4539	66,3%	0,6%	1	
3.1	3	1	1		14,153	12,303132			19,605	12,3134	59,2%	-0,1%	1	
4.1	4	1	1		14,377	12,497038			18,5254	12,4947	48,3%	0,0%	1	-0,1%
5.1	5	1	1		13,2935	11,589421			19,2336	11,6023	65,8%	-0,1%	1	
6.1	6	1	1		14,327	12,451293			18,6137	12,4651	49,3%	-0,1%	1	
7.1	7	1	1		14,209	12,372635			20,8476	12,4294	67,7%	-0,5%	1	
8.1	8	1	1		12,0878	10,648186			19,6187	10,6195	84,7%	0,3%	1	
9.1	9	1	1		10,8024	9,5158479			17,5251	9,4678	85,1%	0,5%	1	
10.1	10	1	1		12,3754	10,896537			18,6426	10,8591	71,7%	0,3%	1	
11.1	11	1	1		12,2782	10,823739			18,1891	10,8016	68,4%	0,2%	1	
12.1	12	1	1		12,3002	10,81687			18,8118	10,7831	74,5%	0,3%	1	
13.1	13	1	1		10,7082	9,4070088			17,0473	9,3867	81,6%	0,2%	1	0,3%
14.1	14	1	1		12,115	10,680671			19,097	10,6658	79,0%	0,1%	1	
15.1	15	1	1		10,485	9,2395924			15,932	8,9928	77,2%	2,7%	1	
16.1	16	1	1		10,3486	9,1140359			13,5435	8,461	60,1%	7,2%	2	
17.1	17	1	1		12,6866	11,196853			19,824	11,1582	77,7%	0,3%	1	
18.1	18	1	1		11,4789	10,11286			16,1293	10,0817	60,0%	0,3%	1	
19.1	19	1	1		20,4025	17,68			22,8858	17,7493	28,9%	-0,4%	1	
20.1	20	1	1		20,734	17,891626			22,7912	17,9397	27,0%	-0,3%	1	
21.1	21	1	1		20,1725	17,443811			22,2608	17,4737	27,4%	-0,2%	1	
22.1	22	1	1		20,3995	17,619193			22,4952	17,6689	27,3%	-0,3%	1	
23.1	23	1	1		19,8475	17,103328			22,1411	17,1253	29,3%	-0,1%	1	
24.1	24	1	1		20,1285	17,388767			22,8881	17,4427	31,2%	-0,3%	1	-0,3%
25.1	25	1	1		18,69	16,136339			20,9088	16,2055	29,0%	-0,4%	1	
26.1	26	1	1		20,304	17,553839			21,8791	17,5989	24,3%	-0,3%	1	
27.1	27	1	1		19,4685	16,809486			22,1425	16,8368	31,5%	-0,2%	1	
28.1	28	1	1		20,0965	17,403794			22,7104	17,4442	30,2%	-0,2%	1	
29.1	29	1	1		18,029	16,019447			20,2379	16,3572	23,7%	-2,1%	1	
30.1	30	1	1		17,879	15,799242			20,2324	16,2276	24,7%	-2,7%	1	
31.1	31	1	1		12,655	11,191787			14,5813	11,5049	26,7%	-2,8%	1	
32.1	32	1	1		14,175	12,485747			15,9415	12,8461	24,1%	-2,9%	1	
33.1	33	1	1		15,2445	13,39838			16,9592	13,7232	23,6%	-2,4%	1	-2,1%
34.1	34	1	1		14,7155	12,917799			16,6423	13,0972	27,1%	-1,4%	1	
35.1	35	1	1		16,361	14,295209			18,1346	14,3857	26,1%	-0,6%	1	
36.1	36	1	1		14,3465	12,641094			16,5895	12,8461	29,1%	-1,6%	1	
37.1	37	1	1		15,298	13,397709			17,1673	13,6796	25,5%	-2,1%	1	
38,3	38	1	1		17,122	14,905587			19,2189	15,0088	28,1%	-0,7%	1	
39.1	39	1	1		18,8445	16,430767			22,8192	16,253	40,4%	1,1%	1	
40.1	40	1	1		18,3245	15,927953			20,7733	15,8876	30,8%	0,3%	1	
41.1	41	1	1		19,5375	16,982972			22,9973	17,2193	33,6%	-1,4%	1	
42.1	42	1	1		18,6535	16,205843			23,1457	16,36	41,5%	-1,0%	1	-0,3%
43.1	43	1	1		19,737	17,140367			22,9874	17,2534	33,2%	-0,7%	1	
44.1	44	1	1		18,435	15,942021			21,9077	16,0062	36,9%	-0,4%	1	
45.1	45	1	1		18,264	15,799163			22,4916	15,747	42,8%	0,3%	1	
46,1	46	1	1		19,2225	16,597505			22,1564	16,6633	33,0%	-0,4%	1	
47.1	47	1	1		16,6355	14,452966			24,1727	14,1864	70,4%	1,8%	1	
48.1	48	1	1		16,705	14,512238			23,4058	13,8622	68,8%	4,5%	1	
49.1	49	1	1		19,255	16,772891			25,69	15,9628	60,9%	4,8%	1	4,5%
50.1	50	1	1		18,3765	16,029			23,9913	15,0056	59,9%	6,4%	2	
51,2	51	1	1		17,459	15,250326			24,9979	14,779	69,1%	3,1%	1	

extra code	plank	nr	fungus		Weight 22 C / 65%RH (g)	Calculated dry weight (g)	dry matter moisture control [g]	ds% [%]	Weight after 16 weeks (g)	Dry weight after 16 weeks (g)	Moisture after 16 weeks (%)	Mass loss (%)	DK	
oria placenta														
1.3	1	3	3		14,997	13,093958			17,9093	13,0909	36,8%	0,0%	1	
2.3	2	3	3		13,0935	11,401036			14,8367	11,4151	30,0%	-0,1%	1	
3.3	3	3	3		14,29	12,422225			16,5526	12,4193	33,3%	0,0%	1	
4.3	4	3	3		14,374	12,49443			18,5597	12,6109	47,2%	-0,9%	1	-0,1%
5.3	5	3	3		13,1825	11,49265			15,7991	11,5554	36,7%	-0,5%	1	
6.3	6	3	3		14,25	12,384374			16,1674	12,4081	30,3%	-0,2%	1	
7.3	7	3	3		14,0005	12,191082			15,4913	12,1911	27,1%	0,0%	1	
8.3	8	3	3		12,8104	11,284727			17,1796	11,2586	52,6%	0,2%	1	
9.3	9	3	3		10,4546	9,2094704			13,0327	8,9438	45,7%	2,9%	1	
10.3	10	3	3		13,2475	11,664421			15,8474	11,628	36,3%	0,3%	1	
11.3	11	3	3		11,9117	10,500654			15,1281	10,4753	44,4%	0,2%	1	
12.3	12	3	3		12,478	10,973228			15,4519	10,9318	41,3%	0,4%	1	
13.3	13	3	3		10,7471	9,4411819			12,9376	9,3929	37,7%	0,5%	1	0,4%
14.3	14	3	3		11,9431	10,529122			15,713	10,4954	49,7%	0,3%	1	
15.3	15	3	3		11,3495	10,001407			13,5312	9,0547	49,4%	9,5%	2	
16.3	16	3	3		9,726	8,5657106			9,9304	6,7671	46,7%	21,0%	4	
17.3	17	3	3		12,0549	10,639332			15,4088	10,5881	45,5%	0,5%	1	
18.3	18	3	3		11,379	10,024849			13,8119	9,9817	38,4%	0,4%	1	
19.3	19	3	3		20,2635	17,559548			21,4817	17,6059	22,0%	-0,3%	1	
20.3	20	3	3		20,458	17,653463			21,6069	17,691	22,1%	-0,2%	1	
21.3	21	3	3		20,183	17,45289			21,3247	17,4628	22,1%	-0,1%	1	
22.3	22	3	3		20,505	17,710314			21,6938	17,7748	22,0%	-0,4%	1	
23.3	23	3	3		19,668	16,948646			20,8386	16,9846	22,7%	-0,2%	1	-0,1%
24.3	24	3	3		19,94	17,225924			21,0966	17,2226	22,5%	0,0%	1	
25.3	25	3	3		18,749	16,187278			20,4334	16,2308	25,9%	-0,3%	1	
26.3	26	3	3		20,237	17,495914			21,4533	17,5113	22,5%	-0,1%	1	
27.3	27	3	3		19,6605	16,975263			20,9702	16,9437	23,8%	0,2%	1	
