

INTRODUCTION OF PAULOWNIA IN PAKISTAN

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Introduction

Paulownia is the only tree genus in the family Scrophulariaceae which is primarily herbaceous. The genus has nine species of fast growing trees indigenous to China with wide distribution from 18 to 40° North latitudes and from 100 to 128° East longitudes. It grows equally well on the plains and in mountainous regions upto 2000 m altitude (Anon, 1986). One of its species (*P. tomentosa*) was accidentally introduced into United States about 150 years ago and now appears throughout the southern and central hardwood regions as naturalized wild plantation tree (Beckjord, *et. al.*, 1984; Hardie, *et. al.*, 1989). It also grows in Japan, Brazil, Paraguay and Argentina. Presently, the interest in the *Paulownia* species is increasing due to its ability in rooting and its tolerance of rocky, disturbed and relatively infertile soils. It is grown as an ornamental and in shelterbelts (Beckjord and Melhuish, 1983).

Paulownia has strong, light-weight and white to straw coloured wood with low shrinkage co-efficient and resistance to warping, cracking, and deformation. It is very good for thermal and electric insulation, has high sound conduction, is easy to plane, saw, and carve. It has beautiful wood colour and grain, and is rot-resistant. For these qualities, wood is highly sought and priced in Japan for veneers, construction material, furniture, musical instruments etc. Prices of imported logs are as high as US \$ 7 for a board foot (Hardie, *et.al.*, 1989).

Paulownia wood is utilized in China for house construction, aircraft, vehicle and ship components, packing boxes, plywood, furniture, toys, barrels, tea and fruit boxes, wood carvings, life rafts, sheds, surfboards, musical instruments and many other manufactured items. In Japan, *Paulownia* is also suitable for pulp and paper production and its wood is used as insulation material for cooling systems (Anon, 1986 and Hardie, *et.al.*, 1989).

Paulownia is one of the fastest growing trees in the world. It can produce commercial timber at six years of age under optimal conditions, and at 10 to 18 years of age under normal conditions. An added advantage is that *Paulownia* can be grown in conjunction with agricultural crops. Its deciduous nature, late leaf emergence and deep root system makes it a suitable tree species for intercropping.

Because of its fast growth and numerous uses, *Paulownia* is attracting the attention of foresters and landowners the world over. Pakistan lies between 23° — 30° and 36° — 45° North latitudes; the range within which all *Paulownia* species are found in China. Some species are likely to succeed under local climatic and soil conditions if high temperature

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and low rainfall are compensated by artificial irrigation as practiced in the case of poplar and mulberry cultivation in many parts of the country.

Keeping in view the above considerations, a project was initiated at Pakistan Forest Institute (PFI), Peshawar, with the financial assistance of International Development Research Centre (IDRC) for introducing *Paulownia* species in Pakistan. Seed of a number of *Paulownia* species was procured from the Chinese Academy of Forestry in 1989 and sown in the Institute nursery at Peshawar for seedlings production. This paper describes briefly the results of studies carried out on *Paulownia* so far.

Raising of Nursery

Paulownia can be propagated from seeds, root cuttings or stem cuttings. Preliminary nursery experiments at the PFI have indicated 43 to 76% seed germination for different *Paulownia* species and more than 50% survival of root cuttings. However, stem cuttings are difficult to propagate as compared to root cuttings. In a study conducted in April, 1989, stem cuttings exhibited about 90% less rooting as compared to root cuttings. Beckjord and Melhuish (1984) studied the effects of various concentrations of IBA on the propagation of stem cuttings of *Paulownia tomentosa*. He observed that fresh root weight increased as IBA concentrations increased, but survival of cuttings was about the same for many treatments.

Propagation from Seed

Seed requires pre-sowing treatment which consists of soaking of seed in warm and cold water. It is first wetted and then soaked in warm water (40° C) for 10 minutes, followed by soaking for 24 hours at room temperature. The seed is dried for one or two hours before sowing. The treated seed is afterwards sown in the nursery beds or containers. It is better to mix seed with dry sand as a spreader before sowing. This will facilitate a uniform distribution of seeds in the nursery beds (Anon, 1986).

Because the species prefer well-drained soils, the sowing medium should be any of the sand, silt or clay loams. It was observed in experiments conducted at the Institute that survival of seedlings after two months was significantly better in soil and sand mixtures of 1:1 and 4:1 ratio, than the soil mixture containing equal proportions of soil, sand and manure. However, the seedling growth was significantly better in the soil and sand mixture in 1:1 ratio as compared to 4:1 mixture.

