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Full Length Research Paper

Physical and mechanical properties and the use of lesser-known native Silver Lime (*Tilia argentea* Desf.) wood from Western Turkey

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Turkey including its native wood species with high commercial value are recognised internationally. This work presents information about physical and mechanical properties and the use of lesser-known native wood species. This article's aim is to familiarize wood expert outside Turkey with the wood of Silver Lime by comparing its physical and mechanical properties with some of the world's most recognized hardwood species. The sample trees were harvested from a mixed oak-hornbeam- Silver Lime stand, western part of Turkey. Conventional destructive methods were followed on small clean specimens. Silver Lime wood's air dry (526), oven dry (504) and basic (415 kgm^{-3}) densities were determined. Fiber saturation point was calculated as 32.287%; volumetric shrinkage and swelling were found as 13.398 and 20.401%; while bending strength (MOR), modulus of elasticity (MOE), compression strength parallel to grain, impact bending, tensile strength parallel and perpendicular to grain, shear strength, cleavage strength, Janka hardness values (parallel and perpendicular to grain) and surface roughness (Ra) value were determined as 72.026 N/mm^2, 5206.026 N/mm^2, 50.531 N/mm^2, 6.708 J/cm^2, 90.521 N/mm^2, 2.692 N/mm^2, 11.742 N/mm^2, 0.598 N/mm^2, 0.636 and 0.569 kN, and 9.051 (µm), respectively. Further research should be used to determine the properties and suitable end uses of lesser known species that are likely to be beneficial to the country.

Key words: *Tilia argentea* Desf., Silver Lime, wood properties, density, surface roughness.

INTRODUCTION

Tilia is a genus of about 30 species of trees native throughout most of the temperate Northern Hemisphere, in Asia (where the greatest species diversity is found), Europe and eastern North America; they are not native to western North America. *Tilia* species are large deciduous trees, reaching typically 20 to 40 m tall, with oblique-cordate leaves 6 to 20 cm (2 to 8 in) across, and are found throughout the north temperate regions. The exact number of species is subject to considerable uncertainty, as many or most of the species will hybridise readily, both in the wild and in cultivation (Yaltirik and Efe, 2000; Anonymous, 2011).

It spreads over 5425 ha, which consists only 0.03% of the total forest area in Turkey (Anonymous, 2001). The timber of *Tilia* trees is soft, easily worked, and has very little grain, and a density of 560 (kg/m^3) kg per cubic metre. It is a popular wood for model building and intricate carving. Ease of working and good acoustic properties also make it popular for electric guitar and bass bodies and wind instruments such as recorders. In the past, it was typically used (along with Agathis) for less-expensive models. However, due to its better resonance at mid and high frequency, and its better sustainability than alder, it is now more commonly used with the "superstrat" type of guitar. It can also be used for the neck because of its excellent material integrity when bent and ability to produce consistent tone without any dead spots according to Parker Guitars. In the percussion industry, *Tilia* is sometimes used as a material for drum shells, both to enhance their sound and their aesthetics. It is also the wood of choice for the window-blinds and shutters industries. Real wood blinds are often made from this lightweight but strong and stable wood which is well suited to natural and stained finishes (Yaltırık and

Efe, 2000; Anonymous, 2011).

In Turkey, Silver Lime is found primarily in the west and northwest Anatolia as small groups in angiosperm mixed forests (Yaltırık and Efe, 2000).

Literature review has shown that there is not any detailed and original previous research reporting important wood properties (that is, physical and mechanical properties) of this species. A strong relationship is well known with wood properties and the quality of wood. Thus, these properties are classically used to select wood for the particular applications (Haygreen and Bowyer, 1996). Silver Lime (*Tilia argentea* Desf.) is not widely used because its properties and potential uses are not well known. Besides it has limited natural stands in Turkey. There are many lesser-known wood species, sometimes with similar properties to those well-known species, which are less exploited and used because of a lack of knowledge regarding their properties. Thus, further research to determine their properties and possible end uses is likely to be beneficial to the forest industry. "Silver Lime (*Tilia argentea* Desf.) shows potential to occupy a more important position in forestry in the future, especially with respect to the re-afforestation of areas prejudiced by air pollution in the uplands. In these areas, the Silver Lime-tree will not only serve as a pioneer species, but also will increasingly deliver useful trunk wood grades, therefore the technologically important wood properties for this species are of interest".

