

# TROPICAL PINES OF ODISHA

Report Card 2016



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### INTRODUCTION

To meet the demand of pulp wood & fuel wood in Odisha field trials of 25 nos. of tropical pines were conducted since 1958, in high altitude degraded forest areas of Koraput and Kandhamal districts. The growth performance of each species was recorded over the years and was analysed. It has been observed through comparative analysis that, the following have proved to be suitable for the state of Odisha.

1. *Pinus caribaea*
2. *Pinus oocarpa*
3. *Pinus kesiya*.

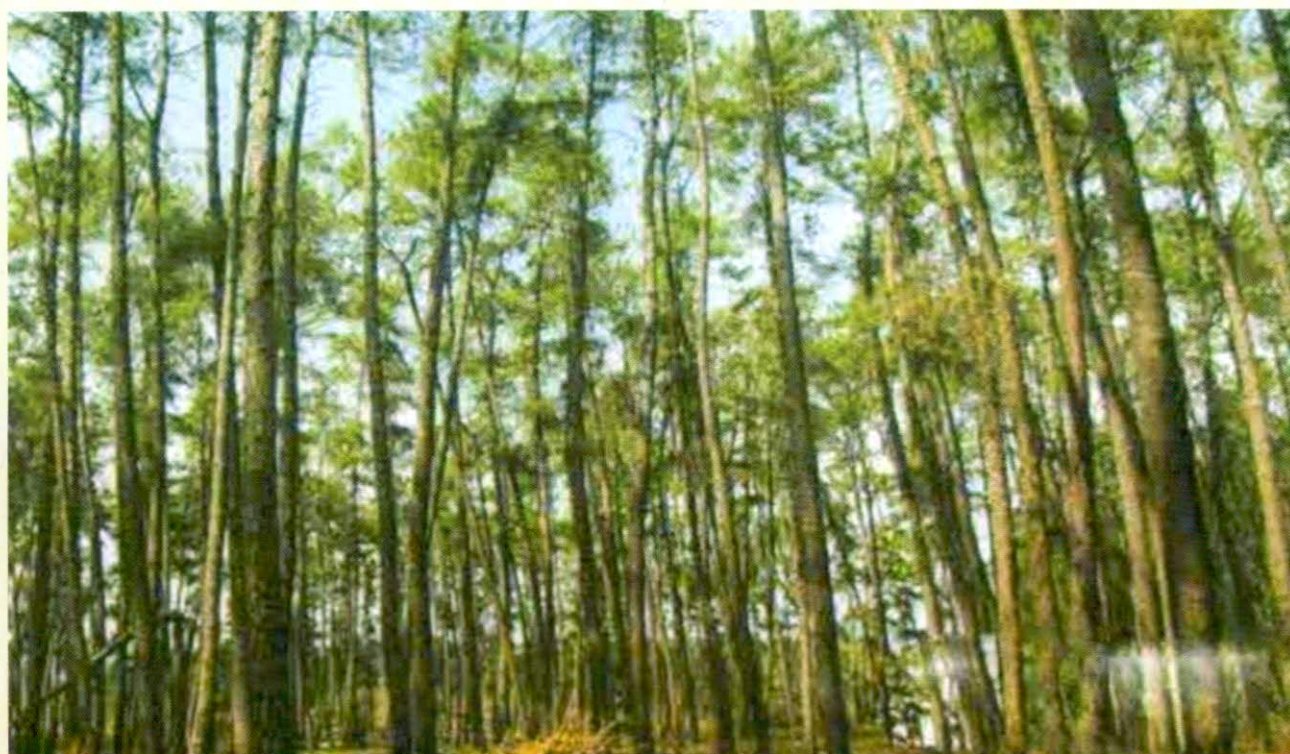
**1) *Pinus caribaea*:** - The *pinus caribaea* is a hard pine, native to Central America, Cuba, the Bahamas and the Turks and Caicos Islands. It inhabits tropical and subtropical coniferous forests, which include both lowland savannas and montane forests. Wildfire plays a major role limiting the range of this species. But it has been reported that this tree regenerates quickly and aggressively, replacing latifoliate trees. The succession continues and a tropical forest thrives in zones not subject to periodic fires. It has been widely cultivated outside its natural range. While the species as a whole is not threatened, the typical variety of Cuba has markedly declined due to deforestation and is now considered a vulnerable species by the IUCN. Population in Bahamas and Turks & Caicos Island would be particularly vulnerable in a global warming scenario due to the increase in sea level and consequent reduction in the emerged land area.