The sowing beds (including containers) should be watered before sowing the seed. After sowing the bed should be kept moist using mist sprayers. Watering through spray should be done frequently and the surface should not be allowed to dry. Young *Paulownia* seedlings are susceptible to damping-off unless proper precautions are taken e.g., fungicide application or sterilizing growth media (Beckjord, 1982). Attention should also be paid to anthracnose disease which may infect the *Paulownia* seedlings. A large number of shoots die especially after rains when the weather is warm and wet. The prevention of injuries is important for normal seedling growth. In order to prevent damping-off and

anthracnose diseases, strong Bordeaux mixture or 0.1% pentachloronitro-benzene should be sprayed every 10-15 days when the seedlings have one or two pairs of leaves (Anon. 1986).

Transplanting of seedlings is done in two stages. In the first instance, seedlings are transplanted in containers after two weeks of germination when the seedlings develop at least two pairs of leaves and are about 1-2 cms tall. These seedlings are transplanted subsequently in the field nursery when they have attained a height of 3-4 cms in about 4 weeks and have four or five pairs of leaves. The soil of the field nursery should be sandy, silty or clayey loam, well drained and at least 0.5 m deep. The area should be tilled to whatever depth possible, shaped and levelled. The seedlings should be transplanted at a spacing of 75 cm \times 75 to 100 cm. The site should be protected from hot winds.

Seedling/Sapling Management

During first two to three months, the shoot portion of the seedlings grows slowly, while the root system develops relatively fast. At this stage the top soil should be worked to preserve its moisture and raise its temperature in order to accelerate the development of the root system. The field nursery should be irrigated once or twice a month depending upon the climatic and soil moisture conditions. The saplings attain a height of about 4-5 m at the end of the growing season. The saplings should be lifted from the nursery in December/January and planted in the field during the spring season. There is considerable mortality of seedlings in seed beds, containers and field nursery as shown in Table 1 and 2.

Propagation from Roots

One year old saplings lifted from the field nursery for field planting provide root cuttings for vegetative propagation. All the lateral roots of 1-4 cm diameter are trimmed to the base and the tap root is reduced to 15-30 cms length. The root cuttings are converted into 10 to 15 cms long cuttings. In order to prevent roots from being buried upside-down, their tops should be cut flat and their bottoms slanting. The cuttings are air-dried for 3-5 days depending upon the weather conditions. In order to accelerate growth, and the formation of root and shoot primordia, the cuttings are placed in the moist sand for a week and covered with polythene sheet to raise the temperature. They can be taken out of the sand when their bark shows cracks and a few root and shoot tips emerge. At this stage, the cuttings are ready for planting in the field nursery. The rest of the tending and management techniques are the same as for the seedling nursery.

Field Planting

Paulownia is very adaptable and can be planted in plains and mountainous regions up to about 2,000 m elevation. However, it is best to plant it on land with fertile, deep, loose, sandy loam or loamy soil with good drainage and a water table deeper than 1.5 m. Planting in single or multiple rows or along water channels, paths, roads and farm boundaries; around houses and cattle sheds, and on the marginal land would ensure full

TABLE 1

SURVIVAL OF PAULOWNIA SEEDLINGS IN CONTAINER NURSERY

S. No.	Species	Provenance	No.	No. of seedlings pricked out	Survival after 4 months	
					No.	%
1.	<i>Paulownia fortunei</i>	89- 1		244	78	32.0
2.	<i>Paulownia fortunei</i>	89- 2		306	10	3.3
3.	<i>Paulownia fortunei</i>	89- 4		425	30	7.1
4.	<i>Paulownia fortunei</i>	89- 6		165	28	17.0
5.	<i>Paulownia fortunei</i>	89- 9		369	103	27.9
6.	<i>Paulownia elongata</i>	89- 3		532	11	2.1
7.	<i>Paulownia elongata</i>	89-13		362	74	20.4
8.	<i>Paulownia australis</i>	89- 5		546	95	17.4
9.	<i>Paulownia australis</i>	89- 8		56	27	48.2
10.	<i>Paulownia kawakamii</i>	89- 7		13	8	61.5
11.	<i>Paulownia kawakamii</i>	89-10		177	49	27.7
12.	<i>Paulownia fargesii</i>	89-11		1341	242	18.0
13.	<i>Paulownia tomentosa</i>	89-14		1270	287	22.6
14.	<i>Paulownia catalpifolia</i>	89-12		57	5	8.8
15.	<i>Paulownia tomentosa</i>	(PFI)		274	89	32.5
Total				6137	1136	18.5