28.3	28	3	3		20,284	17,566171			21,6612	17,5409	23,5%	0,1%	1	
29.3	29	3	3		17,9975	15,991458			19,6288	16,1866	21,3%	-1,2%	1	
30.3	30	3	3		17,8425	15,766988			19,4086	16,0436	21,0%	-1,8%	1	
31.3	31	3	3		12,6485	11,186039			13,8546	11,4106	21,4%	-2,0%	1	
32.3	32	3	3		14,6085	12,867587			15,7771	13,1505	20,0%	-2,2%	1	
33.3	33	3	3		15,5325	13,651503			16,7441	13,9514	20,0%	-2,2%	1	-2,0%
34.3	34	3	3		14,878	13,060447			16,1655	13,3474	21,1%	-2,2%	1	
35.3	35	3	3		16,29	14,233174			17,7287	14,4047	23,1%	-1,2%	1	
36.3	36	3	3		14,485	12,76313			15,7106	13,0264	20,6%	-2,1%	1	
37.3	37	3	3		14,694	12,868737			15,8273	13,12	20,6%	-2,0%	1	
38,4	38	3	3		17,2055	14,978278			18,7289	15,1137	23,9%	-0,9%	1	
39.3	39	3	3		19,11	16,662259			22,7332	16,4814	37,9%	1,1%	1	
40.3	40	3	3		18,3255	15,928822			19,9177	15,8709	25,5%	0,4%	1	
41.3	41	3	3		19,6025	17,039473			21,0196	17,0797	23,1%	-0,2%	1	
42.3	42	3	3		18,2395	15,846167			19,7145	15,8469	24,4%	0,0%	1	-0,1%
43.3	43	3	3		19,968	17,340976			21,3953	17,4445	22,6%	-0,6%	1	
44.3	44	3	3		18,726	16,193669			20,0259	16,2189	23,5%	-0,2%	1	
45.3	45	3	3		18,127	15,680652			19,622	15,634	25,5%	0,3%	1	
46,3	46	3	3		19,287	16,653197			20,7069	16,6732	24,2%	-0,1%	1	
47.3	47	3	3		16,559	14,386502			22,0398	14,279	54,4%	0,7%	1	
48.3	48	3	3		16,816	14,608668			21,2372	14,436	47,1%	1,2%	1	
49.3	49	3	3		19,089	16,62829			23,7647	16,3994	44,9%	1,4%	1	1,2%
50,2	50	3	3		17,935	15,643453			21,5469	15,3412	40,5%	1,9%	1	
51.3	51	3	3		17,567	15,344664			22,0275	15,198	44,9%	1,0%	1	

extra code	plank	nr	fungus		Weight 22 C / 65%RH (g)	Calculated dry weight (g)	dry matter moisture control [g]	ds% [%]	Weight after 16 weeks (g)	Dry weight after 16 weeks (g)	Moisture after 16 weeks (%)	**Mass loss** (%)		
olus versicolor														
1.4	1	4	4		14,929	13,034587			20,462	12,9852	57,6%	0,4%	1	
2.4	2	4	4		13,086	11,394506			16,9559	11,3658	49,2%	0,3%	1	
3.4	3	4	4		14,3715	12,493073			19,5564	11,4536	70,7%	8,3%	2	
4.4	4	4	4		14,345	12,469222			18,7026	10,4787	78,5%	16,0%	4	0,7%
5.4	5	4	4		13,143	11,458213			18,264	11,4083	60,1%	0,4%	1	
6.4	6	4	4		14,189	12,33136			18,9748	12,2413	55,0%	0,7%	1	
7.4	7	4	4		14,129	12,302975			18,2732	9,3041	96,4%	24,4%	4	
8.4	8	4	4		12,4465	10,964166			18,6813	10,9461	70,7%	0,2%	1	
9.4	9	4	4		10,577	9,3172927			16,2694	9,2729	75,5%	0,5%	1	
10.4	10	4	4		12,5742	11,071581			16,7493	11,0234	51,9%	0,4%	1	
11.4	11	4	4		11,6986	10,312798			16,5957	10,2866	61,3%	0,3%	1	
12.4	12	4	4		12,9992	11,431575			17,7793	11,4031	55,9%	0,2%	1	
13.4	13	4	4		10,9194	9,5925452			14,5616	9,5518	52,4%	0,4%	1	0,3%
14.4	14	4	4		12,0874	10,656338			18,0736	10,6437	69,8%	0,1%	1	
15.4	15	4	4		11,5277	10,158441			16,7107	10,0809	65,8%	0,8%	1	
16.4	16	4	4		9,8336	8,6604742			14,024	8,1947	71,1%	5,4%	2	
17.4	17	4	4		12,1701	10,741004			18,1532	10,7232	69,3%	0,2%	1	
18.4	18	4	4		11,3079	9,9622099			15,3154	9,9416	54,1%	0,2%	1	
19.4	19	4	4		20,106	17,423065			22,8365	17,4415	30,9%	-0,1%	1	
20.4	20	4	4		20,364	17,572349			22,9389	17,5875	30,4%	-0,1%	1	
21.4	21	4	4		20,194	17,462402			22,5985	17,453	29,5%	0,1%	1	
22.4	22	4	4		20,302	17,534981			22,8226	17,5218	30,3%	0,1%	1	
23.4	23	4	4		19,648	16,931411			22,1839	16,8893	31,3%	0,2%	1	0,2%
24.4	24	4	4		20,1465	17,404317			22,559	17,3534	30,0%	0,3%	1	
25.4	25	4	4		18,9255	16,339663			21,8387	16,1704	35,1%	1,0%	1	
26.4	26	4	4		20,1245	17,398652			22,536	17,3919	29,6%	0,0%	1	
27.4	27	4	4		19,652	16,967924			22,2555	16,8945	31,7%	0,4%	1	
28.4	28	4	4		20,1075	17,41332			22,6614	17,3727	30,4%	0,2%	1	
29.4	29	4	4		18,0085	16,001232			21,3158	16,2532	31,1%	-1,6%	1	
30.4	30	4	4		17,876	15,796591			20,8773	16,0644	30,0%	-1,7%	1	
31.4	31	4	4		12,812	11,330634			16,8548	11,6363	44,8%	-2,7%	1	
32.4	32	4	4		14,6135	12,871991			17,778	13,1215	35,5%	-1,9%	1	
33.4	33	4	4		15,665	13,767957			18,0731	13,9655	29,4%	-1,4%	1	-1,6%
34.4	34	4	4		14,264	12,521456			16,7646	12,7474	31,5%	-1,8%	1	
35.4	35	4	4		16,4045	14,333217			19,0603	14,4236	32,1%	-0,6%	1	
36.4	36	4	4		14,421	12,706738			17,0261	12,9445	31,5%	-1,9%	1	
37.4	37	4	4		14,6535	12,833268			17,0621	12,8837	32,4%	-0,4%	1	
38,5	38	4	4		16,9565	14,761511			19,2673	14,8861	29,4%	-0,8%	1	
39.4	39	4	4		19,0215	16,585095			19,8745	13,7437	44,6%	17,1%	4	
40.4	40	4	4		18,5445	16,119181			19,5564	13,7816	41,9%	14,5%	3	
41.4	41	4	4		19,6185	17,053381			22,5932	16,6353	35,8%	2,5%	1	
42.4	42	4	4		18,321	15,916973			22,0135	15,9028	38,4%	0,1%	1	0,2%
43.4	43	4	4		20,3395	17,663601			23,1191	17,6557	30,9%	0,0%	1	
44.4	44	4	4		19,157	16,566385			21,8867	16,5164	32,5%	0,3%	1	
45.4	45	4	4		18,111	15,666811			21,0216	13,5286	55,4%	13,6%	3	
46,4	46	4	4		19,3525	16,709752			22,618	16,6983	35,5%	0,1%	1	
47.4	47	4	4		16,5785	14,403444			24,4811	14,1413	73,1%	1,8%	1	
48.4	48	4	4		16,831	14,621699			24,0971	14,0155	71,9%	4,1%	1	
49.4	49	4	4		18,9855	16,538132			25,5453	15,7452	62,2%	4,8%	1	4,8%
50,3	50	4	4		17,5655	15,321164			23,3094	13,0324	78,9%	14,9%	3	
51.4	51	4	4		17,696	15,457344			niet gemeten	12,5584	#WAARDE!	18,8%	4	

					Weight	Calculated	dry matter	ds%	Weight	Dry weight	Moisture			