***P. caribaea*, 1975 - Kalinga**  
Date of Photograph - 07.02.2015



**2) Pinus oocarpa:** - *Pinus oocarpa* is a species of pine tree native to Mexico and Central America. It is the national tree of Honduras, where it is known as ocote. Common names include ocote chino, Mexican yellow pine, egg-cone. This species ranges from latitudes of 14° to 29° north, including western Mexico, Guatemala and the higher elevations of Honduras, EL Salvador and northwestern Nicaragua. An average temperature of 15 to 24° C and annual rainfall of 1,000 – 1,900 mm are needed for best development of the species. Preferred elevations are 900 – 2,400 m (3,000 – 7,900 ft.) above sea level. *Pinus oocarpa* was introduced for commercial production of wood for the paper industry in Ecuador, Kenya, Zambia, Colombia, Bolivia, Queensland (Australia), Brazil and South Africa.



**P. Oocarpa, 1976 - Daringbadi**

Date of Photograph - 07.02.2015

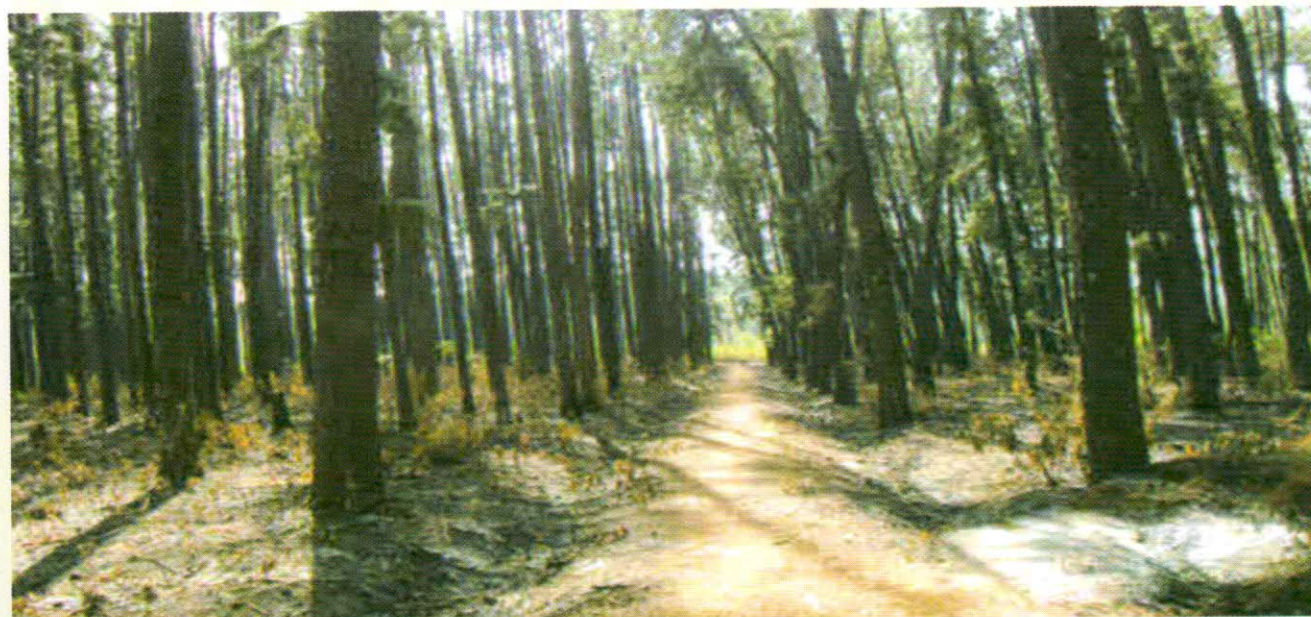
**3) Pinus kesiya:-** *Pinus kesiya* (Khasi pine, is one of the most widely distributed pines in Asia. Its range extends south and east from the Khasi hills in the northeast Indian state of Meghalaya, to northern Thailand, Philippines, Burma, Cambodia, Laos, southernmost China and Vietnam. It is an important plantation species elsewhere in the world, including in southern Africa and South America. The common name Khasi Pine is from the Khasi hills in India.