TABLE 2

SURVIVAL OF PAULOWNIA SEEDLINGS IN THE FIELD NURSERY

Species/Source	No. of plants planted April, 1989	Survival in November 1989	
		Number	Percent
<i>Paulownia fortunei</i> (China)	1015	623	61
<i>Paulownia tomentosa</i> (China)	81	56	69
<i>Paulownia tomentosa</i> (Peshawar, Pakistan.)	486	300	62
<i>Paulownia elongata</i> (China)	192	137	71
<i>Paulownia fargesii</i> (China)	192	128	67
Total	1966	1244	63

use of all the available land on any farm.

According to techniques developed by the Chinese Academy of Forestry, the trees should be planted at 5 m intervals in single rows and at 5×6 m spacing in multiple row strip plantings. For block plantations, the initial spacing of planting could be 6×6 m, 5×5 m or 5×4 m, with 278, 400 or 500 trees per hectare respectively. Thinning can be carried out when the trees are 5-6 years old, alternate rows can be removed in block plantations to give a final spacing of 6×12 m, 5×10 m or 5×8 m. Further, the size of saplings will determine the dimensions of the pits. Generally these are 70-80 cms wide and 50-60 cms deep. Surface soil and sub-soil is kept separately at the time of digging of pits and the surface soil is mixed with manure and put in the pit before the saplings are planted.

Planting of entire plants

The saplings should be graded on the basis of their height before planting. Tall saplings should not be planted in areas with poor soils and strong winds. The root should be retained as much as possible while digging out the saplings in the field nursery. 4-5 m high saplings normally require 40 to 50 cm root length. The depth of planting should be 6-10 cm deeper than the height of root collar of saplings in the nursery. After planting, earth should be heaped around the saplings to a height of 15-20 cm.

Planting of root cuttings

Root cuttings are also suitable for field planting when there are insufficient saplings for afforestation. Root cuttings reduce transplanting costs and shock. However, the resulting plantation will be uneven in structure as the trees may be of different sizes.

Protection

The bark of the saplings and young trees is very thin. Bark injuries heal with difficulty and damage timber quality. Therefore, bark injuries caused by various agencies should be avoided. As *Paulownia* trees are tall and have few roots in the first one or two years, strong winds and rainstorms often cause inclined stems which should be straightened out, propped up and firmed immediately.

Watering

Timely and regular watering should be carried out especially during the dry season. Saplings should be watered once on the day of planting and should be watered again seven to ten days after planting. Flooding causes maximum damage. The growth of *Paulownia* is adversely affected and its leaves wilt or drop and the plant dies when it is submerged during flooding. Therefore, a well laidout drainage and water run off system is essential.

Pruning and Debudding

The pruning of *Paulownia* trees promotes growth of a single stem at the rate of about 2.4 m (8 ft.) each year for the first two years, and debudding stops branch formation on the stem. The growers are encouraged to carry out these operations during the second, third and fourth year after planting for production of high quality timber and high economic returns (Hardie, et.al., 1989).

Thinning

The time of thinning *Paulownia* plantations is very closely related to the initial planting density. In a plantation with initial spacing of 5×5 m or 6×6 m as well as in single or multiple row planting of close spacings, the first thinning should be carried out five or six years after planting.

Rotation

Depending upon the objectives of management and market requirements, rotation is fixed between 10 to 20 years, although with good management practices, trees of timber size can be grown in five to six years. In China, different species of *Paulownia* produce 0.2 to 0.6 m³ of timber per tree in 10 years. Similar growth rate is expected in Pakistan.

Acknowledgements

The authors are indebted to the International Development Research Centre (IDRC) for providing financial assistance for the project "Paulownia Research in Pakistan". Thanks are due to Dr. C.B. Sastry, Senior Programme Officer, IDRC Regional Office, Singapore and Mr. Xiong Yao gao, Researcher, Chinese Academy of Forestry, Beijing for providing support and assistance in the implementation of the project.

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