extra code	plank	nr	fungus		22 C / 65%RH	dry weight	moisture control		after 16 weeks	after 16 weeks	after 16 weeks	**Mass loss**		
					(g)	(g)	[g]	[%]	(g)	(g)	(%)	(%)		
ioporia expansa														
1.5	1	5	5		14,7955	12,918028			19,6322	12,886	52,4%	0,2%	1	
2.5	2	5	5		13,387	11,656598			17,3055	11,6764	48,2%	-0,2%	1	
3.5	3	5	5		14,3145	12,443523			18,8162	12,4121	51,6%	0,3%	1	
4.5	4	5	5		14,396	12,513554			17,8644	12,4742	43,2%	0,3%	1	0,2%
5.5	5	5	5		13,0645	11,389776			18,3153	11,3864	60,9%	0,0%	1	
6.5	6	5	5		14,0465	12,207516			16,8904	12,1755	38,7%	0,3%	1	
7.5	7	5	5		14,294	12,44665			17,6162	12,4221	41,8%	0,2%	1	
8.5	8	5	5		12,635	11,130216			20,0419	11,0793	80,9%	0,5%	1	
9.5	9	5	5		10,7482	9,468103			16,9393	9,4404	79,4%	0,3%	1	
10.5	10	5	5		11,9551	10,526463			16,8134	10,4825	60,4%	0,4%	1	
11.5	11	5	5		11,8082	10,409415			18,1408	10,3677	75,0%	0,4%	1	
12.5	12	5	5		12,5282	11,017374			18,539	10,9677	69,0%	0,5%	1	
13.5	13	5	5		10,6721	9,3752954			15,1782	9,2845	63,5%	1,0%	1	0,5%
14.5	14	5	5		12,0698	10,640822			18,5797	10,5472	76,2%	0,9%	1	
15.5	15	5	5		11,6756	10,288773			17,1339	10,2322	67,5%	0,5%	1	
16.5	16	5	5		9,8444	8,6699858			16,9502	8,3526	102,9%	3,7%	1	
17.5	17	5	5		12,161	10,732973			18,2777	10,6347	71,9%	0,9%	1	
18.5	18	5	5		11,3609	10,008903			15,7468	9,9704	57,9%	0,4%	1	
19.5	19	5	5		20,007	17,337275			22,0266	17,3907	26,7%	-0,3%	1	
20.5	20	5	5		20,4165	17,617652			22,5215	17,627	27,8%	-0,1%	1	
21.5	21	5	5		20,0345	17,324477			22,2502	17,3128	28,5%	0,1%	1	
22.5	22	5	5		20,1365	17,392038			22,4608	17,4098	29,0%	-0,1%	1	
23.5	23	5	5		19,8775	17,12918			22,0109	17,1403	28,4%	-0,1%	1	0,0%
24.5	24	5	5		19,9395	17,225492			22,1103	17,2173	28,4%	0,0%	1	
25.5	25	5	5		18,9685	16,376787			21,6353	16,3783	32,1%	0,0%	1	
26.5	26	5	5		20,2535	17,510179			22,6485	17,5377	29,1%	-0,2%	1	
27.5	27	5	5		19,6815	16,993395			22,2898	16,9846	31,2%	0,1%	1	
28.5	28	5	5		19,988	17,309832			22,7015	17,3041	31,2%	0,0%	1	
29.5	29	5	5		18,01	16,002564			20,9515	16,1801	29,5%	-1,1%	1	
30.5	30	5	5		17,927	15,841659			20,3571	16,0263	27,0%	-1,2%	1	
31.5	31	5	5		12,919	11,425263			15,2366	11,5978	31,4%	-1,5%	1	
32.5	32	5	5		15,065	13,269685			16,9922	13,5411	25,5%	-2,0%	1	
33.5	33	5	5		16,3855	14,401204			18,2294	14,7965	23,2%	-2,7%	1	-2,1%
34.5	34	5	5		14,137	12,409971			16,2398	12,7105	27,8%	-2,4%	1	
35.5	35	5	5		16,4145	14,341954			18,5372	14,5703	27,2%	-1,6%	1	
36.5	36	5	5		14,101	12,424777			16,6007	12,6939	30,8%	-2,2%	1	
37.5	37	5	5		14,5885	12,776342			16,5924	13,0655	27,0%	-2,3%	1	
38,6	38	5	5		16,7905	14,616999			18,6881	14,9592	24,9%	-2,3%	1	
39.5	39	5	5		18,7885	16,381939			22,6394	15,1615	49,3%	7,4%	2	
40.5	40	5	5		18,5885	16,157426			20,796	15,1867	36,9%	6,0%	2	
41.5	41	5	5		19,6265	17,060335			23,1532	16,7359	38,3%	1,9%	1	
42.5	42	5	5		18,161	15,777967			21,894	15,7768	38,8%	0,0%	1	0,0%
43.5	43	5	5		20,434	17,745669			23,3938	17,8714	30,9%	-0,7%	1	
44.5	44	5	5		19,0625	16,484664			22,3662	16,5385	35,2%	-0,3%	1	
45.5	45	5	5		18,121	15,675462			20,5162	14,921	37,5%	4,8%	1	
46,5	46	5	5		19,271	16,639382			21,9824	16,7564	31,2%	-0,7%	1	
47.5	47	5	5		16,74	14,543756			23,3384	14,3004	63,2%	1,7%	1	
48.5	48	5	5		16,838	14,62778			22,9824	14,2885	60,8%	2,3%	1	
49.5	49	5	5		18,9985	16,549456			24,8248	16,1935	53,3%	2,2%	1	1,9%
50,4	50	5	5		17,373	15,153259			21,2497	14,8688	42,9%	1,9%	1	
51.5	51	5	5		17,359	15,162977			21,9231	14,8971	47,2%	1,8%	1	

Appendix 4 Data of Shrinkage and swelling tests

houtsoort	**ingipipa**													
tangentiale swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
btan 0%	btan 30%	Z0-30	btan 50%	Z0-50	btan al	Z0-al	btan 65%	Z0-65	btan 81%	Z0-81	btan 94%	Z0-94	btan wv	Z0-wv
28,718	29,348	2,193746	29,359	2,23205	30,126	4,902848	29,783	3,708476	30,218	5,223205	30,871	7,49704	31,376	9,255519
28,662	29,316	2,281767	29,532	3,035378	30,044	4,821715	29,73	3,726188	30,161	5,229921	30,779	7,386086	31,199	8,851441
28,673	29,308	2,214627	29,532	2,99585	30,03	4,732675	29,73	3,686395	30,16	5,186064	30,798	7,411153	31,352	9,343285
28,65	29,28	2,198953	29,498	2,95986	30,061	4,924956	29,687	3,619546	30,106	5,082024	30,717	7,21466	31,196	8,886562
28,621	29,221	2,096363	29,44	2,861535	29,967	4,702841	29,617	3,479962	30,026	4,908983	30,611	6,952937	31,014	8,360994
28,779	29,389	2,119601	29,62	2,92227	30,046	4,402516	29,787	3,502554	30,19	4,902881	30,778	6,946037	31,176	8,32899
gem		2,184176		2,83449		4,747925		3,62052		5,088846		7,234652		8,837798
stdv		0,067294		0,301158		0,190976		0,106691		0,151252		0,239163		0,428672
min		2,096363		2,23205		4,402516		3,479962		4,902881		6,946037		8,32899
max		2,281767		3,035378		4,924956		3,726188		5,229921		7,49704		9,343285
radiale swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
b rad 0%	brad 30%	Z0-30	brad 50%	Z0-50	brad al	Z0-al	brad 65%	Z0-65	brad 81%	Z0-81	b rad 94%	Z0-94	b rad wv	Z0-wv
28,733	29,17	1,520899	29,368	2,210002	29,759	3,570807	29,514	2,718129	29,884	4,005847	30,375	5,714683	30,647	6,66133
29,175	29,635	1,576692	29,809	2,173093	30,197	3,502999	29,948	2,649529	30,246	3,670951	30,638	5,014567	30,831	5,676093