*Pinus kesiya* is a tree reaching up to 30-35 m tall with a straight, cylindrical trunk. The bark is thick and dark brown with deep longitudinal fissures. The branches are robust, red brown from the second year, the branch-lets horizontal to drooping. The leaves are needle like, dark green, usually 3 per fascicle, 15-20 cm long. The seeds are winged, 6-7 mm long with a 1.5-2.5 cm wing.



Pollination is in mid spring, with the cones maturing 18-20 months after. Khasi pine usually grows in pure stands or mixed with broad- leaved trees, but does not form open pine forests.

The soft and light timber of *Pinus kesiya* can be used for a wide range of applications, including boxes, paper pulp, and temporary electric poles. It is intensely used for timber, both sourced in natural forests and plantations.



**P. kesiya, 1967 - Daringbadi**  
Date of Photograph - 07.02.2015

### Field Trials of Pines

The following field and block trials of *Pinus caribaea*, *Pinus oocarpa* and *Pinus kesiya* have been tried in various Research Gardens of the Division Silviculturist, Bhubaneswar since long. The list of each trial with their December, 2014 measurements is furnished below.

#### **1. *Pinus caribaea*:-**

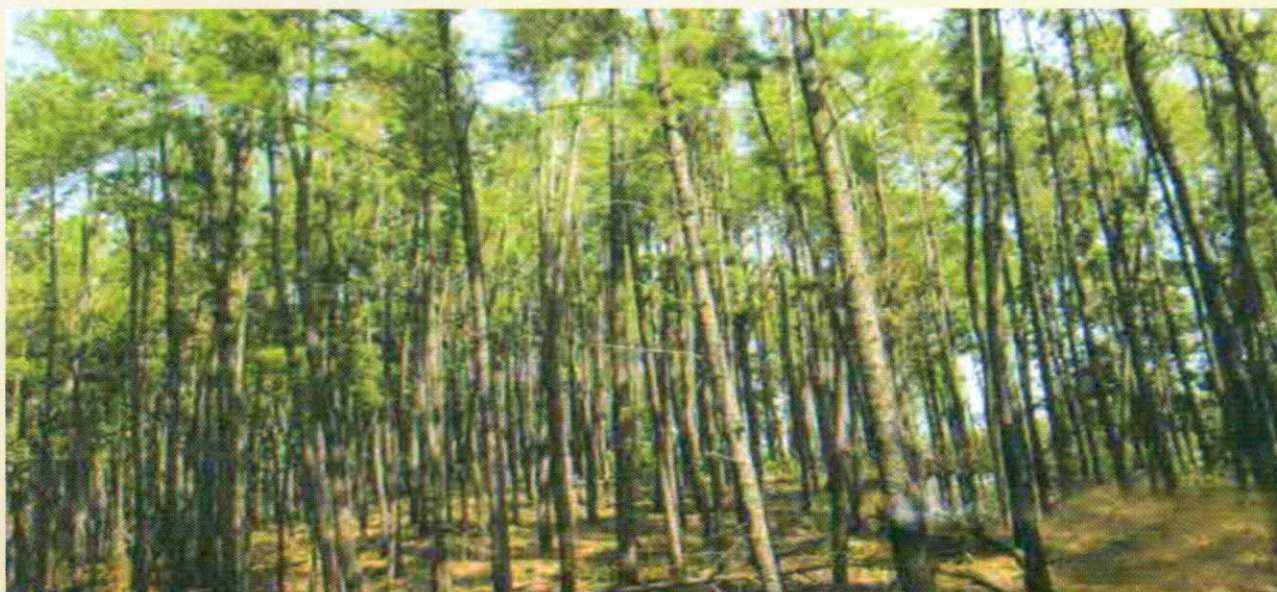
Divn. Expt.No	Origin	Place of trial	Years of trials(Age)	Av.Ht. (Cm)	Av.Dia (Cm)	M.A.I.		Sur. %
						Ht.	Dia.	
1	2	3	4	5	6	7	8	9
117/69	Bahama	Kalinga -I	1969(46)	3250	35.4	70.6	0.8	20
117/72	A. Island	Daringbadi	1972(43)	3450	29.3	80.2	0.7	60
117/72	Bahama	Daringbadi	1972(43)	3570	35.5	83	0.8	45
117/74	F.R.I.143/71	Kalinga -II	1974(41)	2990	33.3	73	0.8	25
239/78	F.R.I. 649	Kalinga -I	1978(37)	2740	32.4	74	0.9	30
415/78	F.R.I. 487	Kalinga -I	1978(37)	2770	26.9	74.9	0.7	45
225/78	F.R.I. 484	Kalinga -I	1978(37)	2970	32.2	80.2	0.9	50
117/79	F.R.I. 662	Daringbadi	1979(36)	3520	34.4	97.8	0.9	45
117/79	F.R.I.612	Kalinga -I	1979(36)	2890	32.4	80.2	0.9	45