As recognized by Korkut and Bilgin (2008), research of lesser-known species should be promoted and supported in Turkey, following the successful example of Europe countries. This is because the use of lesser-known species will not only increase the resource base in the country but also will reduce the high pressure on the better known species. Thus, research on wood characteristics and properties of lesser-known Turkey native wood species is important. It will provide knowledge of physical and mechanical properties of selected wood species and thus enable methods to produce high quality products. This will provide beter knowledge of physical and mechanical properties of selected wood species with regard to their use.

The aim of this study was to fulfill the gap in research and to facilitate optimal utilization fields of this species. Further research to determine the properties and suitable end uses of this lesser known species is likely to be beneficial.

MATERIALS AND METHODS

The sample trees used for this present study were harvested from a mixed oak-hornbeam-rowan stand in the Duzce Forest Enterprises, western part of Turkey. The experimental area is located at an average altitude of 650 m. The mean annual precipitation of the experimental area is about 816.7 mm/year, the yearly average temperature is 13.01°C, and prevailing wind direction is north. Soil is moist but well-drained. (All climatic data obtained from Duzce meteorology station located very close to experimental area).

Five plots, 20 by 20m^2, were chosen randomly from the experimental area. Breast height diameters (d1.30) of Silver Lime (*Tilia argentea* Desf.) trees were measured for every plot, and the arithmetic mean values were calculated. The arithmetic mean tree was felled as sample tree. To avoid errors during sampling, extreme cases were taken into account such as excessively knotty trees and the presence of reaction wood or slope grain (ISO 4471, 1982). Table 1 shows the properties of sample trees.

Determination of density, sorption, fiber saturation point (FSP) and maximum moisture content (MMC)

Five different sampling heights (0.30, 1.30, 3.30, 5.30, and 7.30 m) were chosen through the stems and one disk 10 cm in thickness was removed at each height. From each disk, a sample of 3 cm width from bark to bark was cut. This sample was then cut into a strip 2 cm thick. Air-dry and oven dry densities (D_{m12}, D_{m0}) (ISO 3131, 1975), shrinking [(tangential, radial, longitudinal, volumetric) (β (t,r,l,v))] (ISO 4469, 1981) and swelling [(tangential, radial, longitudinal, volumetric) (α (t,r,l,v))] (ISO 4859, 1982) of the wood were determined according to International Organization for Standardization (ISO) Standards using wood specimens of 2 × 2 × 3 cm (along the grain).

FSP was calculated by the following equation (Bozkurt and Goker, 1987):

$$FSP = \frac{\beta v}{D_b} (\%)$$

Where, βv is the volumetric shrinkage (%) and D_b is the density value in volume (g cm^{-3}).

MMC was calculated by the following equation:

$$FSP = \frac{\beta v}{D_b} (\%)$$

D_b is the density value (D_b) in volume (wood basic density). The basic density was determined by the gravimetric method (Haygreen and Bowyer, 1996).

$$D_b = \frac{M_0}{V_g}$$

Where, D_b is the basic density of wood (g cm^{-3}), V_g is the green volume of the specimen (cm^3), and M_0 is the dry-matter weight of the specimen (g). Percentage of the cell wall and porosity were calculated by the following equations (Bozkurt and Goker, 1987).

$$V_C = \frac{D_{m0}}{D_C} \times 100$$

$$V_H = 100 - V_C$$

Where, V_C is percentage of the cell wall (%), D_{m0} is oven dry density (g cm^{-3}), D_C is oven dry density of the cell wall (1.5 g cm^{-3}) and V_H is percentage of the porosity.

The shape factor (T/R) was the ratio between tangential and radial shrinkage.

Table 1. Properties of sample trees.

Tree number	Age of tree	Diameter of tree $d_{1.30}$ (cm)	Height of tree (m)	Green branch (m)	Dead branch (m)	Altitude (m)	Slope (%)	Direction
1	53	41	22.4	9.2	1.5	650	45	NW
2	55	43	20.1	10.3	2.6	650	45	NW
3	60	45	21.7	7.2	3.9	650	45	NW
4	63	47	25.6	11.8	3.1	650	45	NW
5	58	44	20.4	7.9	3.6	650	45	NW

Measurement of strength properties

Sections of 1.5 m were cut from the 2 to 4 m height of trees to obtain samples for strength properties.The boards which were 8 cm in thickness sawn and sawdust were immediately removed from the surfaces then they were stored in an unheated room for air drying (ISO 3129, 1975).