28,956	29,436	1,657688	29,623	2,303495	30,001	3,608924	29,774	2,824976	30,099	3,947368	30,547	5,494543	30,807	6,392458
28,886	29,332	1,544001	29,506	2,146368	29,923	3,589974	29,66	2,679499	29,973	3,763069	30,392	5,213598	30,619	5,999446
29,012	29,458	1,537295	29,629	2,126706	30,039	3,539915	29,768	2,605818	30,062	3,619192	30,44	4,922101	30,638	5,604577
29,119	29,538	1,438923	29,73	2,098286	30,059	3,228133	29,862	2,551599	30,162	3,581854	30,56	4,948659	30,769	5,666403
gem		1,545916		2,176325		3,506792		2,671592		3,764713		5,218025		6,000051
stdv		0,071542		0,073166		0,14157		0,094833		0,176021		0,323937		0,439077
min		1,438923		2,098286		3,228133		2,551599		3,581854		4,922101		5,604577
max		1,657688		2,303495		3,608924		2,824976		4,005847		5,714683		6,66133
tangentiale shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
btan wv	btan 94%	Kwv-94%	btan 81%	Kwv-81%	btan al	Kwv-al	btan 65%	Kwv-65%	btan 50%	Kwv-50%	btan 30%	Kwv-30%	btan 0%	Kwv-0%
31,341	30,955	1,231614	30,657	2,182445	30,118	3,902237	30,122	3,889474	29,819	4,856259	29,319	6,451613	28,73	8,33094
31,167	30,841	1,045978	30,609	1,790355	30,031	3,644881	30,067	3,529374	29,763	4,504765	29,279	6,057689	28,665	8,027722
31,325	30,877	1,430168	30,575	2,394254	30,025	4,15004	30,06	4,038308	29,745	5,043895	29,257	6,601756	28,642	8,565044
31,235	30,839	1,267809	30,57	2,129022	30,083	3,68817	30,072	3,723387	29,758	4,72867	29,279	6,262206	28,688	8,154314
30,999	30,689	1,000032	30,453	1,761347	29,962	3,345269	29,979	3,290429	29,665	4,303365	29,196	5,816317	28,618	7,680893
31,16	30,847	1,004493	30,602	1,790757	30,041	3,591142	30,109	3,372914	29,804	4,351733	29,332	5,866496	28,738	7,772786
gem		1,163349		2,00803		3,72029		3,640648		4,631448		6,176013		8,088616
stdv		0,174612		0,264451		0,276343		0,294486		0,29395		0,317435		0,334579
min		1,000032		1,761347		3,345269		3,290429		4,303365		5,816317		7,680893
max		1,430168		2,394254		4,15004		4,038308		5,043895		6,601756		8,565044
radiale shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
b rad wv	brad 94%	Kwv-94%	brad 81%	Kwv-81%	brad al	Kwv-al	b rad 65%	Kwv-65%	brad 50%	Kwv-50%	brad 30%	Kwv-30%	brad 0%	Kwv-0%
30,575	30,375	0,654129	30,17	1,324612	29,734	2,750613	29,798	2,541292	29,561	3,316435	29,147	4,670482	28,696	6,145544
30,796	30,69	0,344201	30,51	0,928692	30,163	2,055462	30,206	1,915833	29,98	2,649695	29,599	3,886868	29,151	5,341603
30,764	30,573	0,620856	30,385	1,231959	29,998	2,489923	30,026	2,398908	29,791	3,162788	29,392	4,459758	28,901	6,055779
30,633	30,459	0,568015	30,29	1,119708	29,956	2,210035	29,983	2,121895	29,75	2,882512	29,372	4,116476	28,913	5,61486
30,619	30,478	0,460498	30,33	0,943858	30,04	1,890983	30,045	1,874653	29,819	2,612757	29,449	3,821157	29,021	5,218982
30,745	30,592	0,497642	30,431	1,021304	30,052	2,254025	30,12	2,032851	29,888	2,787445	29,506	4,029924	29,074	5,43503
gem		0,524223		1,095022		2,275173		2,147572		2,901939		4,164111		5,6353
stdv		0,114286		0,160014		0,307482		0,2684		0,283051		0,334238		0,383994
min		0,344201		0,928692		1,890983		1,874653		2,612757		3,821157		5,218982
max		0,654129		1,324612		2,750613		2,541292		3,316435		4,670482		6,145544

houtsoort	**Bostamarinde**													
tangential swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
btan 0%	btan 30%	Z0-30	btan 50%	Z0-50	btan al	Z0-al	btan 65%	Z0-65	btan 81%	Z0-81	btan 94%	Z0-94	btan wv	Z0-wv
28,613	29,204	2,065495	29,37	2,645651	29,711	3,837417	29,524	3,183867	29,831	4,256806	30,24	5,686227	30,377	6,16503
27,889	28,572	2,448994	28,815	3,320305	29,309	5,091613	29,035	4,109147	29,515	5,830256	30,282	8,580444	30,656	9,921474
28,233	28,828	2,107463	29,056	2,915029	29,533	4,604541	29,288	3,736762	29,8	5,550243	30,598	8,376722	30,989	9,761626
28,877	29,492	2,129723	27,159	-5,94937	30,036	4,013575	29,849	3,366001	30,222	4,657686	30,662	6,18139	30,755	6,503446
28,998	29,515	1,782882	29,684	2,36568	29,993	3,431271	29,812	2,80709	30,087	3,755431	30,442	4,979654	30,58	5,455549
28,224	28,745	1,845947	29,019	2,816752	29,503	4,531604	29,245	3,617489	29,752	5,413832	30,613	8,464427	31,252	10,72846
gem		2,063417		2,812683		4,25167		3,470059		4,910709		7,044811		8,089264
stdv		0,237067		0,352095		0,60162		0,454656		0,816576		1,612674		2,292295
min		1,782882		2,36568		3,431271		2,80709		3,755431		4,979654		5,455549
max		2,448994		3,320305		5,091613		4,109147		5,830256		8,580444		10,72846
radial swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
b rad 0%	brad 30%	Z0-30	brad 50%	Z0-50	brad al	Z0-al	brad 65%	Z0-65	brad 81%	Z0-81	b rad 94%	Z0-94	b rad wv	Z0-wv
29,65	29,767	0,394604	29,835	0,623946	30,016	1,234401	29,939	0,974705	30,084	1,463744	30,291	2,161889	30,374	2,441821
28,779	29,092	1,087599	29,219	1,528893	29,513	2,550471	29,346	1,970187	29,598	2,845825	29,97	4,138434	30,134	4,708294
28,854	29,173	1,105566	29,324	1,62889	29,575	2,498787	29,445	2,048243	29,684	2,876551	30,037	4,099951	30,181	4,599016
29,475	29,708	0,7905	29,803	1,112807	29,978	1,706531	29,885	1,391009	30,046	1,937235	30,226	2,547922	30,256	2,649703
