

# 九州大学演習林に生育する95樹種の生材含水率, 飽和率と 容積密度

誌名	九州大学農学部演習林報告 = Bulletin of the Kyushu University Forest
ISSN	04530284
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巻/号	92号
掲載ページ	p. 33-44
発行年月	2011年3月

## Green moisture content and basic density of 95 woody species growing in Kyushu University Forests, Japan

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We investigated the green moisture content and basic density of 95 woody species growing in Kyushu University Forests. In softwood species, the green moisture content of heartwood ranged from 28% in *Cryptomeria japonica* to 67% in *Abies firma*, and in sapwood, from 75% in *Tsuga sieboldii* to 160% in *Cryptomeria japonica*. The green moisture content of softwood trees was greater in sapwood than heartwood. The green moisture content in the heartwood of hardwood species ranged from 34% in *Euonymus alatus* f. *striatus* to 83% in *Kalopanax pictus*, and in sapwood, from 45% in *Fraxinus sieboldiana* to 153% in *Actinidia polygama*. We found three radial variation pattern types in stems of hardwood species. The green moisture content was higher in heartwood than sapwood, in the first type, whereas in the second, it was higher in sapwood than heartwood. In a third type, differences between heartwood and sapwood were relatively small. The basic density of softwood species ranged from 378 kg/m<sup>3</sup> in *Cryptomeria japonica* to 524 kg/m<sup>3</sup> in *Tsuga sieboldii*. Most trees tended to decrease in basic density from corewood to outerwood. Basic density in hardwood species ranged from 266 kg/m<sup>3</sup> in *Paulownia tomentosa* to 751 kg/m<sup>3</sup> in *Rhaphiolepis indica* var. *umbellata*. We identified three types of radial variation pattern in stems of hardwood species. In the first type, basic density was higher in corewood than outerwood, whereas in second, it was higher in outerwood. In the third type, differences between corewood and outerwood were small. We also provided the information on the age and size of heartwood formation.

**Keyword :** green moisture content; basic density; Kyushu University Forests; Japan

国内に生育する樹木の木材性質に関するデータベースを作成する一環として、九州大学演習林（北海道演習林、宮崎演習林、福岡演習林）に生育するつる性木本植物3樹種を含む95樹種の生材含水率および容積密度数を測定した。針葉樹の生材含水率は辺材が心材よりも大きく、心材ではスギの28%からモミの67%の範囲にあり、辺材ではツガの75%からスギの160%の範囲にあった。一方、広葉樹の生材含水率は、心材ではヌルデの34%からハリギリの83%の範囲にあり、辺材ではアオダモの45%からマタタビの153%の範囲にあった。樹幹半径方向の生材含水率のバラツキについては、辺材よりも心材が高いタイプ、心材よりも辺材が高いタイプ、心材と辺材にほとんど差がないタイプの3タイプが認められた。針葉樹材の容積密度数は、スギの378 kg/m<sup>3</sup>からツガの524 kg/m<sup>3</sup>の範囲にあり、樹幹半径方向の変動では、中心部が外周部よりも高かった。広葉樹材の容積密度数は、キリの266 kg/m<sup>3</sup>からシャリンバイの751 kg/m<sup>3</sup>の範囲にあり、樹幹半径方向の変動では、外周部よりも中心部が高いタイプ、中心部よりも外周部が高いタイプ、中心部と外側部にはほとんど差がないタイプの3タイプが認められた。最後に心材形成を開始する樹齢やサイズに係わる情報について記載した。

**キーワード：**生材含水率、容積密度数、九州大学演習林、日本

### 1. Introduction

Wood moisture strongly affects wood quality characteristics, including physical and mechanical properties, dimensional stability, machining, drying performance, adhesion properties, durability, burning characteristics, and transport efficiency (e.g., Watanabe 1978; Fushitani *et al.* 1989; Forestry and Forest Products

Research Institute 2004). Thus, wood moisture content is of concern to foresters, wood processors, and users at every stage from standing trees to the service performance of various wood products.

Living trees contain a large amount of water in their stems, because they transport water from the soil to their leaves via their stems, and also store some water in their stems (Tyree & Zimmermann 2002). Previous studies

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reported wood moisture content (green moisture content) of living trees growing in Japan. For example, Yazawa *et al.* (1965) reported interspecies variation in green moisture content distribution in the stems of nine hardwood species. Nakada (2006) investigated water distribution in the stems of 11 softwood species. Kawazumi *et al.* (1991) and Nakada *et al.* (1999) reported intraspecies variation in green moisture content in the stems of *Cryptomeria japonica*. Previous studies also have reported seasonal variations in *Fagus crenata* (Yazawa 1960), and *Fraxinus mandshurica* var. *japonica*, *Ulmus davidiana*, and *Populus maximowiczii* trees (Yazawa & Ishida 1965). Kano (1987), Miyajima (1992), and Forestry and Forest Products Research Institute (2004) documented the green moisture content for 27 species (14 softwood species and 13 hardwood species), 25 species (9 softwood species and 16 hardwood species), and 15 species (9 softwood species and 6 hardwood species), respectively. However, previous reports were mainly focused on commercial woody species. Thus, data from many woody species are required to determine green moisture content in various woody species growing in Japan. These data should be supplemented with additional information, because green moisture content varies with a number of factors, e.g., seasons, site conditions, geographical locations, inter-tree variation, and intra-tree variation (Gibbs 1958; Yazawa 1960; Forestry and Forest Products Research Institute 2004).

Wood density (or specific gravity) is an important characteristics of wood, which is strongly correlated with physical properties, mechanical properties, burning characteristics, biomass, and carbon stocking (Watanabe 1978; Zobel & van Buitjenen 1989; Zhang 1997; Niklas 1997; Forestry and Forest Products Research Institute 2004). There are many previous investigations of wood density. Basic density data for woody species growing in Japan are summarized and listed in several reports and books (Nakai & Yamai 1982; Forestry and Forest Products Research Institute 2004). However, as with green moisture content, these data were mainly focused on commercial woody species. Data from many wood species are required to determine the basic density of various woody species growing in Japan. These data should be supplemented with additional information, for the same reasons as noted for variability in moisture content (Zobel & van Buitjenen 1989).

We aimed to provide data on green moisture content and basic density for 95 woody species, including three woody lianas, which were investigated in Kyushu University Forests between 2003 and 2006, as part of a project to develop wood properties database.

## 2. Materials and methods

Wood samples were collected from three Kyushu University sites, which ranged from warm temperate forest

to cool temperate forest, i.e., Kasuya Research Forest, Shiiba Research Forest, and Ashoro Research Forest (Table 1 and Fig.1).



Fig.1 Location of sampling site

We sampled two to four trees for each of 95 species from three sites, comprised of five softwood species and 90 hardwood species. A total of 204 trees were cut down during July and August between 2003 and 2006, i.e., 35 species in Kasuya Research Forest, 58 species in Shiiba Research Forest, and nine species in Ashoro Research Forest. Table 2 shows species name, age, height, and diameter at breast height (DBH) for the trees sampled. DBH, tree height, and tree age ranged from 1 cm to 10 cm, 2 m to 12 m, and one year to 123 years, respectively.

We cut a short log (about 20 cm length) at breast height from each sample tree and vaseline was applied immediately to the cut sections at both ends, to prevent desiccation. Logs were wrapped in plastic and taken to the laboratory. A wood disc (3 cm thickness) was cut from the middle of each log immediately samples arrived in the laboratory. A wedge spanning from pith to bark was removed from the wood disc. The wedge was separated into inner sapwood and outer sapwood. If the wedge contained colored heartwood, it was separated into heartwood and sapwood based on visual demarcation. The heartwood and sapwood blocks were then separated into inner and outer sections. We did not separate the intermediate wood, which was usually recognized as a pale colored zone between the sapwood and heartwood. If heartwood was found in the stem, we regarded heartwood and sapwood as corewood and outerwood, respectively. When heartwood was not present in the stem, inner sapwood and outer sapwood were regarded as corewood

Table 1 Description of sampling sites.