Following the air-drying process, small and clear specimens were cut from the boards according to International organization for Standardization (ISO), to determine compression strength parallel to grain (σc//) (ISO 3787, 1976), bending strength (MOR) (ISO 3133, 1975), modulus of elasticity in bending (MOE) (ISO 3349, 1975), janka-hardness [(parallel, perpendicular to grain) (Hj(//,⊥))] (ISO 3350, 1975), impact bending strength (σi) (ISO 3348, 1975), tension strength parallel ($\sigma t_{//}$) and perpendicular to grain (σt⊥) [ISO 3345 (1975), 3346 (1975)], shear strength (τ_{aB}) (ISO 3347, 1976) and cleavage strength (σs) (ASTM D 143, 1994). The specimens were then conditioned at 20 ± 2°C with 65% relative humidity according to ISO 554 (1976). After acclimatization, mechanical properties of the Silver Lime (*Tilia argentea* Desf.) wood were determined.

At the end of experiments, moisture contents (M) of specimens were measured according to ISO 3130 (1975) and the moisture content of specimen in which moisture content deviated from 12% was determined. Strength values were corrected (transformed to 12% moisture content) using the following strength conversion equation:

$$\delta_{12} = \delta_m * [\, 1 + \alpha\,(M_2 - 12)\,]$$

Where, δ_{12} = strength at 12 percent moisture content (N/mm^2), δ_m = strength at moisture content deviated from 12 percent (N/mm^2), α = constant value showing relationship between strength and moisture content (α = 0.05, 0.04, 0.02, 0.025, 0.015, 0.04 and 0.025 for σc// (Bozkurt and Goker, 1987), MOR, MOE, σi, σt and Hj, respectively) M_2= moisture content during test (%).

To better understand completely the quality of the species, quality values which are calculated based upon a relationship between strength and density should be determined. Static, specific and dynamic quality values (I, I_s, I_d) and toughness (S_E) in bending were calculated by the equations below:

$$I = \frac{d_{B12}}{D_{m12}} \times 100$$

$$I_s = \frac{d_{B12}}{(D_{m12})^2} \times 100$$

$$I_d = \frac{a}{(D_{m12})^2}$$

$$S_E = \frac{MOR}{s\,c//}$$

δ_{B12} is the compression strength parallel to grain in 12% moisture content (N/mm^2) and D_{m12} is the air-dry (12%) density (g/cm^3), a: impact work (work arising by impact bending) (Bozkurt and Goker, 1987).

Measurement of surface roughness

Surface roughness of the samples was measured on hardness test samples. Samples were finished by a fixed-knife planer with a feed speed of 1 m/s. The bias angle of the knife was 45° for the sample. If the wood pieces are sawn so that the annual rings are at least in 45° angle to the surface, the deformations will be smaller, the hardness of the surface will be stronger and the ''general looks'' after heat treatment will be better.

Surface roughness of the samples was measured by using a profilometer (Mitutoyo Surftest SJ-301). The surface roughness of the samples was measured with the profile method using a stylus device standard. The measuring speed, pin diameter, and pin top angle of the tool were 10 mm/min, 4 µm, and 90°, respectively. The points of roughness measurement were randomly marked on the surface of the samples. Measurements were made in the direction perpendicular to the fiber of the samples.

Three roughness parameters, mean arithmetic deviation of profile (Ra), mean peak-to-valley height (Rz), and maximum roughness (Ry) were commonly used in previous studies to evaluate surface characteristics of wood and wood composites including veneer (Stombo, 1963). Ra is the average distance from the profile to the mean line over the length of assessment. Rq is the square root of the arithmetic mean of the squares of profile deviations from the mean line. Rz can be calculated from the peak-to-valley values of five equal lengths within the profile, while maximum roughness (Ry) is the distance between peak and valley points of the profile which can be used as an indicator of the maximum defect height within the assessed profile (Mummery, 1993). Therefore, such parameters which are characterized by ISO 4287 (1997) and DIN 4768 (1990) were recorded.

Specification of this parameter is described by Hiziroglu (1996) and Hiziroglu and Graham (1998). Roughness values were measured with a sensitivity of 0.5 µm. The length of scanning line (Lt) was 15 mm and the cut off was λ = 2.5 mm. The measuring force of the scanning arm on the surfaces was 4 mN (0.4 g), which did not put any significant damage on the surface according to Mitutoyo Surftest SJ-301 user manual. Measurements were performed at room temperature and the pin was calibrated before the tests.