29,78	29,79	0,03358	29,892	0,376091	29,988	0,698455	29,955	0,587643	30,082	1,014103	30,27	1,6454	30,332	1,853593
29,163	29,394	0,7921	29,535	1,275589	29,779	2,112266	29,647	1,659637	29,868	2,417447	30,193	3,531873	30,35	4,070226
gem		0,700658		1,091036		1,800152		1,438571		2,092484		3,020911		3,387109
stdv		0,416838		0,498971		0,733629		0,573533		0,757655		1,051469		1,222285
min		0,03358		0,376091		0,698455		0,587643		1,014103		1,6454		1,853593
max		1,105566		1,62889		2,550471		2,048243		2,876551		4,138434		4,708294
tangential shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
btan wv	btan 94%	Kwv-94%	btan 81%	Kwv-81%	btan al	Kwv-al	btan 65%	Kwv-65%	btan 50%	Kwv-50%	btan 30%	Kwv-30%	btan 0%	Kwv-0%
30,411	30,285	0,414324	30,118	0,963467	29,741	2,20315	29,794	2,028871	29,588	2,706258	29,276	3,732202	28,676	5,705172
30,678	30,369	1,007236	30,028	2,118782	29,339	4,364691	29,401	4,162592	29,074	5,228503	28,631	6,672534	27,901	9,052089
31,035	30,722	1,008539	30,432	1,942968	29,643	4,485259	29,807	3,956823	29,462	5,068471	29,044	6,415338	28,272	8,902852
30,798	30,685	0,366907	30,506	0,948114	30,065	2,380025	30,179	2,009871	29,956	2,733944	29,651	3,724268	28,995	5,854276
30,603	30,473	0,424795	30,312	0,950887	29,975	2,052086	30,024	1,891971	29,832	2,519361	29,542	3,46698	29,033	5,130216
31,143	30,579	1,811001	30,197	3,037601	29,473	5,362361	29,606	4,935298	29,3	5,917863	28,863	7,321067	28,201	9,446746
gem		0,8388		1,660303		3,474595		3,164238		4,029066		5,222065		7,348559
stdv		0,561537		0,858268		1,429375		1,341778		1,535769		1,759374		1,97863
min		0,366907		0,948114		2,052086		1,891971		2,519361		3,46698		5,130216
max		1,811001		3,037601		5,362361		4,935298		5,917863		7,321067		9,446746
radial shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
b rad wv	brad 94%	Kwv-94%	brad 81%	Kwv-81%	brad al	Kwv-al	b rad 65%	Kwv-65%	brad 50%	Kwv-50%	brad 30%	Kwv-30%	brad 0%	Kwv-0%
30,394	30,318	0,250049	30,243	0,496809	30,026	1,210765	30,13	0,868592	30,033	1,187734	29,868	1,730605	29,67	2,382049
30,178	30,038	0,463914	29,894	0,941083	29,554	2,067731	29,615	1,865597	29,436	2,458745	29,175	3,323613	28,818	4,506594
30,269	30,166	0,340282	30,027	0,799498	29,682	1,939278	29,768	1,655159	29,589	2,246523	29,362	2,996465	28,968	4,298127
30,244	30,215	0,095887	30,134	0,363709	29,955	0,955561	30,029	0,710885	29,925	1,054755	29,757	1,610237	29,466	2,572411
30,387	30,298	0,292888	30,236	0,496923	29,997	1,283444	30,161	0,743739	30,076	1,023464	29,934	1,490769	29,816	1,879093
30,376	30,202	0,572821	30,075	0,990914	29,789	1,932447	29,866	1,678957	29,721	2,156308	29,481	2,946405	29,211	3,835265
gem		0,335974		0,681489		1,564871		1,253822		1,687921		2,349682		3,24559
stdv		0,166952		0,263141		0,469896		0,532813		0,66606		0,823495		1,10561
min		0,095887		0,363709		0,955561		0,710885		1,023464		1,490769		1,879093
max		0,572821		0,990914		2,067731		1,865597		2,458745		3,323613		4,506594

houtsoort	**Gindya udu**													
tangential swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
btan 0%	btan 30%	Z0-30	btan 50%	Z0-50	btan_al	Z0-al	btan 65%	Z0-65	btan 81%	Z0-81	btan 94%	Z0-94	btan wv	Z0-wv
38,028	38,983	2,51	39,337	3,44	40,13	5,53	39,654	4,28	40,299	5,97	41,222	8,40	41,614	9,43
37,416	38,451	2,77	38,79	3,67	39,826	6,44	39,108	4,52	39,789	6,34	40,593	8,49	40,814	9,08
37,614	38,596	2,61	38,953	3,56	40,034	6,43	39,277	4,42	39,977	6,28	40,83	8,55	41,097	9,26
37,905	38,871	2,55	39,216	3,46	40,118	5,84	39,54	4,31	40,205	6,07	41,054	8,31	41,374	9,15
37,152	38,248	2,95	38,616	3,94	39,643	6,70	38,958	4,86	39,67	6,78	40,581	9,23	40,921	10,14
37,598	38,576	2,60	38,884	3,42	39,782	5,81	39,16	4,15	39,745	5,71	40,47	7,64	40,735	8,34
37,803	38,767	2,55	39,064	3,34	39,969	5,73	39,331	4,04	39,896	5,54	40,597	7,39	40,904	8,20
28,378	29,129	2,65	29,353	3,44	30,035	5,84	29,56	4,17	29,984	5,66	30,593	7,81	30,914	8,94
28,253	28,933	2,41	29,138	3,13	29,788	5,43	29,357	3,91	29,783	5,42	30,284	7,19	30,461	7,82
28,348	29,082	2,59	29,317	3,42	29,981	5,76	29,525	4,15	29,971	5,73	30,518	7,65	30,719	8,36
28,339	29,074	2,59	29,332	3,50	29,978	5,78	29,526	4,19	29,966	5,74	30,521	7,70	30,765	8,56
28,278	29,029	2,66	29,272	3,52	29,949	5,91	29,465	4,20	29,914	5,79	30,475	7,77	30,711	8,60
37,62	38,61	2,63	38,926	3,47	39,841	5,90	39,184	4,16	39,767	5,71	40,491	7,63	40,823	8,51
gem		2,6		3,5		5,9		4,3		5,9		8,0		8,8
stdv		0,1		0,2		0,4		0,2		0,4		0,6		0,6
min		2,4		3,1		5,4		3,9		5,4		7,2		7,8
max		3,0		3,9		6,7		4,9		6,8		9,2		10,1
radial swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
b rad 0%	brad 30%	Z0-30	brad 50%	Z0-50	brad_al	Z0-al	brad 65%	Z0-65	brad 81%	Z0-81	b rad 94%	Z0-94	b rad wv	Z0-wv
38,451	39,212	1,979142	39,463	2,631921	40,053	4,166342	39,699	3,245689	40,139	4,390003	40,731	5,929625	40,939	6,470573
38,462	39,073	1,588581	39,308	2,199574	40,035	4,089751	39,53	2,776767	39,965	3,907753	40,459	5,192138	40,591	5,535334
38,439	39,088	1,688389	39,346	2,359583	40,068	4,237883	39,567	2,93452	40,023	4,120815	40,534	5,450194	40,66	5,777986