Divn. Expt.No	Origin	Place of trial	Years of trials(Age)	Av.Ht. (Cm)	Av.Dia (Cm)	M.A.I.		Sur. %
						Ht.	Dia.	
1	2	3	4	5	6	7	8	9
487/79	F.R.I. 649	Kalinga -I	1979(36)	2500	30.8	69.4	0.8	48
117/79	F.R.I. 607	Kalinga -I	1979(36)	2710	32	75.3	0.3	50
117/80	F.R.I.649	Kalinga -I	1980(35)	2690	33.3	76.9	0.9	30
117/80	F.R.I.649	Daringbadi	1980(35)	3180	34.2	90.8	1	50
117/81	F.R.I.649	Kalinga -II	1981(34)	2760	32.8	81.2	1	25
117/82	F.R.I.4	Kalinga -II	1982(33)	2580	25.4	78.2	0.8	30
117/82	F.R.I.30	Kalinga -II	1982(33)	2770	26.7	83.9	0.8	40
06/85	Cuba	Kalinga -II	1985(30)	2880	35.5	96	1.1	30
117/87	Guatemala	Kalinga -II	1987(28)	2530	25.5	90.3	0.9	50

## 2. Pinus Oocarpa:-

Divn. Expt.No	Origin	Place of trial	Years of trials(Age)	Av.Ht. (Cm)	Av.Dia (Cm)	M.A.I.		Sur. %
						Ht.	Dia.	
1	2	3	4	5	6	7	8	9
162/72	Guatemala	Daringbadi	1972(43)	2690	33.4	62.6	0.8	40
162/79	F.R.I.604	Kalinga -I	1979(36)	3700	37	102.8	1	40
162/79	F.R.I.624	Kalinga -I	1979(36)	2880	29.5	80	0.8	40
162/79	F.R.I.625	Kalinga -I	1979(36)	3210	33.9	89	0.9	35
162/79	F.R.I.650	Kalinga -I	1979(36)	2880	35.4	80	1	40
162/79	F.R.I.608	Kalinga -I	1979(36)	2770	33	76.9	0.9	50
162/80	F.R.I.609	Kalinga -I	1980(37)	2780	36.6	75.1	1	30
162/85	T.P.R.C.64	Kalinga -II	1985(30)	2730	32	91	1	50



