Trees for Life Journal
a forum on beneficial trees and plants
Open access, freely available online

Essays

Paulownia: An Agroforestry Gem

Timothy Hall
President of Eco Ranchos, LLC, Ojai, CA. Office: (805) 640-8534; cell: (805) 794-1285

Introduction

The Paulownia tree has been grown in China for at least 2600 years. It may well hold the record for history's oldest plantation tree. In ancient times (221-207 BC), a book entitled *On Qin Dynasty* reported that thousands of Paulownias were planted around Arfang City in China (1).

Paulownia wood, a light-colored hardwood, has been revered for centuries by Japanese craftsmen because of its workability and

Figure 1: *Paulownia fortunei* in Santa Paula, California, approximately 5 years old

beauty. In the Japanese tradition, Paulownia was used to build *kotos* (Japanese harps) because of the wood's superior acoustical quality.

Paulownia species probably first came to the United States sometime during the mid-1800s, although researchers have also discovered evidence that the genus Paulownia grew in the northwestern United States in prehistoric times (2). Because the seeds are very tiny and light in weight (1.75 million per pound), the Chinese immigrants often used the seed to cushion their dishes and other breakables when shipping from the Orient. Some seeds undoubtedly escaped and took root. About 1970, a group of Japanese wood buyers, while driving through Virginia, noticed the trees growing wild. The Japanese began buying up these old-growth (*P. tomentosa*) Paulownia logs. By 1979, U.S. growers established a commercial plot with three acres of *P. elongata* planted in Polk County, North Carolina.

The genus *Paulownia* is found in the family *Scrophulariaceae*, and is composed of nine major species. All originate in China except *P. fortunei*, which is found in Vietnam and Laos. *P. tomentosa* also grows in Korea and Japan. Some common names for Paulownia include Empress Tree, Royal Paulownia, Royal Princess Tree, and *Kiri* (Japanese). After China opened its doors to the West following their Cultural Revolution, an Australian was able to travel to China and return with several varieties of Paulownia. In early 1992, a California joint venture was formed to market two of these varieties in the West: *P. fortunei* and *P. kawakamii.* Today we find Paulownia growing on every continent except Antarctica.

Background

Let me begin by sharing with you a little about my background in agriculture and silviculture, specifically as it relates to Paulownia.

As a teenager, I spent my summers in the mountains of Central California working on a large cattle ranch, riding the range, growing alfalfa, and planting apple orchards. I could feel my life changing, and that is when I discovered the intrinsic value associated with farming—hard work, but very rewarding.

I studied agriculture in school, completed two tours of duty in Vietnam, and then in 1970 was asked to participate in the development of subtropical commercial fruit plantations in the Sonoran Desert of Northern Mexico. I became a partner in a large ranch, developing a 100,000 tree nursery and working as a farm advisor. During a part of each year, I worked as a sub-tropical fruit researcher in the Central Valley of California, and co-authored a

Contact: Timothy Hall
E-mail: eco_ranchos@msn.com
Published: April 29, 2008

The electronic version of this article is the complete one and can be found online at: http://www.TFLJournal.org/article.php/20080418100402327

Trees for Life Journal 2008, 3:3

booklet for the University of California Extension Service. In the 1980s, I worked in Mexico to promote the commercial establishment of Amaranth, a native grain of Mexico.

I first read about Paulownia in the early 1990s. In 1992, a group of Australian and American investors arranged a joint venture to market the Paulownia in the United States. Their company, known as Sapphire Dragon Corp., established a nursery in Santa Paula, California. As far as I know, this was the first commercial production of Paulownia in the Western U.S. By early 1995, after some unsuccessful attempts to market the Paulownia in Mexico, Sapphire Dragon called upon me to market two Paulownia species (*P. kawakamii* and *P. fortunei*) in Mexico. By this time, I had married a woman from Mexico City and our three children had been born in Mexico.

The Wood

I read all the technical information about Paulownia I could get my hands on. I was truly impressed, but I still had doubts about the various incredible assertions made about the wood. I soon set about to see for myself what the wood was capable of doing. I obtained several 3-year-old logs, and eventually ordered some milled 12 year-old *P. tomentosa* from a fellow member of the American Paulownia Association, Bob Davis. My brother (a home builder who has a cabinet-making shop) and I began testing the wood. We cross-cut the wood, stained it, air dried the logs, and varnished it. We milled it, hammered nails into it, and planed the wood. We also had musical instruments, wood carvings and molding made from it.