38,486	39,15	1,725303	39,421	2,429455	40,108	4,21452	39,665	3,063452	40,144	4,30806	40,713	5,78652	40,878	6,215247
38,126	38,878	1,972407	39,151	2,688454	39,946	4,773645	39,386	3,304831	39,869	4,571683	40,449	6,092955	40,622	6,546714
38,542	39,069	1,36734	39,312	1,997821	39,914	3,559753	39,526	2,553059	39,953	3,660941	40,457	4,968606	40,638	5,438223
38,423	38,925	1,306509	39,158	1,912917	39,722	3,380788	39,354	2,423028	39,741	3,430237	40,198	4,619629	40,375	5,08029
29,03	29,423	1,353772	29,585	1,911815	29,982	3,279366	29,725	2,394075	30,004	3,35515	30,359	4,578023	30,519	5,129177
28,836	29,254	1,449577	29,439	2,091136	29,883	3,630878	29,592	2,621723	29,899	3,686364	30,243	4,879318	30,356	5,271189
28,879	29,329	1,558226	29,521	2,223069	29,99	3,847086	29,678	2,766716	30,004	3,895564	30,38	5,197548	30,511	5,651165
28,943	29,391	1,54787	29,579	2,197423	30,034	3,769478	29,736	2,739868	30,056	3,845489	30,431	5,141139	30,589	5,68704
28,651	29,114	1,615999	29,314	2,314055	29,819	4,076647	29,481	2,896932	29,82	4,080137	30,218	5,469268	30,372	6,006771
38,474	38,967	1,281385	39,208	1,907782	39,772	3,373707	39,398	2,401622	39,788	3,415293	40,254	4,626501	40,44	5,109944
gem		1,571885		2,220385		3,876911		2,778637		3,897499		5,225497		5,686127
stdv		0,22832		0,260607		0,432757		0,303874		0,386999		0,501072		0,501165
min		1,281385		1,907782		3,279366		2,394075		3,35515		4,578023		5,08029
max		1,979142		2,688454		4,773645		3,304831		4,571683		6,092955		6,546714

houtsoort	**Gindya udu**													
tangential shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
btan wv	btan 94%	Kwv-94%	btan 81%	Kwv-81%	btan al	Kwv-al	btan 65%	Kwv-65%	btan 50%	Kwv-50%	btan 30%	Kwv-30%	btan 0%	Kwv-0%
41,581	41,228	0,848945	40,884	1,676246	40,081	3,607417	40,086	3,595392	39,536	4,918112	38,782	6,73144	37,999	8,614511
40,934	40,735	0,486148	40,5	1,060243	39,909	2,504031	39,89	2,550447	39,267	4,072409	38,482	5,99013	37,806	7,641569
41,13	40,901	0,556771	40,672	1,113542	40,04	2,650134	40,007	2,730367	39,369	4,281546	38,571	6,221736	37,673	8,405057
41,47	41,157	0,754762	40,863	1,463709	40,128	3,236074	40,168	3,139619	39,613	4,477936	38,861	6,291295	38,282	7,687485
40,987	40,699	0,702662	40,399	1,434601	39,644	3,276649	39,601	3,38156	38,999	4,850318	38,197	6,807036	37,417	8,710079
40,806	40,576	0,563643	40,345	1,129736	39,795	2,477577	39,788	2,494731	39,265	3,776405	38,547	5,535951	37,876	7,180317
40,951	40,718	0,568973	40,492	1,120852	39,96	2,419965	39,966	2,405314	39,444	3,680008	38,722	5,443091	37,924	7,391761
30,956	30,724	0,749451	30,512	1,434294	30,056	2,907352	30,037	2,96873	29,644	4,238274	29,099	5,998837	28,44	8,127665
30,545	30,379	0,54346	30,212	1,090195	29,831	2,337535	29,859	2,245867	29,474	3,506302	28,963	5,179244	28,415	6,973318
30,761	30,591	0,552648	30,4	1,173564	30,004	2,460908	29,995	2,490166	29,595	3,790514	29,038	5,601248	28,477	7,424986
30,827	30,645	0,590392	30,472	1,151588	30,025	2,601615	30,042	2,546469	29,65	3,818082	29,094	5,621695	28,512	7,509651
30,759	30,563	0,637212	30,394	1,186645	29,949	2,633376	29,969	2,568354	29,564	3,885042	29,002	5,712149	28,452	7,500244
40,904	40,666	0,58185	40,413	1,200372	39,868	2,53276	39,832	2,620771	39,299	3,923822	38,584	5,671817	37,728	7,764522
gem		0,625917		1,248891		2,741953		2,74906		4,093751		5,908128		7,763936
stdv		0,105842		0,18901		0,394		0,403129		0,439084		0,491809		0,54284
min		0,486148		1,060243		2,337535		2,245867		3,506302		5,179244		6,973318
max		0,848945		1,676246		3,607417		3,595392		4,918112		6,807036		8,710079
radial shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
b rad wv	brad 94%	Kwv-94%	brad 81%	Kwv-81%	brad al	Kwv-al	b rad 65%	Kwv-65%	brad 50%	Kwv-50%	brad 30%	Kwv-30%	brad 0%	Kwv-0%
40,896	40,736	0,391236	40,534	0,885172	40,053	2,061326	40,068	2,024648	39,693	2,941608	39,136	4,303599	38,453	5,973689
40,632	40,537	0,233806	40,395	0,583284	40,028	1,486513	40,026	1,491435	39,606	2,525103	39,04	3,918094	38,475	5,308624
40,653	40,554	0,243524	40,411	0,595282	40,056	1,468526	40,044	1,498044	39,619	2,543478	39,041	3,965267	38,415	5,505129
40,878	40,766	0,273986	40,593	0,697197	40,114	1,868976	40,133	1,822496	39,716	2,842605	39,108	4,329957	38,515	5,780615
40,632	40,507	0,307639	40,327	0,75064	39,875	1,863064	39,853	1,917208	39,432	2,953337	38,815	4,471845	38,169	6,061725
40,638	40,514	0,305133	40,338	0,738225	39,909	1,793887	39,938	1,722526	39,565	2,640386	39,028	3,961809	38,498	5,266007
40,365	40,234	0,324539	40,076	0,715967	39,711	1,620216	39,734	1,563235	39,395	2,403072	38,887	3,661588	38,409	4,845782
30,52	30,41	0,360419	30,264	0,838794	29,978	1,775885	30,003	1,693971	29,76	2,49017	29,387	3,71232	29,007	4,957405
30,404	30,319	0,279568	30,197	0,680831	29,912	1,618208	29,928	1,565583	29,653	2,47007	29,256	3,775819	28,845	5,127615
30,496	30,399	0,318075	30,268	0,747639	29,962	1,751049	29,971	1,721537	29,679	2,67904	29,254	4,072665	28,834	5,449895
30,582	30,469	0,369498	30,335	0,807665	30,023	1,827873	30,044	1,759205	29,766	2,668236	29,342	4,054673	28,925	5,41822