	Kasuya Research Forest	Shiiba Research Forest	Ashoro Research Forest
Forest area	481ha	2916 ha	3713 ha
Latitude	33° 38'N	32° 22'N	43° 14'N
Longitude	130° 31'E	131° 08'E	143° 33'E
Altitude	30 m - 553 m	650 m - 1607 m	100 m - 450 m
Annual average temperature	16.2°C	12.9°C	6.0°C
Warmth Index	134.9	101.6	60.0
Annual average precipitation	1599 mm	3356 mm	749 mm
Forest type*	WTF	ITF	CTF

\*WTF: warm temperate forest, ITF: intermediate temperate forest, CTF: cool temperate forest

and outerwood, respectively. We measured the green weight and volume of each block were measured before reweighting after drying the blocks in a 105°C oven until constant weight. Green volume was determined by the water displacement method.

Green moisture content (GMC) was calculated using formula 1.

$$GMC(\%) = \frac{\text{Green weight(g)} - \text{Over dry weight(g)}}{\text{Oven dry weight(g)}} \times 100 \quad (1)$$

Basic density (BD) was calculated using formula 2.

$$BD(\text{kg/m}^3) = \frac{\text{Oven dry weight(kg)}}{\text{Green volume(m}^3\text{)}} \quad (2)$$

### 3. Results and discussion

Table 3 shows the green moisture content and basic density values of heartwood and sapwood for each sample tree.

#### 3. 1. Green moisture content

Average green moisture content for heartwood in softwood species ranged from 28% in *Chamaecyparis obtusa* to 67% in *Abies firma*. The minimum and maximum values for individual trees were 28% in *Chamaecyparis obtusa* (tree nos. 3 & 4) and 95% in *Abies firma* (tree no. 2), respectively. Average green moisture content for sapwood ranged from 75% in *Tsuga sieboldii* to 160% in *Cryptomeria japonica*. The minimum and maximum values for individual tree were 28% in *Tsuga sieboldii* (tree no. 14) and 202% in *Cryptomeria japonica* (tree no. 8).

It is well known that the green moisture content of softwood species is generally high in sapwood and low in heartwood (e.g, Fushitani *et al.* 1989). However the heartwood of some species also has high moisture content, including *Cryptomeria japonica* and *Abies sachalinensis* (Kano 1987; Kawazumi *et al.* 1991; Nakada *et al.* 1999; Forestry and Forest Products Research Institute 2004; Nakada 2006). Our study found that the green moisture content of sapwood was higher than that of heartwood in all softwood trees. The heartwood of *Abies firma* (tree no.2) had a higher moisture content than all other softwood trees.

Our study also showed that the green moisture content of outer sapwood was higher than that of inner sapwood in all softwood trees. This result may be attributable to intermediate wood, because we did not separate intermediate wood from the sapwood and heartwood. Further investigations testing the separation of intermediate wood from sapwood and heartwood are required.

Only 25 tree samples from 12 hardwood species contained heartwood. Average green moisture content in heartwood ranged from 34% of *Euonymus alatus* f. *striatus* to 83% in *Quercus crispula*. The minimum and maximum values for individual tree were 30% in *Rhus javanica* var. *roxburghii* (tree no.57) and 90% in *Kalopanax pictus* (tree no.32). Average green moisture content of sapwood ranged from 45% in *Fraxinus sieboldiana* to 153% in *Actinidia polygama*. The minimum and maximum values for individual trees were 45% in *Fraxinus sieboldiana* (tree no.27) and 159% in *Actinidia polygama* (tree no.15).

The difference in green moisture content between the heartwood and sapwood was relatively small in hardwood species (2% to 46%) compared with softwood species (31% to 95%). This result agreed with previous reports (Kano

1987; Fushitani *et al.* 1989).

Yazawa *et al.* (1965) studied radial variation in green moisture content in the stem of nine hardwood species and reported three types of distribution pattern. In the first type, the moisture content was higher in the heartwood than sapwood. In the second type, the moisture content was higher in the sapwood than in heartwood. In the third type, only small differences in moisture contents were detected in the sapwood and heartwood. We found the following species belong to the first type: *Castanea crenata*, *Fraxinus mandshurica* var. *japonica*, *Kalopanax pictus*, *Maackia amurensis* subsp. *buergeri*, *Phellodendron amurense*, and *Quercus crispula*. *Rhus javanica* var. *roxburghii* and *Euonymus alatus* f. *striatus* were of the second type, whereas *Morus australis* belonged to the third type. The attribution of *Fraxinus mandshurica* var. *japonica* to type 1 agreed with the results of Yazawa *et al.* (1965), but our classification of *Morus australis* as type 3 was not agreement.

The outer sapwood had a higher green moisture content than the inner sapwood in the majority of the 173 hardwood trees tested. This finding may be attributed to the fact that the region involved in water transport does not include the entire sapwood in broad-leaved species (Umebayashi *et al.* 2007; 2010).

Our study was limited by the short sampling season (July to August) and limits on sampling, i.e., low sample number per species, small tree size, and restriction of tree sampling mainly to Kasuya Forest and Shiiba Forest. Further green moisture content data collection is required.

### 3.2. Basic density

The basic density of whole stems showed large interspecies variations, especially in hardwood species. In softwood species, the mean basic density ranged from 378 kg/m<sup>3</sup> in *Cryptomeria japonica* to 524 kg/m<sup>3</sup> in *Tsuga sieboldii*. The minimum and maximum values for individual trees were 326 kg/m<sup>3</sup> in *Cryptomeria japonica* (tree no. 8) and 536 kg/m<sup>3</sup> in *Tsuga sieboldii* (tree no. 13). In contrast, the mean basic density of hardwood species ranged from 266 kg/m<sup>3</sup> in *Paulownia tomentosa* to 725 kg/m<sup>3</sup> in *Rhaphiolepis indica* var. *umbellata*. The minimum and maximum values for individual trees were 251 kg/m<sup>3</sup> in

*Zanthoxylum ailanthoides* (tree no. 191) and 751 kg/m<sup>3</sup> in *Rhaphiolepis indica* var. *umbellata* (tree no. 163).

Numerous reports indicate that basic density varies with radial variations from the pith to bark in the stem of woody species (Fushitani *et al.* 1989; Zobel & Sprague 1998). In all but one of softwood trees (tree no. 1), basic density tended to decrease from corewood to outerwood. We observed three types of radial variation patterns in the basic density of hardwood species. In the first type, basic density was higher in corewood than outerwood (e.g., *Kalopanax pictus* and *Maackia amurensis* subsp. *buergeri*). In the second type, basic density was higher in outerwood than corewood (e.g., *Betula grossa* and *Litsea acuminata*). Only small differences in the basic density of corewood and outerwood were detected in the third type (e.g., *Magnolia obovata* and *Dendropanax trifidus*). Further basic density data are required to determine radial variation patterns for each species.

### 3.3. Information on the age and size of heartwood formation

It is well known that heartwood formation begins after trees reach a certain age or size (Watanabe 1978). However, there is little information on the starting size and age of heartwood formation for woody species growing in Japan. We derived data on the age and size of heartwood formation from the presence or absence of heartwood (Table 3), tree age and DBH (Table 2). Heartwood was observed in the stems of three species of five softwood species (16 trees) and 12 of 90 hardwood species (26 trees). Among the softwood species, the smallest size and ring number (cambial age) for a stem containing heartwood was 6 cm and seven growth rings in *Chamaecyparis obtuse* (tree no. 3). Among the hardwood species, this was 4 cm in *Euonymus alatus* f. *striatus* (tree no. 104) and seven growth rings in *Rhus javanica* var. *roxburghii* (tree nos. 55, 56 and 57). In contrast, the largest size and ring number for a hardwood species stem containing no heartwood was 9 cm in *Chamaecyparis obtuse* (trees no. 6) and 11 growth rings in *Pinus densiflora* (tree no. 11), whereas among the hardwood species, this was 10 cm in *Ilex crenata* var. *fukasawana* (tree no. 120) and 80 growth rings in *Fraxinus sieboldiana* (tree no. 27).

Table 2 Description of sample trees.