RESULTS AND DISCUSSION

Descriptive statistics were given for air-dry, oven-dry and basic density values (Table 2) and for shrinkage,

Table 2. Descriptive statistics for basic, air-dry and oven-dry density values (kg/m^{-3})

Property	Arithmetic mean (x)	Standard deviation (SD)	Variance (V)	Coefficient of variation (CV)	Minimum value (Minimum)	Maximum value (Maximum)	Sample size (N)
D_{m12}	526	0.025	0.0006	4.837	508	595	150
D_{m0}	504	0.014	0.0002	2.758	488	545	150
D_b	415	0.011	0.0001	2.748	396	444	150

Table 3. Shrinkage, swelling, FSP, MMC and T/R of Silver lime (*Tilia argentea* Desf.).

Property		x	SD	V	CV	Minimum	Maximum	N
	βt	7.941	1.314	1.726	16.54	5.892	10.49	150
	βr	4.444	1.143	1.306	25.72	3.269	6.85	150
β	βl	0.972	0.245	0.06	25.18	0.439	1.269	150
	βv	13.398	1.390	1.932	10.375	11.418	16.138	150
	αt	11.633	0.563	0.317	4.843	10.274	12.788	150
	αr	7.826	0.626	0.392	7.996	6.967	9.370	150
α	αl	0.942	0.234	0.055	24.82	0.606	1.317	150
	αv	20.401	0.828	0.686	4.060	19.216	22.544	150
FSP		32.287	3.590	12.886	11.118	26.889	40.723	150
MMC		174.239	6.487	42.083	3.723	158.643	185.678	150
T/R		1.938	0.668	0.446	34.47	1.062	3.209	150

swelling, fiber saturation point and maximum moisture content of Silver Lime (*Tilia argentea* Desf.) wood (Table 3).

The cell wall percentage and porosity were calculated as 33.578, and 66.422%, respectively.

The most widely used trait is certainly wood density, because it is easily measurable (non-destructive methods are possible as well) and it is commonly considered a key indicator of wood quality and a good predictor of the physical and mechanical properties of wood (Zobel and van Buijtenen, 1989).

Descriptive statistics for the strength, hardness and quality factors of Silver Lime (*Tilia argentea* Desf.) wood are shown in Table 4 and for surface roughness values in Table 5.

The surface roughness values (Ra, Ry, Rz and Rq) of Turkish Hazel (*Corylus colurna* L.) and European Rowan (*Sorbus aucuparia*) was found as 10.398, 86.176, 66.380, 13.226, 7.239, 93.787, 60.635 and 9.828 µm, respectively (Sevim et al., 2008; Korkut et al., 2009). Silver Lime (*Tilia argentea* Desf.) had lower surface roughness values compared to Turkish Hazel (*Corylus colurna* L.) and European Rowan (*Sorbus aucuparia*)

Various factors can affect surface roughness such as annual ring width, differences between juvenile and mature wood, density, differences between early and late wood and cell structures. Increase in smoothness or decrease in roughness is very important for many applications of solid wood. In addition, losses occurring in the planning machine are reduced and high quality surfaces are attained. Also, the wooden materials with rough surface requires much more sanding process compared to one with smooth surface, which leads to decrease in thickness of material and, therefore, increase the losses due to the sanding process (Dündar et al., 2008, Sevim et al., 2008).

The wood of Silver Lime (*Tilia argentea* Desf.) grown in the middle Black Sea district is hard, very tough and heavy, similar to the wood of European Hophornbeam (*Ostrya carpinifolia*), making it difficult to work with. This is as expected from the remarkably high Janka hardness value. However, this is preferable for use as flooring raw material.

The disparate size of different wood cells in the hardwoods results in heterogeneous compressive deformation. During compression, large vessels cause smaller surrounding cells to be deformed more than in regions without vessels, increasing the energy absorbed. However, vessels that are too close together initiate kink banding at low loads and less energy is absorbed. The different morphologies of hardwoods are probably responsible for the variation in resistance between species (Hepworth et al., 2002). As a reference basis, these results were also compared to published values for some other species which have similar anatomical properties in the same or other families (Table 6)

The variations of wood properties in the same species arise from different factors, such as genetics, growth

Table 4. Strength (N/mm^2 , J/cm^2), Janka hardness (kN), static, specific and dynamic quality values of Silver Lime (*Tilia argentea* Desf.)