30,325	30,229	0,31657	30,083	0,798021	29,772	1,823578	29,779	1,800495	29,464	2,839242	29,016	4,31657	28,552	5,846661
40,438	40,307	0,323953	40,134	0,751768	39,765	1,664276	39,766	1,661803	39,418	2,52238	38,918	3,758841	38,455	4,903803
gem		0,311381		0,73773		1,74026		1,710938		2,655287		4,023311		5,418859
stdv		0,046231		0,086814		0,165055		0,158943		0,185515		0,264603		0,405214
min		0,233806		0,583284		1,468526		1,491435		2,403072		3,661588		4,845782
max		0,391236		0,885172		2,061326		2,024648		2,953337		4,471845		6,061725

houtsoort	**Pakoeli**													
tangential swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
btan 0%	btan 30%	Z0-30	btan 50%	Z0-50	btan al	Z0-al	btan 65%	Z0-65	btan 81%	Z0-81	btan 94%	Z0-94	btan wv	Z0-wv
28,506	29,15	2,259174	29,341	2,929208	29,94	5,03052	29,564	3,711499	29,968	5,128745	30,563	7,216025	30,851	8,226338
28,131	28,89	2,698091	29,126	3,537023	29,857	6,13558	29,384	4,454161	29,92	6,359532	30,762	9,352671	31,151	10,73549
28,272	29,088	2,886248	29,32	3,706848	30,055	6,306593	29,579	4,622949	30,112	6,508206	30,94	9,436899	31,371	10,96138
28,597	29,28	2,388362	29,487	3,112215	30,081	5,189356	29,691	3,825576	30,115	5,308249	30,743	7,504284	31,05	8,577823
28,479	29,093	2,155975	29,334	3,002212	29,908	5,017732	29,528	3,683416	30,075	5,604129	30,63	7,552934	31,056	9,048773
28,315	29,031	2,528695	29,24	3,26682	29,885	5,544764	29,451	4,012008	29,873	5,502384	30,509	7,748543	30,892	9,101183
28,595	29,196	2,101766	29,426	2,906102	30,027	5,007869	29,652	3,69645	30,121	5,336597	30,85	7,885994	31,29	9,424725
gem		2,431187		3,208633		5,461773		4,000866		5,678263		8,099621		9,439386
stdv		0,289686		0,311168		0,553476		0,387404		0,539286		0,909338		1,039012
min		2,101766		2,906102		5,007869		3,683416		5,128745		7,216025		8,226338
max		2,886248		3,706848		6,306593		4,622949		6,508206		9,436899		10,96138
radial swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
b rad 0%	brad 30%	Z0-30	brad 50%	Z0-50	brad al	Z0-al	brad 65%	Z0-65	brad 81%	Z0-81	b rad 94%	Z0-94	b rad wv	Z0-wv
29,229	29,619	1,334291	29,752	1,789319	30,109	3,010709	29,875	2,210134	30,102	2,98676	30,425	4,091827	30,558	4,546854
29,171	29,508	1,155257	29,637	1,597477	30,074	3,09554	29,778	2,080834	30,037	2,968702	30,415	4,264509	30,582	4,836996
29,111	29,534	1,453059	29,671	1,923671	30,072	3,301158	29,802	2,373673	30,057	3,249631	30,418	4,489712	30,574	5,025592
29,072	29,481	1,406852	29,619	1,881535	29,981	3,12672	29,742	2,304623	29,983	3,133599	30,319	4,289351	30,471	4,81219
28,9	29,315	1,435986	29,461	1,941176	29,863	3,33218	29,596	2,408304	29,856	3,307958	30,234	4,615917	30,439	5,32526
28,939	29,362	1,461695	29,51	1,973116	29,925	3,407167	29,643	2,432703	29,905	3,338056	30,275	4,616607	30,46	5,255883
29,218	29,538	1,095215	29,672	1,553837	30,004	2,690123	29,786	1,944007	30,018	2,738038	30,352	3,881169	30,517	4,44589
gem		1,334622		1,80859		3,137656		2,250611		3,103249		4,321299		4,892666
stdv		0,150086		0,169829		0,243414		0,182827		0,217731		0,274769		0,333042
min		1,095215		1,553837		2,690123		1,944007		2,738038		3,881169		4,44589
max		1,461695		1,973116		3,407167		2,432703		3,338056		4,616607		5,32526
tangential shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
btan wv	btan 94%	Kwv-94%	btan 81%	Kwv-81%	btan al	Kwv-al	btan 65%	Kwv-65%	btan 50%	Kwv-50%	btan 30%	Kwv-30%	btan 0%	Kwv-0%
30,799	30,713	0,27923	30,487	1,01302	29,964	2,711127	29,988	2,633202	29,623	3,818306	29,179	5,259911	28,639	7,013215
31,016	30,896	0,386897	30,572	1,431519	29,884	3,649729	29,887	3,640057	29,449	5,052231	28,895	6,838406	28,371	8,527857
31,241	31,084	0,502545	30,774	1,494831	30,086	3,697065	30,082	3,709868	29,64	5,124676	29,066	6,962005	28,559	8,584872
30,942	30,841	0,326417	30,603	1,095598	30,059	2,853726	30,099	2,724452	29,718	3,955788	29,208	5,604033	28,692	7,27167
31,034	30,779	0,821679	30,522	1,649803	29,922	3,583167	29,968	3,434942	29,579	4,688406	29,088	6,270542	28,545	8,020236
30,912	30,681	0,747283	30,453	1,48486	29,908	3,24793	29,924	3,19617	29,529	4,473991	29,019	6,123835	28,487	7,84485
31,143	30,947	0,629355	30,638	1,621552	30,006	3,650901	30,061	3,474296	29,678	4,704107	29,172	6,32887	28,715	7,796295
gem		0,527629		1,398741		3,341949		3,258998		4,545358		6,198229		7,865571
stdv		0,21122		0,248689		0,412232		0,429555		0,503237		0,612987		0,586571
min		0,27923		1,01302		2,711127		2,633202		3,818306		5,259911		7,013215
max		0,821679		1,649803		3,697065		3,709868		5,124676		6,962005		8,584872
radial shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
b rad wv	brad 94%	Kwv-94%	brad 81%	Kwv-81%	brad al	Kwv-al	b rad 65%	Kwv-65%	brad 50%	Kwv-50%	brad 30%	Kwv-30%	brad 0%	Kwv-0%
30,509	30,467	0,137664	30,353	0,511325	30,087	1,383198	30,103	1,330755	29,886	2,04202	29,573	3,067947	29,178	4,362647
30,469	30,459	0,03282	30,325	0,472612	30,037	1,417835	30,05	1,375168	29,821	2,126752	29,499	3,183564	29,091	4,52263
30,479	30,477	0,006562	30,35	0,423242	30,061	1,371436	30,077	1,318941	29,847	2,073559	29,521	3,143148	29,107	4,50146
30,389	30,355	0,111883	30,236	0,503472	29,963	1,401823	29,987	1,322847	29,763	2,059956	29,439	3,126131	29,07	4,340386