Japanese common name (Scientific name)	Tree no.	Tree age (year)	DBH (cm)	Tree height (m)	Sampling date	Sampling site*	Japanese common name (Scientific name)	Tree no.	Tree age (year)	DBH (cm)	Tree height (m)	Sampling date	Sampling site*						
<b>Softwood</b>																			
Momi ( <i>Abies firma</i> )	1	69	8.9	7.8	2004/7/16	S	Nogurumi ( <i>Platycarya strobilacea</i> )	43	4	3.0	3.8	2005/8/8	K						
	2	26	9.0	5.9	2004/7/16	S		44	5	2.5	3.7	2005/8/8	K						
Hinoki ( <i>Chamaecyparis obtusa</i> )	3	8	6.2	4.7	2005/8/30	S	Kunugi ( <i>Quercus acutissima</i> )	45	20	6.8	7.6	2003/8/19	S						
	4	7	5.7	4.1	2005/8/30	S		46	20	7.3	6.2	2003/8/19	S						
	5	10	7.5	5.6	2005/8/26	K	Abemaki ( <i>Quercus variabilis</i> )	47	18	6.8	7.5	2003/8/19	S						
	6	10	8.6	6.0	2005/8/26	K		48	20	9.3	8.2	2003/8/19	S						
Sugi ( <i>Cryptomeria japonica</i> )	7	5	2.8	3.3	2005/8/25	S		49	22	6.5	6.1	2005/8/10	K						
	8	8	3.7	4.7	2005/8/25	S		50	16	5.5	4.4	2005/8/10	K						
	9	10	3.5	4.1	2005/8/26	K	Mizunara ( <i>Quercus crispula</i> )	51	27	7.0	9.2	2003/8/22	S						
	10	10	8.1	5.9	2005/8/26	K		52	23	5.5	8.8	2003/8/22	S						
Akamatsu ( <i>Pinus densiflora</i> )	11	11	4.6	4.4	2004/8/24	S		53	44	9.8	11.1	2004/8/12	A						
	12	9	4.8	4.2	2004/8/24	S		54	41	9.7	8.8	2004/8/12	A						
Tsuga ( <i>Tsuga sieboldii</i> )	13	76	7.5	7.3	2004/8/24	S	Nurude ( <i>Rhus javanica</i> var. <i>roxburghii</i> )	55	7	6.4	5.1	2004/8/31	S						
	14	76	8.2	10.0	2004/8/24	S		56	7	6.4	7.8	2004/8/31	S						
<b>Hardwood</b>																			
<b>Ring-porous wood</b>																			
Matatabi ( <i>Actiniaria polygama</i> )	15	12	1.9	8.3	2004/7/16	S	Yamaurushi ( <i>Toxicodendron trichocarpum</i> )	59	33	4.7	4.7	2004/8/7	A						
	16	9	2.0	10.9	2004/7/16	S		60	43	6.4	6.0	2004/8/7	A						
Urinoki ( <i>Alangium platanifolium</i> var. <i>trilobum</i> )	17	22	2.3	4.4	2003/8/10	S	Kurozuru ( <i>Tripterygium regelii</i> )	61	10	5.8	9.4	2004/8/31	S						
	18	25	4.4	7.3	2003/8/10	S		62	11	6.4	7.9	2004/8/31	S						
Taranoki ( <i>Aralia elata</i> )	19	4	3.5	2.8	2004/7/16	S	Yamafuji ( <i>Wisteria brachybotrys</i> )	63	19	2.5	9.2	2003/7/25	S						
	20	4	4.9	2.7	2004/7/16	S		64	22	3.5	11.5	2003/7/25	S						
Kuri ( <i>Castanea crenata</i> )	21	20	5.8	6.9	2005/8/22	K	Inuzansho ( <i>Zanthoxylum schinifolium</i> )	65	7	3.3	4.8	2004/7/7	S						
	22	18	5.7	4.1	2005/8/22	K		66	10	2.5	4.5	2004/7/7	S						
Aodamo ( <i>Fraxinus lamuginosa</i> f. <i>serrata</i> )	23	23	5.7	5.8	2004/8/9	A	<b>Semi-ring-porous wood</b>												
	24	35	6.0	8.1	2004/8/9	A	Kakuremino ( <i>Dendropanax trifidus</i> )	67	23	3.5	5.1	2006/7/28	K						
Yachidamo ( <i>Fraxinus mandshurica</i> var. <i>japonica</i> )	25	22	6.4	7.8	2003/8/13	A		68	36	5.5	6.8	2006/7/28	K						
	26	10	4.9	8.7	2003/8/13	A	Nawashirogumi ( <i>Elaeagnus pungens</i> )	69	10	4.7	5.2	2005/8/16	K						
Marubaodamo ( <i>Fraxinus sieboldiana</i> )	27	80	7.5	11.1	2003/8/31	S		70	9	1.1	2.2	2005/8/16	K						
	28	34	4.7	10.2	2003/8/31	S	<b>Diffuse-porous wood</b>												
Harigiri ( <i>Kalopanax pictus</i> )	29	60	5.8	5.8	2003/8/25	S	Chidorinoki ( <i>Acer carpinifolium</i> )	71	26	6.0	5.5	2003/8/22	S						
	30	15	4.7	4.9	2003/8/25	S		72	21	5.6	6.1	2003/8/22	S						
	31	48	9.7	11.5	2004/8/12	A	Irohamomiji ( <i>Acer palmatum</i> )	73	31	4.5	5.3	2003/7/30	S						
	32	69	8.3	10.3	2004/8/12	A		74	23	3.3	3.5	2003/7/30	S						
Inuenju ( <i>Maackia amurensis</i> subsp. <i>buergeri</i> )	33	51	7.9	7.4	2004/8/12	A	Itayakaede ( <i>Acer pictum</i> subsp. <i>dissectum</i> )	75	29	7.2	5.9	2003/7/31	S						
	34	52	9.8	8.7	2004/8/12	A		76	33	7.2	7.0	2003/7/31	S						
Yamaguwa ( <i>Morus australis</i> )	35	48	5.4	7.5	2004/8/25	S	Ezoitaya ( <i>Acer pictum</i> subsp. <i>mono</i> f. <i>mono</i> )	77	28	6.2	8.2	2004/8/11	A						
	36	33	5.5	7.4	2004/8/25	S		78	32	6.8	9.4	2004/8/11	A						
Kiri ( <i>Paulownia tomentosa</i> )	37	1	4.2	5.5	2005/8/17	K	Enkoukaede ( <i>Acer pictum</i> subsp. <i>dissectum</i> f. <i>dissectum</i> )	79	21	7.6	6.6	2003/8/1	S						
	38	3	5.1	5.0	2005/8/17	K		80	15	6.8	5.5	2003/8/1	S						
Kihada ( <i>Phellodendron amurense</i> )	39	21	9.4	8.3	2004/7/16	S	Kohauchiwakaede ( <i>Acer sieboldianum</i> )	81	57	9.7	9.4	2003/7/22	S						
	40	19	8.6	6.5	2004/7/16	S		82	54	9.0	6.8	2003/7/22	S						
Kobannoki ( <i>Phyllanthus flexuosus</i> )	41	9	3.9	2.3	2005/8/30	K	Yashabushi ( <i>Ahnus firma</i> )	83	5	2.9	4.0	2005/8/28	K						
	42	9	2.4	2.4	2005/8/30	K		84	8	6.8	5.0	2005/8/28	K						

\* S: Shiiba Research Forest, K: Kasuya Research Forest, A: Ashoro Research Forest

Table 2 (Continued)