Property		x	SD	V	CV	Minimum	Maximum	N
MOR		72.026	8.886	78.951	12.336	59.645	81.549	200
MOE		5206.026	981.856	964041.3	18.860	4029.207	6741.957	200
σc//		50.531	3.295	10.857	6.521	45.789	58.033	200
$σt_{//}$		90.521	19.475	379.26	21.514	49.021	122.91	200
$σt_{⊥}$		2.692	0.53	0.28	19.68	1.825	3.445	200
σi		6.708	0.263	0.069	3.92	6.305	7.123	200
$τ_{aB}$		11.742	1.307	1.708	11.13	8.315	14.095	200
σs		0.598	0.133	0.018	22.20	0.502	0.983	200
	Crossection	1.455	0.150	0.022	10.30	1.268	1.903	200
Hj	Tangential	0.636	0.077	0.006	12.07	0.516	0.854	200
	Radial	0.569	0.084	0.007	14.78	0.402	0.750	200
I		9.636	0.776	0.602	8.051	7.911	11.05	200
I_s		18.408	1.972	3.888	10.711	13.285	21.047	200
I_d		2.446	0.254	0.065	10.39	1.778	2.738	200
S_E		1.430	0.192	0.037	13.44	1.079	1.743	200

Table 5. Surface roughness (µm) values of Silver Lime (*Tilia argentea* Desf.).

Property	x	SD	V	CV	Minimum	Maximum	N
Ra	9.051	1.324	1.753	14.63	7.29	11.33	100
Ry	78.75	12.811	164.13	16.268	61.97	105.3	100
Rz	64.216	10.226	104.57	15.925	49.07	86.5	100
Rq	11.83	1.577	2.487	13.33	9.3	14.67	100

conditions and ecological factors. In particular, altitude, soil and climate are the most influential ecological factors. In addition, tree age, sample size, ring properties (for example, ring width and ring orientation), and the test procedure also affect test results (Haygreen and Bowyer, 1996). As most of these factors (except test procedure) were different in the reference (Sachsse et al., 1988), it is difficult to explain the different density findings for the same species. However, additionally tree age difference, and sample preparation could be one of the effective factors.

Sachsse et al. (1988) found wood density separately for hearth wood and sap wood and calculated mean density on equal sample size. However, we did not separate sample as hearth wood, sap wood or together considering the material usage in practice. Our hearth wood ratio might have been higher than the other study. Wood density is accepted as a good indicator of mechanical properties (Forest Products Laboratory, 2010). The existence of a strong relationship between wood density and strength has been demonstrated by several investigators (Kollmann and Cote, 1968; Pernestal et al., 1995; Hernandez, 2007). Since Silver Lime (*Tilia argentea* Desf.) grown in Turkey has mid-density value among all of the species (Table 6), higher strength values were normally expected. Although, the density value of Silver Lime is lower than beech (*Fagus* ssp.) and birch (*Betula* ssp.), it had closer or higher hardness values (Table 6). Differences of mechanical properties should be explained by both density and presence of extractives (Hernandez, 2007). Therefore, extractive contents, anatomical properties and chemical composition of Silver Lime (*Tilia argentea* Desf.) should be investigated.

Hardwoods can be classified as low ($I_s < 6$), fair ($6 < I_s < 7$) and good ($7 < I_s$) quality according to their static quality value (I_s). Limit values for the classification change depend on density and hardness of species. According to this classification, Silver Lime (*Tilia argentea* Desf.) has a good quality wood. Furthermore, dense hardwoods, such as Silver Lime (*Tilia argentea* Desf.), can also be classified as low, fair and good quality according to the value of dynamic quality (Id). Id < 1 is low quality, 1< Id < 2 is fair quality and 2 < Id is good quality wood. According to this classification, it can be said that the Silver Lime (*Tilia argentea* Desf.) has a good impact quality. Woods can be classified as low ($S_E < 2$), medium ($2 < S_E < 3$) and the toughest ($3 < S_E < 4$) quality according to their toughness value (S_E). According to this classification, it can be said that the Silver Lime (*Tilia argentea* Desf.) has

Table 6. Comparison of physical and mechanical properties of Silver Lime (*Tilia argentea* Desf.) with other tree species.