30,427	30,314	0,371381	30,175	0,828212	29,865	1,847044	29,883	1,787886	29,643	2,576659	29,312	3,664508	28,97	4,78851
30,438	30,342	0,315395	30,221	0,712925	29,929	1,672252	29,946	1,616401	29,701	2,421315	29,36	3,541626	29,021	4,655365
30,433	30,403	0,098577	30,278	0,509316	30,014	1,376795	30,03	1,32422	29,82	2,014261	29,528	2,973746	29,155	4,199389
gem		0,153469		0,565872		1,495769		1,43946		2,187789		3,242953		4,481484
stdv		0,138345		0,146944		0,18785		0,187111		0,219936		0,257277		0,200083
min		0,006562		0,423242		1,371436		1,318941		2,014261		2,973746		4,199389
max		0,371381		0,828212		1,847044		1,787886		2,576659		3,664508		4,78851

houtsoort	**Kimboto**													
tangential swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
btan 0%	btan 30%	Z0-30	btan 50%	Z0-50	btan al	Z0-al	btan 65%	Z0-65	btan 81%	Z0-81	btan 94%	Z0-94	btan wv	Z0-wv
28,272	29,111	2,9676	29,4	3,989813	30,075	6,377334	29,684	4,994341	30,286	7,123656	31,322	10,78806	32,51	14,9901
28,179	28,973	2,817701	29,268	3,86458	29,924	6,192555	29,543	4,840484	30,141	6,962632	31,182	10,65687	32,096	13,90042
28,169	29,014	2,999751	29,352	4,199652	29,961	6,361603	29,632	5,193653	30,285	7,511804	31,387	11,42391	32,135	14,07931
28,132	28,967	2,96815	29,269	4,041661	29,825	6,018058	29,537	4,994313	30,165	7,226646	31,269	11,151	31,847	13,2056
28,133	29,05	3,259517	29,317	4,208581	29,909	6,312871	29,591	5,182526	30,18	7,276153	31,117	10,60676	31,495	11,95038
gem		3,002544		4,060857		6,252484		5,041063		7,220178		10,92532		13,62516
stdv		0,160167		0,145797		0,14974		0,148236		0,202403		0,35068		1,132033
min		2,817701		3,86458		6,018058		4,840484		6,962632		10,60676		11,95038
max		3,259517		4,208581		6,377334		5,193653		7,511804		11,42391		14,9901
radial swelling														
ovendroo	0,3		0,5		al		0,65		0,81		0,94		waterverzadigd	
b rad 0%	brad 30%	Z0-30	brad 50%	Z0-50	brad al	Z0-al	brad 65%	Z0-65	brad 81%	Z0-81	b rad 94%	Z0-94	b rad wv	Z0-wv
29,051	29,456	1,3941	29,637	2,017142	30,002	3,273553	29,787	2,533476	30,091	3,579911	30,54	5,125469	30,765	5,899969
29,155	29,583	1,468016	29,757	2,064826	30,106	3,261876	29,898	2,548448	30,173	3,491682	30,564	4,83279	30,76	5,505059
28,859	29,465	2,099865	29,681	2,848332	30,127	4,393777	29,879	3,534426	30,271	4,892754	30,858	6,926782	31,115	7,817319
28,732	29,358	2,178755	29,566	2,902687	29,955	4,256578	29,745	3,525686	30,089	4,722957	30,617	6,560629	30,841	7,340248
28,796	29,366	1,979442	29,556	2,639255	29,922	3,910265	29,711	3,177525	30,039	4,316572	30,486	5,868871	30,636	6,389776
gem		1,824036		2,494448		3,81921		3,063912		4,200775		5,862908		6,590474
stdv		0,366624		0,42581		0,533402		0,498646		0,642885		0,897724		0,96986
min		1,3941		2,017142		3,261876		2,533476		3,491682		4,83279		5,505059
max		2,178755		2,902687		4,393777		3,534426		4,892754		6,926782		7,817319
tangential shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
btan wv	btan 94%	Kwv-94%	btan 81%	Kwv-81%	btan al	Kwv-al	btan 65%	Kwv-65%	btan 50%	Kwv-50%	btan 30%	Kwv-30%	btan 0%	Kwv-0%
32,286	31,414	2,700861	30,888	4,33005	30,081	6,829586	30,07	6,863656	29,657	8,142848	29,097	9,877346	28,292	12,37069
32,115	31,289	2,572007	30,774	4,175619	29,932	6,797447	29,976	6,660439	29,563	7,946442	29,005	9,683948	28,21	12,15943
32,048	31,394	2,040689	30,802	3,887918	29,907	6,680604	29,959	6,518347	29,535	7,841363	28,978	9,579381	28,335	11,58575
31,973	31,393	1,814031	30,829	3,578019	29,876	6,558659	30,024	6,095768	29,619	7,362462	29,114	8,94192	28,35	11,33144
31,495	31,144	1,114463	30,709	2,495634	29,906	5,045245	29,952	4,89919	29,57	6,112081	29,082	7,661534	28,329	10,05239
gem		2,04841		3,693448		6,382308		6,20748		7,481039		9,148826		11,49994
stdv		0,637789		0,728638		0,755019		0,783658		0,817394		0,902403		0,911631
min		1,114463		2,495634		5,045245		4,89919		6,112081		7,661534		10,05239
max		2,700861		4,33005		6,829586		6,863656		8,142848		9,877346		12,37069
radial shrinkage														
waterverz	0,94		0,81		al		0,65		0,5		0,3		ovendroog	
b rad wv	brad 94%	Kwv-94%	brad 81%	Kwv-81%	brad al	Kwv-al	b rad 65%	Kwv-65%	brad 50%	Kwv-50%	brad 30%	Kwv-30%	brad 0%	Kwv-0%
30,758	30,56	0,643735	30,349	1,329735	30,002	2,457897	30,027	2,376617	29,806	3,09513	29,478	4,161519	29,033	5,608297
30,785	30,614	0,555465	30,416	1,198636	30,118	2,16664	30,11	2,192626	29,902	2,86828	29,579	3,917492	29,157	5,28829
31,076	30,877	0,640366	30,603	1,522075	30,146	2,992663	30,143	3,002317	29,849	3,948385	29,448	5,238769	28,829	7,23066
30,845	30,665	0,583563	30,392	1,468633	29,983	2,794618	29,977	2,81407	29,72	3,647269	29,359	4,817637	28,707	6,931431
30,617	30,559	0,189437	30,294	1,054969	29,917	2,286312	29,929	2,247118	29,699	2,998334	29,363	4,095764	28,776	6,012999
gem		0,522513		1,31481		2,539626		2,52655		3,311479		4,446236		6,214336
stdv		0,189958		0,192261		0,346493		0,360933		0,463599		0,558908		0,838529
min		0,189437		1,054969		2,16664		2,192626		2,86828		3,917492		5,28829
max		0,643735		1,522075		2,992663		3,002317		3,948385		5,238769		7,23066