Japanese common name (Scientific name)	Tree no.	Tree age (year)	DBH (cm)	Tree height (m)	Sampling date	Sampling site*	Japanese common name (Scientific name)	Tree no.	Tree age (year)	DBH (cm)	Tree height (m)	Sampling date	Sampling site*
<b>Diffuse-porous wood</b>													
Mukunoki ( <i>Aphananthe aspera</i> )	85	12	1.8	4.3	2005/7/19	K	Nezumimochi ( <i>Ligustrum japonicum</i> )	129	26	3.0	3.3	2005/8/23	K
	86	10	5.5	5.6	2005/7/19	K		130	29	2.5	3.2	2005/8/23	K
Mizume ( <i>Betula grossa</i> )	87	23	8.6	9.5	2003/8/22	S	Kanakuginoki ( <i>Lindera erythrocarpa</i> )	131	21	5.6	7.0	2003/8/4	S
	88	20	6.8	8.0	2003/8/22	S		132	29	9.7	6.3	2003/8/4	S
Yabutsubaki ( <i>Camellia japonica</i> )	89	61	7.8	6.0	2003/8/22	S	Aburachan ( <i>Lindera praecox</i> )	133	14	3.8	5.5	2003/8/1	S
	90	33	5.0	5.8	2003/8/22	S		134	19	2.6	4.0	2003/8/1	S
	91	15	2.6	3.4	2005/8/28	K	Shiromoji ( <i>Lindera triloba</i> )	135	27	6.0	6.9	2003/8/9	S
	92	18	2.3	3.3	2005/8/28	K		136	15	2.9	5.2	2003/8/9	S
Akashide ( <i>Carpinus laxiflora</i> )	93	11	4.9	6.6	2003/8/27	S	Baribarinoki ( <i>Litsea acuminata</i> )	137	15	3.8	4.9	2005/7/19	K
	94	10	5.1	5.4	2003/8/27	S		138	15	3.8	4.8	2005/7/19	K
Inushide ( <i>Carpinus tschonoskii</i> )	95	11	5.0	6.9	2003/8/27	S	Kagonoki ( <i>Litsea coreana</i> )	139	9	2.8	3.2	2005/8/6	K
	96	10	5.0	4.6	2003/8/27	S		140	9	3.1	4.1	2005/8/6	K
Isunoki ( <i>Distylium racemosum</i> )	97	14	3.9	6.2	2005/8/27	K	Tabunoki ( <i>Machilus thunbergii</i> )	141	13	4.1	4.7	2006/8/3	K
	98	14	3.3	5.5	2005/8/27	K		142	12	3.6	3.5	2006/8/3	K
Yamagaki ( <i>Diospyros kaki</i> var. <i>sylvestris</i> )	99	9	4.9	6.5	2005/8/18	K	Hoonoki ( <i>Magnolia obovata</i> )	143	17	4.8	5.8	2003/8/28	S
	100	9	4.1	4.9	2005/8/18	K		144	17	5.0	5.4	2003/8/28	S
Utsugi ( <i>Deutzia crenata</i> )	101	7	2.5	4.2	2004/8/22	S	Tamushiba ( <i>Magnolia salicifolia</i> )	145	16	4.0	5.2	2003/8/6	S
	102	9	2.9	4.3	2004/8/22	S		146	16	6.3	5.7	2003/8/6	S
Komayumi ( <i>Euonymus alatus</i> f. <i>striatus</i> )	103	57	6.4	5.1	2004/7/16	S	Awabuki ( <i>Meliosma myriantha</i> )	147	16	6.9	6.5	2003/8/4	S
	104	43	4.0	5.0	2004/7/16	S		148	23	7.5	6.0	2003/8/4	S
Fusazakura ( <i>Euptelea polyandra</i> )	105	11	4.0	7.3	2003/8/6	S	Shirodamo ( <i>Neolitsea sericea</i> )	149	28	7.5	6.2	2003/8/20	S
	106	17	4.1	7.4	2003/8/6	S		150	29	8.5	5.9	2003/8/20	S
Hisakaki ( <i>Eurya japonica</i> )	107	28	3.9	3.3	2005/8/11	K		151	8	2.6	3.2	2005/8/25	K
	108	25	2.2	3.6	2005/8/11	K		152	7	3.9	3.3	2005/8/25	K
Buna ( <i>Fagus crenata</i> )	109	19	5.5	6.3	2003/8/19	S	Asebi ( <i>Pieris japonica</i> )	153	9	5.3	5.4	2003/8/5	S
	110	24	6.4	8.2	2003/8/19	S		154	10	6.2	5.4	2003/8/5	S
Inubuna ( <i>Fagus japonica</i> )	111	16	5.6	5.6	2003/8/5	S	Tobera ( <i>Pittosporum tobira</i> )	155	8	3.2	4.2	2006/8/9	K
	112	17	5.2	6.4	2003/8/5	S		156	15	5.6	6.0	2006/8/9	K
Hosobainubiwa ( <i>Ficus erecta</i> f. <i>sieboldii</i> )	113	10	2.5	4.2	2006/7/20	K	Yamanarashū ( <i>Populus sieboldii</i> )	157	36	8.6	8.5	2004/8/12	A
	114	9	3.3	4.0	2006/7/20	K		158	30	7.7	7.3	2004/8/12	A
Nanaminoki ( <i>Ilex chinensis</i> )	115	15	3.2	6.0	2006/8/8	K	Kamatsuka ( <i>Pourthiae villosa</i> var. <i>laevis</i> )	159	32	7.2	7.0	2003/8/6	S
	116	15	3.4	4.9	2006/8/8	K		160	35	4.5	5.2	2003/8/6	S
Inutsuge ( <i>Ilex crenata</i> )	117	10	1.5	2.2	2005/8/13	K	Asagara ( <i>Pterostyrax corymbosa</i> )	161	21	8.5	6.2	2003/7/25	S
	118	12	2.0	2.7	2005/8/13	K		162	21	5.0	5.1	2003/7/25	S
Tsukushinutsuge ( <i>Ilex crenata</i> var. <i>fukasawana</i> )	119	43	6.6	6.2	2004/7/16	S	Sharinbai ( <i>Rhaphiolepis indica</i> var. <i>umbellata</i> )	163	22	3.1	4.9	2003/8/6	K
	120	51	9.9	6.8	2004/7/16	S		164	30	5.2	6.3	2003/8/6	K
Soyogo ( <i>Ilex pedunculosa</i> )	121	38	5.1	5.0	2003/8/22	S	Nekoyanagi ( <i>Salix gracilistyla</i> )	165	25	6.2	5.2	2004/8/23	S
	122	38	5.0	7.0	2003/8/22	S		166	16	3.3	4.0	2004/8/23	S
Kuroganemochi ( <i>Ilex rotunda</i> )	123	10	4.3	4.2	2005/7/22	K	Yamayanagi ( <i>Salix sieboldiana</i> )	167	22	6.0	5.6	2003/8/30	S
	124	11	5.8	3.5	2005/7/22	K		168	23	3.9	4.1	2003/8/30	S
Inuumemodoki ( <i>Ilex serrata</i> f. <i>argutidens</i> )	125	41	3.0	4.1	2004/8/27	S	Shiraki ( <i>Sapium japonicum</i> )	169	17	4.2	6.2	2003/7/31	S
	126	34	2.2	3.8	2004/8/27	S		170	9	3.7	3.9	2003/7/31	S
Shikimi ( <i>Illicium anisatum</i> )	127	18	3.6	3.7	2003/8/22	S	Nankinnanakamado ( <i>Sorbus gracilis</i> )	171	29	1.8	4.9	2003/8/22	S
	128	45	4.6	3.5	2003/8/22	S		172	26	2.0	5.8	2003/8/22	S

Table 2 (Continued)