**P. oocarpa, 1971 Kalinga**  
Date of Photograph - 07.02.2015



### 3. Pinus kesiya:-

Divn. Expt.No	Origin	Place of trial	Years of trials(Age)	Av.Ht. (Cm)	Av.Dia (Cm)	M.A.I.		Sur. %
						Ht.	Dia.	
1	2	3	4	5	6	7	8	9
1/73	Shillong	Daringbadi	1973(42)	3580	40	85.2	0.9	30
1/74	Assam	Kalinga -II	1974(41)	2810	44.2	78.5	1	60
1/76	K & J Hills	Kalinga -II	1976(39)	2880	34.1	73.8	0.9	70
1/78	F.R.I.467	Kalinga -I	1978(37)	2880	31.9	77.8	0.9	48
1/78	F.R.I.502	Kalinga -I	1978(37)	2880	35.6	77.8	1	30
1/78	Assam	Kalinga -I	1978(37)	2870	32.4	77.6	0.9	50
1/79	F.R.I.502	Kalinga -I	1979(36)	2930	30.8	81.4	9	50
1/79	Assam	Daringbadi	1971(44)	3720	37.6	84.5	0.9	25
1/80	Assam	Kalinga -I	1980(35)	2620	27	74.9	0.8	30
1/85	T.P.R.C.91	Kalinga -II	1985(30)	2590	28.7	86.3	1	45

## KORAPUT RESEARCH GARDEN, SILVICULTURE DIVISION, RAYAGADA

### INTRODUCTION:

Koraput Research Range was functioning under the erstwhile Silviculture Division, Angul and subsequently under State Silviculturist, Bhubaneswar since 1962. After re-organization of Forest Department, Silviculture Division, Rayagada has been created and functioned with effect from 01.10.2003. Since then Koraput Research Range is under Silviculture Division, Rayagada. The Research activities at Koraput Research Garden were centered around the study of species trial of both indigenous and exotic, development of seed stand, seed orchards etc.. But first time introduction of Pine in Koraput hilly zone outside its natural zone was made during 1968 to find out the suitable species/ provenance for large scale plantation in Koraput hills. Species of different origin like *P.kesiya*, *P.caribaca*, *P.oocarpa*, *P.gregii*, *P.patula* etc. were tried in the Research Station. There are 07 numbers of Research Stations including Koraput Research Station. Total area of Koraput Research Station is 120 ha. inside Manahar PRF. Several Research Plots have been taken up inside Research Station in different patches.

### **GEOCLIMATIC CONDITION:**

#### **LOCATION :**

GPS reading of Koraput Research Station as detailed below:

N18 49' 01.43" E 8241'0.42"

#### **FOREST TYPE :**

Koraput Division has mainly dry deciduous forest and there are also patches of semi evergreen forest in small interior pockets.



**ALTITUDE :** 946 Mtr.

**CLIMATE :**

Climate depends on South West Monsoon with long dry season. Long spells (5-7 days) of foggy weather are noticed in rainy season.

**TEMPERATURE :**

As it is a hill station temperature is comparatively lower than other parts of Odisha. Maximum temperature 35c and Min. temperature 9 c.

**RAINFALL :**

Average annual rainfall is 1070 mm.



**Koraput Research Garden,**

Date of Photograph - 08.04.2016

**PROTECTION ACTIVITIES :**

As regards general protection this Research Station is under the control of Koraput Territorial Division. Our research staff is also remaining vigilant against the biotic interference, fire hazard and smuggling etc. Barbed wire fencing has been provided along the periphery of the Research Station. At some vulnerable places trenches were dug out along the boundary. Besides that, protection watcher as well as fire watcher during fire season has also been engaged for protection of plantation as the Pine conifer leaf is very sensitive towards fire. So in summer season major protection is given to Pine plantation.





**Barbed wire fencing to Pine Plantation 2012**

Date of Photograph - 08.04.2016

### **RESEARCH PLOTS**

Various tropical Pines were tried in this Research Station at an altitude ranging from 900 Mtrs. As Koraput is a hilly zone, its maximum temperature is 35 c and minimum 9 c and rainfall 1070 mm. So several Research Plots have been taken in this Research Station. Out of those 05 numbers of Sample Plot have been taken for growth study of height, girth and mean annual increment inside the Research Plots. The previous data were recorded during December, 2004. Next data were recorded during 2014-15.