Species	Property													Hardness (kN)		References
	D_{m0} (g/cm^3)	D_b (g/cm^3)	β_v (%)	α_v (%)	FSP (%)	MOR (N/mm^2)	MOE (N/mm^2)	σc// (N/mm^2)	$\sigma t_\perp$ (N/mm^2)	$\sigma t_{//}$ (N/mm^2)	σi (J/cm^2)	τ_{aB} (N/mm^2)	σs (N/mm^2)	//	⊥	
Tilia argentea Desf.	0.504	415	13.398	20.401	32.28	72.026	5206.026	50.531		90.521	6.708		0.598	0.636	0.569	
Corylus colurna L.	0.699			16.150		115.44	12749.586	115.44		89.910	4.09	7.854	8.364	1.342	1.250	(Korkut and Hiziroglu, 2009; Sevim et al., 2008)
Sorbus aucuparia L.	0.737	0.635	15.048	18.465	23.79	115.571	9843.857	55.027	6.187	120.71	14.849	12.792	0.941	1.416	1.159	(Korkut et al., 2009)
S. aucuparia	0.570					84.220		40.473		97.671	6.415					(Sachsse et al., 1988)
Ostrya carpinifolia Scop.	0.854	0.671	23.02	24.9	34.21	131.5	11501.06	66.94	7.11	105.5	18.66	24.505	1.132	6.89	5.63	(Korkut and Guller, 2008)
Carpinus betulus	0.790		18.8			160	15260-16200	48.3-82		135	8-12			4.80	4.04	(Bozkurt and Erdin,1997; Goker et al.,1999; Aydin and Yardimci, 2007)
Ostrya ssp.	0.760	0.630	18.6		29.52*	91.7	7929	58.61			24.62	12.342	1.00			(Alden, 1995)
Alnus glutinosa	0.454	0.399	12.62	13.78	32.87	77.53	8611.81	41.48		76.3	5.7			2.83**	1.47**	(Guller and Ay, 2001; Korkut and Guller, 2008)
Fagus orientalis	0.645	0.538	16.21	17.84	30.13	83.3***-110	12829.3	61.7***	7.14	131.6	9.5	9.9	0.74	6.9	4.99	(Bektas et al., 2001,2002)
Nothofagus menziesii	445-650					79-124	13000***	33-63								(Olson, 2003)

Table 6. Continue.

Betula pendula	0.610		13.7		144	16180	51							2.2-4.9	(Bozkurt and Erdin,1998)
Betula lutea		0.55	16.8	30.55*	114.5	13858.5	56.33	6.34		14				5.6	(Anonymus,1987; Haygreen and Bowyer,1996)
Quercus dschorochensis K. Koch.	0.681		17.37		128		57		112		10	0.117			(Berkel and Göker, 1974; Goker et al.,1999; Aydin and Yardimci, 2007)
Ceratonia siliqua L.	0.810		12.4		122	11458.35	67					1.207	1.077		(Göker et al., 1999)

*Calculated value; **, Brinell hardness;***Mean value for different regions (Some reference values from different unit system converted to same unit system).

a low toughness quality (Kollmann and Cote, 1968).

The higher the density of the wood, the more it will tend to shrink (Haygreen and Bowyer, 1996). When comparing the shrinkage and swelling of Silver Lime (*Tilia argentea* Desf.) to other species (Table 5), higher values were accepted normal as a result of high density.

Conclusion

The General characteristics of Silver Lime (*Tilia argentea* Desf.), summarized from literature, and the information on swelling and shrinkage, quality and strength properties of Silver Lime (*Tilia argentea* Desf.) obtained from this study, provide a basis for more efficient utilization of these species.

There are lesser-known wood species, sometimes with similar properties to those well-known species, which are less exploited and used because of their poorly known properties. Thus, further research to determine their properties and possible end uses is likely to be beneficial to the country (Ali et al., 2008).

Unfortunately, until now, no data are available about species status and availability in the forest. Therefore, an updated forest inventory is necessary. The Ministry of Environment and Forestry of Turkey is aware of this need and forest inventory with species status is an ongoing process. Thus, research on lesser-known species, provided that they exist in significant abundance, should be carried out in the near future.

Consequently, Silver Lime (*Tilia argentea* Desf.) wood is a suitable raw material for walking sticks, turnery, carving, firewood, bow, tool handles, novelties, levers, mallet heads, bawl, platter, splitting wedges, canes, carpentry, wooden wares, and especially flooring material. However, it is well known that growing stock of a species is a restrictive factor used to determine the preference of forest product industry. Due to a low growing stock of this species in Turkey, it is not possible to excessively use it especially in the flooring industry for the present. However, forest enterprise should give more attention to Silver Lime (*Tilia argentea* Desf.) wood which has the potential to be a valuable wood source in specific plantations.

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