Japanese common name (Scientific name)	Tree no.	Tree age (year)	DBH (cm)	Tree height (m)	Sampling date	Sampling site*	Japanese common name (Scientific name)	Tree no.	Tree age (year)	DBH (cm)	Tree height (m)	Sampling date	Sampling site*						
<b>Diffuse-porous wood</b>																			
Himeshara ( <i>Stewartia monadelpha</i> )	173	21	6.4	6.1	2003/8/19	S	Karasuzanshou ( <i>Zanthoxylum ailanthoides</i> )	191	10	6.8	4.1	2005/8/8	K						
	174	28	5.8	5.8	2003/8/19	S		192	3	5.1	3.7	2005/8/8	K						
Egonoki ( <i>Styrax japonica</i> )	175	22	5.5	5.5	2003/8/23	S	Fuyuzanshou ( <i>Zanthoxylum armatum</i> var. <i>subtrifoliatum</i> )	193	9	4.0	3.8	2006/8/5	K						
	176	22	6.2	5.8	2003/8/23	S		194	13	3.0	4.6	2006/8/5	K						
Kohakuunboku ( <i>Styrax shiraiana</i> )	177	7	2.9	3.8	2004/7/7	S	<b>Radial-porus wood</b>												
	178	9	3.7	5.8	2004/7/7	S	Sudajii ( <i>Castanopsis sieboldii</i> )	195	22	5.0	4.6	2005/8/27	K						
Kurominosawafutagi ( <i>Symplocos tanakana</i> )	179	21	3.7	5.7	2006/7/31	K	Matebashi ( <i>Lithocarpus edulis</i> )	196	18	3.3	3.6	2005/8/27	K						
	180	14	2.2	3.7	2006/7/31	K	Arakashi ( <i>Quercus glauca</i> )	197	16	4.0	5.5	2006/8/2	K						
Kuroki ( <i>Symplocos lucida</i> )	181	6	2.4	2.9	2005/8/13	K	Shirakashi ( <i>Quercus myrsinæfolia</i> )	198	16	3.3	5.0	2006/8/2	K						
Kumanomizuki ( <i>Swida macrophylla</i> )	183	11	3.7	4.4	2003/8/25	S	Urajirogashi ( <i>Quercus salicina</i> )	199	13	6.2	7.6	2005/8/6	K						
	184	11	7.4	5.2	2003/8/25	S		200	8	5.0	6.3	2005/8/6	K						
Oobabodajyu ( <i>Tilia maximowicziana</i> )	185	34	6.5	7.4	2004/8/11	A		201	16	2.9	5.5	2006/8/9	K						
	186	30	6.0	7.8	2004/8/11	A		202	23	5.9	6.7	2006/8/9	K						
Shashanbo ( <i>Vaccinium bracteatum</i> )	187	18	3.2	4.1	2006/7/29	K		203	24	7.4	7.0	2004/7/16	S						
	188	22	4.1	3.3	2006/7/29	K		204	9	3.5	5.4	2004/7/16	S						
Koyabudemari ( <i>Viburnum plicatum</i> var. <i>parvifolium</i> )	189	23	4.0	5.3	2004/7/16	S	Yamaguruma ( <i>Trochodendron aralioides</i> )	205	85	6.8	5.8	2003/8/22	S						
	190	27	3.9	5.3	2004/7/16	S		206	123	7.0	4.8	2003/8/22	S						

Table 3 Green moisture content and basic density ( $\text{kg/m}^3$ ) of the trees. (-: No observation of heartwood)

Japanese common name (Scientific name)	Tree no.	Green moisture content (%)						Basic density ( $\text{kg/m}^3$ )						Japanese common name (Scientific name)	Tree no.	Green moisture content (%)						Basic density ( $\text{kg/m}^3$ )										
		Heartwood			Sapwood			Heartwood			Sapwood					Heartwood			Sapwood			Heartwood			Sapwood							
		Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All							
<b>Softwood</b>																																
Momi ( <i>Abies firma</i> )	1	42	35	39	43	113	84	61	453	422	438	492	473	481	458	35	68	69	69	65	76	71	70	594	600	597	582	569	574	584		
	2	115	75	95	155	181	167	152	373	356	364	337	309	323	331	36	81	72	76	54	95	75	76	613	580	595	498	486	492	540		
	AVG	79	55	67	99	147	126	106	413	389	401	415	391	402	394	AVG	75	71	73	59	85	73	73	603	590	596	540	527	533	562		
Hinoki ( <i>Chamaecyparis obtusa</i> )	3	32	26	28	100	148	123	78	481	489	486	460	446	453	468	Kiri ( <i>Paulownia tomentosa</i> )	37	-	-	-	68	113	91	91	-	-	-	-	244	283	263	263
	4	36	24	28	92	135	115	81	501	503	502	467	401	430	456	38	-	-	-	72	142	107	107	-	-	-	260	275	269	269		
	5	-	-	-	109	162	131	131	-	-	-	458	387	426	426	AVG	-	-	-	70	127	99	99	-	-	-	252	279	266	266		
	6	-	-	-	123	155	138	138	-	-	-	458	398	428	428	Kihada ( <i>Phellodendron amurense</i> )	39	51	63	57	67	101	87	68	377	398	387	446	378	403	393	
	AVG	34	25	28	106	150	127	107	491	496	494	461	408	434	444	40	42	42	42	43	77	61	48	397	467	433	423	388	403	408		
Sugi ( <i>Cryptomeria japonica</i> )	7	-	-	-	123	200	154	154	-	-	-	444	331	391	391	Kobannoki ( <i>Phyllanthus flexuosus</i> )	41	-	-	-	60	76	68	68	-	-	-	-	715	624	668	668
	8	-	-	-	162	247	202	202	-	-	-	357	297	326	326	42	-	-	-	57	73	64	64	-	-	-	752	640	708	708		
	9	-	-	-	116	206	154	154	-	-	-	427	321	375	375	AVG	-	-	-	58	75	66	66	-	-	-	733	632	688	688		
	10	-	-	-	122	142	131	131	-	-	-	444	394	420	420	Nogurumi ( <i>Platycarya strobilacea</i> )	43	-	-	-	94	116	105	105	-	-	-	-	415	442	429	429
	AVG	-	-	-	131	199	160	160	-	-	-	418	336	378	378	44	-	-	-	84	101	93	93	-	-	-	473	486	480	480		
Akamatsu ( <i>Pinus densiflora</i> )	11	-	-	-	152	169	160	160	-	-	-	397	372	385	385	AVG	-	-	-	89	109	99	99	-	-	-	444	464	455	455		
	12	-	-	-	121	159	139	139	-	-	-	411	369	390	390	Kunugi ( <i>Quercus acutissima</i> )	45	-	-	-	72	70	71	71	-	-	-	-	659	615	635	635
	AVG	-	-	-	137	164	150	150	-	-	-	404	371	387	387	46	-	-	-	65	70	68	68	-	-	-	628	611	619	619		
Tsuga ( <i>Tsuga sieboldii</i> )	13	58	47	53	60	108	83	64	600	540	569	532	452	491	536	AVG	-	-	-	69	70	69	69	-	-	-	644	613	627	627		
	14	30	32	31	32	97	66	46	563	498	534	503	471	486	513	47	-	-	-	84	83	84	84	-	-	-	626	564	593	593		
	AVG	44	39	42	46	103	75	55	581	519	552	518	461	488	524	48	-	-	-	84	113	97	97	-	-	-	649	509	579	579		
<b>Hardwood</b>																																
<b>Ring-porous wood</b>																																
Matatabi ( <i>Actinidia polygama</i> )	15	-	-	-	116	206	159	159	-	-	-	463	310	374	374	Mizunara ( <i>Quercus crispula</i> )	51	-	-	-	75	85	81	81	-	-	-	-	685	645	663	663
	16	-	-	-	100	192	146	146	-	-	-	414	316	358	358	52	-	-	-	67	72	69	69	-	-	-	655	591	622	622		
	AVG	-	-	-	108	199	153	153	-	-	-	439	313	366	366	53	80	82	81	67	60	63	74	634	630	632	596	537	558	600		
Urinoki ( <i>Alangium platanifolium</i> var. <i>trilobum</i> )	17	-	-	-	58	59	58	58	-	-	-	648	605	627	627	54	83	87	85	65	71	68	78	649	647	648	598	527	555	607		
	18	-	-	-	50	59	55	55	-	-	-	567	551	558	558	AVG	82	84	83	68	72	70	75	641	639	640	603	549	571	594		
	AVG	-	-	-	54	59	57	57	-	-	-	607	578	593	593	Kurude ( <i>Rhus javanica</i> var. <i>roxburghii</i> )	55	67	57	62	72	122	99	80	371	361	366	365	372	369	367	
Taranoki ( <i>Aralia elata</i> )	19	-	-	-	86	113	105	105	-	-	-	183	455	322	322	56	67	71	69	89	136	111	86	377	452	416	488	272	356	390		
	20	-	-	-	48	65	60	60	-	-	-	184	402	304	304	57	36	24	30	40	113	76	76	410	420	415	472	426	450	450		
	AVG	-	-	-	67	89	83	83	-	-	-	184	428	313	313	58	35	29	32	31	99	72	72	419	452	432	460	407	427	427		
Kuri ( <i>Castanea crenata</i> )	21	71	85	78	83	87	85	82	502	493	498	484	495	490	494	AVG	51	45	48	58	117	90	78	394	421	407	446	369	401	409		
	22	66	79	73	84	101	93	83	517	513	515	495	463	479	496	59	46	41	43	60	83	73	53	422	484	455	455	434	472	455		
	AVG	69	82	75	83	94	89	82	509	503	506	490	479	485	495	Yamaurushi ( <i>Toxicodendron trichocarpum</i> )	60	51	56	53	50	85	68	59	535	542	539	521	476	496	523	
Aodamo ( <i>Fraxinus lanuginosa</i> f. <i>serrata</i> )	23	-	-	-	49	63	57	57	-	-	-	622	604	612	612	50	48	48	48	55	84	70	56	479	513	497	478	474	475	489		
	24	-	-	-	49	56	53	53	-	-	-	640	610	625	625	51	46	45	48	58	117	90	78	394	421	407	446	369	401	409		
	AVG	-	-	-	49	60	55	55	-	-	-	631	607	619	619	Kurozuru ( <i>Tripterygium regelii</i> )	61	-	-	-	129	129	129	129	-	-	-	-	630	375	482	482
Yachidamo ( <i>Fraxinus mandshurica</i> var. <i>japonica</i> )	25	72	87	80	45	66	56	68	502	486	493	487	479	483	488	62	-	-	-	77	136	101	101	-	-	-	656	412	528	528		
	26	74	89	82	49	70	61	72	609	613	611	616	547	575	591	AVG	-	-	-	103	132	115	115	-	-	-	643	393	505	505		
	AVG	73	88	81	47	68	58	70	555	550	552	552	513	529	539	Kumafuji ( <i>Wisteria brachybotrys</i> )	63	-	-	-	121	204	149	149	-	-	-	-	394	265	338	338
Marubaodamo ( <i>Fraxinus sieboldiana</i> )	27	-	-	-	43	46	45	45	-	-	-	608	627	618	618	64	-	-	-	100	173	136	136	-	-	-	380	337	357	357		
	28	-	-	-	42	50	46	46	-	-	-	597	599	598	598	AVG	-	-	-	111	188	143	143	-	-	-	387	301	347	347		
	AVG	-	-	-	43	48	45	45	-	-	-	602	613	608	608	Inuzansho ( <i>Zanthoxylum schinifolium</i> )	65	-	-	-	40	63	52	52	-	-	-	-	567	544	555	555
Harigiri ( <i>Kalopanax pictus</i> )	29	77	75	76	58	95	79	77	498	506	502	525	405	451	474	66	-	-	-	40	52	46	46	-	-	-	560	551				