Details of measurement of height, girth and mean annual increment are shown as detailed below, being recorded during 2015.

Koraput Research Station *Pinus oocarpa* (year 1981), Measurement year 2015,



**Sample Plot No.1.**

SL No	Girth in Metre	Height in Metre	Average Girth (Mtr)	Average Height (Mtr)
1	1.52	27	1.10	21.73
2	1.04	28		
3	1.08	27		
4	1.25	26		
5	1.34	27.5		
6	0.95	25		
7	0.94	24		
8	1.05	22		
9	0.82	20		
10	1.48	24		
11	0.93	20.05		
12	1.35	24		
13	1.06	23		
14	0.76	19		
15	1.33	25		
16	0.78	19		
17	1.12	28		
18	1.24	27		
19	0.88	21		

Similarly the measurement of girth, height and other Sample plots of different Pine species are also taken to find out the mean annual increment.

**Coverage area of Pine in Koraput Research Station.**

Tropical Pine like *Pinus kesiya*, *Pinus carbae*, *Pinus oocarpa*, *Pinus gregii*, *Pinus patula* etc. were introduced in Koraput hilly area for research purpose outside its natural zone at altitude ranging from 900 Mtrs. to find out best species/ provenance suitable for large scale plantation for Koraput hills. The Pine plantation raised during 1962- 1980 over 50.01 ha. and 25 ha. Raised during 2012-13 to 2014-15.



a) Pinus kesiya plantation raised during 1969 to 1980 over	20.4 ha.
b) Pinus caribae plantation raised during 1968 to 1984 over	17.0 ha.
c) Pinus oocarpa plantation raised during 1972 to 1980 over	05.1 ha.
d) Pinus patula plantation raised during 1972 to 1981 over	02.7 ha.
e) Pinus gregii plantation raised during 1972 to 1978 over	01.0 ha.
f) Pine (Mixed) plantation raised during 1974 to 1978 over	03.9 ha.
g) Pine (Mixed) plantation raised during 2012 to 2014 over	25 ha.

**Total Area= 75.1 ha.**

### **Study of Strength Parameters of Pinus kesiya in Meghalaya and Odisha.**

It was decided to compare different strength parameters of Pinus kesiya growing in Odisha vis-a-vis Pinus kesiya of Meghalaya. It is pertinent to mention that Pinus kesiya is naturally found in Khasi hills of Meghalaya. The hilly district of Phulbani and Koraput also have similar climatic conditions and hence the plantations of Pinus kesiya in Odisha are expected to possess similar strength.

### **Climatic Condition of Khasi Hills, Meghalaya**

Average annual rain fall-1150 Cm., Elevation- 1525 Mtr.

Month	Maximum Temperature (Celsius)	Minimum Temperature (Celsius)	No. of precipitation days in the month
January	15.7	7.2	1
February	17.3	8.9	3
March	20.5	12.5	8
April	21.7	14.5	19
May	22.4	16.1	22
June	22.7	17.9	25
July	22.0	18.1	29
August	22.9	18.2	26
September	22.7	17.5	21
October	22.7	15.8	9
November	20.4	12.3	2
December	17.0	8.3	1



**Climatic condition of Phulbani (Elevation-485 Mtr)**

Month	Maximum Temperature (Celsius)	Minimum Temperature (Celsius)	Precipitation in Cm.
January	26.4	12.5	1.3
February	29.0	15.2	2.2
March	32.8	18.8	2.4
April	35.9	23.1	2.1
May	37.5	25.7	4.2
June	33.7	24.9	19.2
July	28.7	23.2	37.8
August	28.6	23.1	30.1
September	29.4	22.9	23.5
October	29.3	20.7	7.9
November	27.2	15.4	0.9
December	25.9	12.1	0.7

The study of various strength parameters like density, compressive strength parallel to grain, compressive strength perpendicular to grain, tensile strength parallel to grain, tensile strength perpendicular to grain and hardness was taken up. The specimens were prepared out of trees from Koraput Research Range of Silviculturist, Rayagada and Kalinga Research Range of State Silviculturist, Bhubaneswar. The experiment of wood strength was carried out at Institute of Wood Science and Technology, Bangalore.