Table 3 (Continued)

Japanese common name (Scientific name)	Tree no.	Green moisture content (%)						Basic density (kg/m <sup>3</sup> )						Japanese common name (Scientific name)	Tree no.	Green moisture content (%)						Basic density (kg/m <sup>3</sup> )							
		Heartwood			Sapwood			Heartwood			Sapwood					Heartwood			Sapwood			Heartwood			Sapwood				
		Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All				
<b>Semi ring porous wood</b>																													
Nawasirogumi ( <i>Elaeagnus pungens</i> )	69	-	-	-	61	74	68	68	-	-	-	710	646	677	677	70	-	-	-	-	-	-	600	518	549	549			
	70	-	-	-	59	72	64	64	-	-	-	627	592	612	612	Avg	-	-	-	-	-	-	587	610	601	601			
	Avg	-	-	-	60	73	66	66	-	-	-	668	619	644	644		-	-	-	-	-	-	593	564	575	575			
<b>Diffuse-porous wood</b>																													
Chidorinoki ( <i>Acer carpinifolium</i> )	71	-	-	-	71	82	77	77	-	-	-	453	483	468	468	72	-	-	-	-	-	-	766	483	581	660			
	72	-	-	-	75	83	79	79	-	-	-	455	491	475	475	Avg	-	-	-	-	-	-	666	700	682	701	587	635	664
	Avg	-	-	-	73	83	78	78	-	-	-	454	487	471	471		-	-	-	-	-	-	691	689	734	535	608		
Irohamomiji ( <i>Acer palmatum</i> )	73	-	-	-	53	62	57	57	-	-	-	521	538	529	529	74	-	-	-	-	-	-	494	571	537	537			
	74	-	-	-	52	63	58	58	-	-	-	502	538	521	521	Avg	-	-	-	-	-	-	504	461	483	483			
	Avg	-	-	-	53	63	58	58	-	-	-	512	538	525	525		-	-	-	-	-	-	499	516	510	510			
Itayakaede ( <i>Acer pictum</i> subsp. <i>dissectum</i> )	75	-	-	-	65	89	77	77	-	-	-	423	462	442	442	76	-	-	-	-	-	-	565	528	545	545			
	76	-	-	-	61	72	66	66	-	-	-	463	489	476	476	Avg	-	-	-	-	-	-	544	528	535	535			
	Avg	-	-	-	63	80	72	72	-	-	-	443	476	459	459		-	-	-	-	-	-	528	557	543	543			
Ezoitaya ( <i>Acer pictum</i> subsp. <i>mono</i> f. <i>mono</i> )	77	-	-	-	54	60	57	57	-	-	-	548	583	565	565	78	-	-	-	-	-	-	504	519	511	511			
	78	-	-	-	56	69	63	63	-	-	-	548	541	544	544	Avg	-	-	-	-	-	-	516	538	527	527			
	Avg	-	-	-	55	65	60	60	-	-	-	548	562	555	555		-	-	-	-	-	-	515	551	532	532			
Enkoukaede ( <i>Acer pictum</i> subsp. <i>dissectum</i> f. <i>dissectu</i> )	79	-	-	-	49	61	54	54	-	-	-	613	586	600	600	80	-	-	-	-	-	-	528	557	543	543			
	80	-	-	-	50	60	55	55	-	-	-	557	590	573	573	Avg	-	-	-	-	-	-	514	555	535	535			
	Avg	-	-	-	49	61	55	55	-	-	-	585	588	586	586		-	-	-	-	-	-	479	536	508	508			
Kohachiwakaede ( <i>Acer sieboldianum</i> )	81	-	-	-	57	64	60	60	-	-	-	541	580	559	559	82	-	-	-	-	-	-	562	529	545	545			
	82	-	-	-	63	60	61	61	-	-	-	493	560	528	528	Avg	-	-	-	-	-	-	520	533	527	527			
	Avg	-	-	-	60	62	61	61	-	-	-	517	570	544	544		-	-	-	-	-	-	531	545	539	539			
Yashabushi ( <i>Alnus firma</i> )	83	-	-	-	72	82	78	78	-	-	-	448	459	454	454	84	-	-	-	-	-	-	578	551	562	562			
	84	-	-	-	75	70	72	72	-	-	-	494	541	515	515	Avg	-	-	-	-	-	-	555	548	551	551			
	Avg	-	-	-	73	76	75	75	-	-	-	471	500	485	485		-	-	-	-	-	-	593	532	562	562			
Mukunoki ( <i>Aphananthe aspera</i> )	85	-	-	-	73	90	83	83	-	-	-	384	462	424	424	86	-	-	-	-	-	-	588	512	548	548			
	86	-	-	-	63	83	72	72	-	-	-	517	510	514	514	Avg	-	-	-	-	-	-	590	522	555	555			
	Avg	-	-	-	68	87	78	78	-	-	-	450	486	469	469		-	-	-	-	-	-	679	627	652	652			
Mizume ( <i>Betula grossa</i> )	87	-	-	-	71	66	69	69	-	-	-	518	589	548	548	88	-	-	-	-	-	-	704	646	675	675			
	88	-	-	-	69	69	69	69	-	-	-	508	560	533	533	Avg	-	-	-	-	-	-	673	586	605	605			
	Avg	-	-	-	70	67	69	69	-	-	-	513	574	540	540		-	-	-	-	-	-	522	474	499	499			
Yabutsubaki ( <i>Camellia japonica</i> )	89	-	-	-	77	82	79	79	-	-	-	631	605	619	619	90	-	-	-	-	-	-	531	474	500	500			
	90	-	-	-	74	73	74	74	-	-	-	610	643	626	626	Avg	-	-	-	-	-	-	511	464	485	485			
	Avg	-	-	-	71	80	75	75	-	-	-	631	614	622	622		-	-	-	-	-	-	521	474	500	500			
		-	-	-	71	68	70	70	-	-	-	615	656	635	635		-	-	-	-	-	-	544	512	528	528			
Akashide ( <i>Carpinus laxiflora</i> )	93	-	-	-	88	88	88	88	-	-	-	451	488	471	471	94	-	-	-	-	-	-	538	493	513	513			
	94	-	-	-	88	88	88	88	-	-	-	451	488	471	471	Avg	-	-	-	-	-	-	515	446	489	489			
	Avg	-	-	-	88	88	88	88	-	-	-	451	488	471	471		-	-	-	-	-	-	476	496	489	489			
Inushide ( <i>Carpinus tschonoskii</i> )	95	-	-	-	95	95	95	95	-	-	-	449	474	462	462	96	-	-	-	-	-	-	563	472	520	520			
	96	-	-	-	95	95	95	95	-	-	-	449	474	462	462	Avg	-	-	-	-	-	-	616	532	574	574			
	Avg	-	-	-	95	95	95	95	-	-	-	449	474	462	462		-	-	-	-	-	-	589	502	547	547			
Isunoki ( <i>Distylium racemosum</i> )	97	-	-	-	76	80	78	78	-	-	-	623	647	634	634	98	-	-	-	-	-	-	671	646	659	659			
	98	-	-	-	85	89	87	87	-	-	-	624	596	610	610	Avg	-	-	-	-	-	-	662	647	654	654			
	Avg	-	-	-	81	85	83	83	-	-	-	623	621	622	622		-	-	-	-	-	-	667	646	657	657			
Yamagaki ( <i>Diospyros kaki</i> var. <i>sylvestris</i> )	99	-	-	-	63	79	71	71	-	-	-	561	546	553	553	100	-	-	-	-	-	-	438	448	443	443			
	100	-	-	-	53	57	55	55	-	-	-	587	566	577	577	Avg	-	-	-	-	-	-	508	461	483	483			
	Avg	-	-	-	58	68	63	63	-	-	-	574	556	565	565		-	-	-	-	-	-	473	454	463	463			

Green moisture content and basic density of woody species

Table 3 (Continued)

Japanese common name (Scientific name)	Tree no.	Green moisture content (%)						Basic density (kg/m <sup>3</sup> )						Japanese common name (Scientific name)	Tree no.	Green moisture content (%)						Basic density (kg/m <sup>3</sup> )										
		Heartwood			Sapwood			Heartwood			Sapwood					Heartwood			Sapwood			Heartwood			Sapwood							
		Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All							
<b>Diffuse-porous wood</b>																																
Inubuna ( <i>Fagus japonica</i> )	111	-	-	-	91	94	93	93	-	-	515	551	532	532	Hoonoki ( <i>Magnolia obovata</i> )	143	-	-	-	77	84	80	80	-	-	-	-	-	520	511	515	515
	112	-	-	-	89	93	91	91	-	-	513	559	538	538		144	-	-	-	69	80	75	75	-	-	-	-	491	509	501	501	
	AVG	-	-	-	90	94	92	92	-	-	514	555	535	535		AVG	-	-	-	73	82	78	78	-	-	-	-	506	510	508	508	
Hosobainubiwa ( <i>Ficus erecta f. sieboldii</i> )	113	-	-	-	132	116	123	123	-	-	479	536	508	508	Tamushiba ( <i>Magnolia salicifolia</i> )	145	-	-	-	91	78	83	83	-	-	-	-	-	378	467	426	426
	114	-	-	-	104	104	104	104	-	-	562	529	545	545		146	-	-	-	79	108	94	94	-	-	-	-	433	423	428	428	
	AVG	-	-	-	118	110	113	113	-	-	520	533	527	527		AVG	-	-	-	85	93	89	89	-	-	-	-	406	445	427	427	
Nanaminoki ( <i>Ilex chinensis</i> )	115	-	-	-	91	87	89	89	-	-	531	545	539	539	Awabuki ( <i>Meliosma myriantha</i> )	147	-	-	-	90	95	92	92	-	-	-	-	-	440	473	456	456
	116	-	-	-	87	94	91	91	-	-	578	551	562	562		148	-	-	-	90	112	102	102	-	-	-	-	469	432	449	449	
	AVG	-	-	-	89	91	90	90	-	-	555	548	551	551		AVG	-	-	-	90	103	97	97	-	-	-	-	455	452	452	452	
Inutsuge ( <i>Ilex crenata</i> )	117	-	-	-	63	85	74	74	-	-	593	532	562	562	Shirodama ( <i>Neolitsea sericea</i> )	149	-	-	-	63	74	68	68	-	-	-	-	-	482	519	500	500
	118	-	-	-	70	89	79	79	-	-	588	512	548	548		150	-	-	-	65	81	74	74	-	-	-	-	482	515	500	500	
	AVG	-	-	-	67	87	76	76	-	-	590	522	555	555		151	-	-	-	63	87	75	75	-	-	-	-	358	366	362	362	
Tsukushinutsuge ( <i>Ilex crenata</i> var. <i>fukasawana</i> )	119	-	-	-	66	75	71	71	-	-	655	608	629	629		152	-	-	-	77	111	94	94	-	-	-	-	357	352	354	354	
	120	-	-	-	58	63	60	60	-	-	704	646	675	675		AVG	-	-	-	67	88	78	78	-	-	-	-	419	438	429	429	
	AVG	-	-	-	62	69	66	66	-	-	679	627	652	652	Asebi ( <i>Pieris japonica</i> )	153	-	-	-	95	114	104	104	-	-	-	-	-	516	473	494	494
Soyogo ( <i>Ilex pedunculosa</i> )	121	-	-	-	75	89	82	82	-	-	571	558	565	565		154	-	-	-	102	110	106	106	-	-	-	-	510	474	493	493	
	122	-	-	-	53	72	62	62	-	-	673	614	645	645		AVG	-	-	-	99	112	105	105	-	-	-	-	513	473	493	493	
	AVG	-	-	-	64	80	72	72	-	-	622	586	605	605	Tobera ( <i>Pittosporum tobira</i> )	155	-	-	-	91	127	107	107	-	-	-	-	-	541	500	522	522
Kuroganemochi ( <i>Ilex rotunda</i> )	123	-	-	-	99	119	110	110	-	-	531	474	499	499		156	-	-	-	75	97	85	85	-	-	-	-	638	560	601	601	
	124	-	-	-	94	105	100	100	-	-	544	512	528	528		AVG	-	-	-	83	112	96	96	-	-	-	-	589	530	561	561	
	AVG	-	-	-	97	112	105	105	-	-	538	493	513	513	Yamanarashi ( <i>Populus sieboldii</i> )	157	-	-	-	72	85	81	81	-	-	-	-	-	374	392	386	386
Inuumemodoki ( <i>Ilex serrata</i> f. <i>argutidens</i> )	125	-	-	-	63	137	88	88	-	-	515	446	489	489		158	-	-	-	67	74	71	71	-	-	-	-	408	416	413	413	
	126	-	-	-	85	98	91	91	-	-	438	545	488	488		AVG	-	-	-	69	80	76	76	-	-	-	-	391	404	399	399	
	AVG	-	-	-	74	117	89	89	-	-	476	496	489	489	Kamatsuka ( <i>Pourthiaeavillosa</i> var. <i>laevis</i> )	159	-	-	-	59	71	64	64	-	-	-	-	-	707	670	691	691
Shikimi ( <i>Ilicium anisatum</i> )	127	-	-	-	89	130	106	106	-	-	563	472	520	520		160	-	-	-	61	89	76	76	-	-	-	-	632	633	632	632	
	128	-	-	-	80	109	94	94	-	-	616	532	574	574		AVG	-	-	-	60	80	70	70	-	-	-	-	669	651	662	662	
	AVG	-	-	-	85	119	100	100	-	-	589	502	547	547		161	-	-	-	112	116	114	114	-	-	-	-	411	436	424	424	
Nezumimochi ( <i>Ligustrum japonicum</i> )	129	-	-	-	61	63	62	62	-	-	671	646	659	659		162	-	-	-	109	117	113	113	-	-	-	-	437	434	436	436	
	130	-	-	-	61	60	60	60	-	-	662	647	654	654		AVG	-	-	-	111	116	114	114	-	-	-	-	424	435	430	430	
	AVG	-	-	-	61	62	61	61	-	-	667	646	657	657	Sharinbai ( <i>Raphiolepis indica</i> var. <i>umbellata</i> )	163	-	-	-	51	57	54	54	-	-	-	-	-	783	727	751	751
Kanakuginoki ( <i>Lindera erythrocarpa</i> )	131	-	-	-	65	88	77	77	-	-	438	448	443	443		164	-	-	-	66	69	67	67	-	-	-	-	717	681	700	700	
	132	65	66	66	76	111	93	81	432	468	451	508	461	483	467		AVG	-	-	-	58	63	61	61	-	-	-	-	750	704	725	725
	AVG	65	66	66	70	99	85	85	432	468	451	473	454	463	455		165	70	77	75	50	73	62	66	553	512	522	489	425	454	472	
Aburachan ( <i>Lindera praecox</i> )	133	-	-	-	75	76	75	75	-	-	520	526	523	523		166	-	-	-	38	83	61	61	-	-	-	-	511	505	508	508	
	134	-	-	-	56	81	69	69	-	-	488	522	506	506		AVG	70	77	75	44	78	62	62	553	512	522	500	465	481	490		
	AVG	-	-	-	66	78	72	72	-	-	504	524	514	514		167	-	-	-	68	99	85	85	-	-	-	-	520	472	493	493	
Shiromoji ( <i>Lindera triloba</i> )	135	-	-	-	72	92	81	81	-	-	525	519	522	522		168	-	-	-	88	57	70	70	-	-	-	-	428	486	459	459	
	136	-	-	-	69	77	73	73	-	-	500	517	509	509		AVG	-	-	-	78	78	78	78	-	-	-	-	474	479	476	476	
	AVG	-	-	-	70	84	77	77	-	-	512	518	516	516		169	-	-	-	67	77	71	71	-	-	-	-	562	563	563	563	
Baribarinoki ( <i>Litsea acuminata</i> )	137	-	-	-	71	74	73	73	-	-	397	459	427	427		170	-	-	-	63	63	63	63	-	-	-	-	386	595	479	479	
	138	-	-	-	87	71	78	78	-	-	359	440	400	400		AVG	-	-	-	65	70	67	67	-	-	-	-	474	579	521	521	
	AVG	-	-	-	79	73	76	76	-	-	378	450	414	414		171	-	-	-	52	56	54	54	-	-	-	-	675	686	680	680	
Kagonoki ( <i>Litsea coreana</i> )	139	-	-	-	82	97	90	90	-	-	386	404	395	395		172	-	-	-	52	61	57	57	-	-	-	-	676	659	667	667	
	140	-	-	-	78	99	89	89	-	-	424	443	434	434		AVG	-	-	-	52	58	55	55	-	-	-	-	676	672	673	673	
	AVG	-	-	-	80	98	89	89	-	-	405	424	415	415		173	-	-	-	76	91	83	83	-	-	-	-	611</td				