The result of the experiment on wood strength of *Pinus kesiya* raised in Odisha is summarised below:

Name of the Test:	Values for Meghalaya specimen	Values for Koraput specimen	Value for Kalinga (Phulbani) specimen	Remarks
<b>Density (g/cc)</b>	0.537	0.525	0.627	Values for Meghalaya specimen were recorded at 14.5 % moisture content, that of Koraput at 11 % moisture content and that of Kalinga at 14 % moisture content.
<b>Compression parallel to grain.</b> Compressive stress at maximum load (N/mm <sup>2</sup> )	33.8	47.4	46.5	
<b>Compression perpendicular to grain.</b> Compressive stress at compression of 2.5 mm (N/mm <sup>2</sup> )	13.8	12.1	12.5	
<b>Tensile strength parallel to grain</b> Tensile stress at maximum load (N/mm <sup>2</sup> )	76.4	100.8	76.4	



Name of the Test:	Values for Meghalaya specimen	Values for Koraput specimen	Value for Kalinga (Phulbani) specimen	Remarks
<b>Tensile strength perpendicular to grain.</b> Tensile stress at maximum load (N/mm <sup>2</sup> )	2.6	1.9	2.0	
<b>Hardness</b>				
Side (kN)	1.8	2.2	2.7	
End (kN)	2.7	2.7	2.9	

It is observed that, the wood strength of *Pinus kesiya* raised in Odisha is almost equal to that of Meghalaya Pine. It is also observed that tensile strength parallel to grain and compressive strength parallel to grain is maximum in case of Koraput specimen where as Meghalaya specimen fares better when it comes to compressive strength and tensile strength perpendicular to grain but the difference is very small and hence these may be attributed to difference in moisture content, age of tree and time of conducting the experiment. General conclusion is that all the 3 specimens are almost equal in terms of various strength parameters.



**Plus Tree of *Pinus kesiya*, Koraput**

Date of Photograph-28.08.2015



## POINTS TO NOTE

- ❖ Pine trees are the most common coniferous trees worldwide, numbering around 100 species.
- ❖ Pines are sun-loving trees that do not grow well under shady conditions.
- ❖ Pine trees are evergreen, coniferous resinous trees, growing 3-80 m tall, with majority of species reaching 15-45 m tall. But the dwarf mugo pine (*Pinus mugo pumilio*) grows to a mature size of 1.20 m. tall.
- ❖ Pines are long lived, typically reaching ages of 100-1000 years, some even more. One individual of *pinus longaeva* is one of the world's oldest living organisms at around 4600 years old. This tree can be found in the White Mountains of California.
- ❖ Pines are mostly monoecious, having the male and female cones on the same tree. The male cones are small, typically 1-5 cm long, and only present for a short period, falling as soon as they have shed their pollen. The female cones take 1.5-3 years to mature after pollination. At maturity, the female cones are 3-60 cm long.
- ❖ Pines grow well in acid soils, some also on calcareous soils, most require good soil drainage, preferring sandy soils.
- ❖ Pine wood left outside can be expected to last no more than 12-18 months depending on the local climate.
- ❖ Because pines have no insect or decay resistant qualities after logging, they are generally recommended for construction purposes as indoor use only.
- ❖ Pine trees keep their needles for at least two years. As the older needles fall, new ones are ready to grow in their place. *Pinus longaeva* trees keep their needles for at least 30 years.
- ❖ Most pine trees produce lateral branches in large whorls running up a straight trunk, which makes the tree easy to climb.





**Pines in Koraput Research Garden**

Date of Photograph - 08.04.2016

**Prepared and Produced by:**

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