Table 3 (Continued)

Japanese common name (Scientific name)	Tree no.	Green moisture content (%)						Basic density (kg/m <sup>3</sup> )						Japanese common name (Scientific name)	Tree no.	Green moisture content (%)						Basic density (kg/m <sup>3</sup> )										
		Heartwood			Sapwood			Heartwood			Sapwood					Heartwood			Sapwood													
		Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All	Inner	Outer	All							
<b>Diffuse-porous wood</b>																																
Egonoki ( <i>Styrax japonica</i> )	175	-	-	-	86	104	95	95	-	-	-	479	463	471	471	193	-	-	-	69	76	73	73	-	-	441	531	486	486			
	176	-	-	-	98	98	98	98	-	-	-	463	485	472	472	194	-	-	-	59	87	72	72	-	-	503	475	489	489			
	AVG	-	-	-	92	101	96	96	-	-	-	471	474	472	472	AVG	-	-	-	64	82	72	72	-	-	472	503	488	488			
Kohakuunboku ( <i>Styrax shiraiana</i> )	177	-	-	-	75	95	85	85	-	-	-	533	492	513	513	<b>Diffuse-porous wood</b>						<b>Radial-porus wood</b>										
	178	-	-	-	92	100	97	97	-	-	-	484	487	486	486	Fuyuzanshou ( <i>Zanthoxylum armatum</i> var. <i>subtrifoliatum</i> )	195	-	-	-	83	96	89	89	-	-	-	-	628	559	591	591
	AVG	-	-	-	84	97	91	91	-	-	-	509	489	499	499	196	-	-	-	82	79	81	81	-	-	544	564	554	554			
Koyabudemari ( <i>Viburnum plicatum</i> var. <i>parvifolium</i> )	179	-	-	-	69	72	71	71	-	-	-	686	660	672	672	AVG	-	-	-	83	87	85	85	-	-	586	561	573	573			
	180	-	-	-	65	73	69	69	-	-	-	671	635	653	653	Matebachii ( <i>Lithocarpus edulis</i> )	197	-	-	-	82	75	78	78	-	-	-	-	593	599	596	596
	AVG	-	-	-	67	72	70	70	-	-	-	678	647	663	663	198	-	-	-	77	80	79	79	-	-	605	582	595	595			
Kurominosawafutagi ( <i>Symplocos tanakana</i> )	181	-	-	-	85	92	89	89	-	-	-	613	547	578	578	AVG	-	-	-	80	78	78	78	-	-	599	591	595	595			
	182	-	-	-	89	87	88	88	-	-	-	618	557	588	588	<b>Radial-porus wood</b>						<b>Radial-porus wood</b>										
	AVG	-	-	-	87	90	88	88	-	-	-	615	552	583	583	Arakashi ( <i>Quercus glauca</i> )	199	-	-	-	67	60	63	63	-	-	-	-	653	701	676	676
Kuroki ( <i>Symplocos lucida</i> )	183	-	-	-	104	127	116	116	-	-	-	523	467	492	492	200	-	-	-	70	68	69	69	-	-	647	673	661	661			
	184	-	-	-	90	132	109	109	-	-	-	556	442	498	498	AVG	-	-	-	68	64	66	66	-	-	650	687	668	668			
	AVG	-	-	-	97	129	112	112	-	-	-	540	454	495	495	Shirakashi ( <i>Quercus myrsinæfolia</i> )	201	-	-	-	62	73	67	67	-	-	-	-	722	661	692	692
Kumanomizuki ( <i>Swida macrophylla</i> )	185	-	-	-	106	134	118	118	-	-	-	523	480	504	504	202	-	-	-	68	74	71	71	-	-	659	625	642	642			
	186	-	-	-	83	114	96	96	-	-	-	573	523	551	551	AVG	-	-	-	65	74	69	69	-	-	691	643	667	667			
	AVG	-	-	-	94	124	107	107	-	-	-	548	502	527	527	Urajirogashi ( <i>Quercus salicina</i> )	203	-	-	-	75	77	76	76	-	-	-	-	670	689	679	679
Oobabodaijyu ( <i>Tilia maximowicziana</i> )	187	-	-	-	117	122	120	120	-	-	-	296	325	310	310	204	-	-	-	67	68	67	67	-	-	634	641	638	638			
	188	-	-	-	115	112	113	113	-	-	-	295	362	331	331	AVG	-	-	-	71	73	72	72	-	-	652	665	659	659			
	AVG	-	-	-	116	117	116	116	-	-	-	295	344	321	321	<b>Wood vesselless</b>						<b>Wood vesselless</b>										
Shashanbo ( <i>Vaccinium bracteatum</i> )	189	-	-	-	106	107	106	106	-	-	-	540	525	532	532	Yamaguruma ( <i>Trochodendron aralioides</i> )	205	-	-	-	86	93	89	89	-	-	-	-	574	538	556	556
	190	-	-	-	98	103	101	101	-	-	-	552	534	542	542	206	-	-	-	86	85	85	85	-	-	562	539	550	550			
	AVG	-	-	-	102	105	104	104	-	-	-	546	530	537	537	AVG	-	-	-	86	89	87	87	-	-	568	538	553	553			
Karasuzanshou ( <i>Zanthoxylum ailanthoides</i> )	191	-	-	-	85	186	132	132	-	-	-	239	265	251	251																	
	192	-	-	-	94	154	127	127	-	-	-	289	286	287	287																	
	AVG	-	-	-	89	170	130	130	-	-	-	264	275	269	269																	

Green moisture content and basic density of woody species

## Conclusion

This paper presents green moisture content and basic density data for 95 woody species, including three woody lianas, collected from Kyushu University Forests, which ranges from a warm temperate forest zone to a cool temperate forest zone, during July and August from 2003 to 2006. Many data are previously unreported, which means this dataset contains scientifically important information.

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