We were eventually convinced of the stories told about Paulownia wood. Both the juvenile wood of *P. fortunei* and the older *P. tomentosa* performed well. The wood had lived up to the claims, and then some.

During this time, I took a trip to Mexico where friends in the agricultural community—both private and government—received Paulownia with overwhelming enthusiasm. By mid-1995, my brother and I formed Eco Ranchos (a California partnership) to market Paulownia. By mid-1996, we became members of the Paulownia Association and formed a Mexican corporation, Eco Ranchos, S.A. de C.V., whose focus from the beginning has been large reforestation projects.

We soon generated tremendous interest in nearly a dozen states in Mexico. Sapphire Dragon Corp. proved incapable of filling our orders, which created a challenge. We were, by necessity, forced into the propagation and cultivation of Paulownia.

The Plant

Now that we were getting into the business of growing the tree, we were anxious to see how well the plant would perform under different conditions. Would it really do all it was reported to do?

We worked with three species of the genus *Paulownia*. We propagated plants using both seeds and root cuttings and experimented with cloned plants. We also tried using many combinations of planting mixes, in different sized containers and at different stages of propagation. We planted trees with different exposures to heat, light, and humidity. We subjected our plants to various amounts of water and lack thereof. We also tried transplanting early and late. We exposed the plant to freezing temperatures and desert highs of

Figure 2: This *Paulownia fortunei* "mother tree" resulted from a breeding program to produce a strain well-suited for lumber. Selected from 1700 trees started mostly from seed and grown for seven years, its trunk is 60 feet tall and has very little taper, making it valuable for lumber production. This tree is being reproduced through tissue culture cloning and root cuttings.

115 degrees F and higher. We also had plants growing from about 19° N latitude to about 40° N.

Not only have we pruned in various ways, but we have also coppiced in every season, and allowed insects to have at it. We have made intentional mistakes in every way possible, and the plant has been pushed to its limits. After all of our testing, we ended up producing Paulownia in both Mexico and California.

Benefits of Paulownia

The plant itself can be used in many beneficial ways. Just to name a few, the plant has capabilities for ornamental living posts, as livestock fodder and in honey production. It would also create a barrier for forest erosion and of course would be excellent for wood production.

I will highlight a few specific ways in which Paulownia can have a positive effect on the water, the land and the air.

Water

Let's first look at a few ways Paulownia can be used to reduce water pollution. Paulownia can be used to help alleviate the problem of livestock effluent. This liquid run-off can be a big problem, especially for dairy and pig farmers. A Paulownia plantation surrounding such a farm—in any configuration—can help consume much of the run-off, while producing shade, honey and wood at the same time.

Effluent from food processing plants (such as fish and shrimp processing) can be piped to Paulownia plantations where it can enhance the growth of trees, and the trees in turn can provide industry with carbon credits.

Figure 3: *Paulownia kawakamii* propogated from root cuttings, at three months old. This species is usually used for landscaping purposes.

Paulownia will also flourish from the use of gray water and sewage run-off. A friend planted a Paulownia directly above the end of a leach line to his ranch sewer system. He never irrigated it, but it grew to well over 20 feet tall in its first full growing season and is one of the healthiest Paulownias I've seen. This tree (*P. fortuneii*) is now more than 60 feet high and attracts much attention, especially when in blossom (mid-March to mid-April).

Land

To benefit the land, Paulownia can be used to reclaim mined areas, to prevent erosion, and can be planted on moderately toxic land sites. However, I think intercropping with Paulownia is by far the most land-benevolent use of this cultivar. Millions of acres around the world have been used—or should I say "over-used and abused?"—for centuries by planting the same annual crop (e.g. corn, cotton, wheat, rice, etc.). The topsoil, the root zone for these annuals, is often exhausted. When you intercrop with Paulownia, its roots reach down into soil perhaps never accessed by plant roots.

Paulownia roots—with the help of mycorrhizal fungi—probe deep into the soil, drawing up untapped nutrients through the stem or trunk, and eventually into the leaves where they are incorporated into organic material until, like clockwork, this precious organic material is broadcast in the large circle of the trees' leaf litter. Because of the partial shade, increased moisture, and this rich, high quality leaf-drop, the soil begins the miraculous process of regeneration. Depleted soil that has been over-fertilized, fumigated and often chemically choked is transformed and restored. A life-giving humus begins to form, and with it both flora and fauna microorganisms begin to thrive.

These microorganisms, the basis of almost every healthy ecosystem, begin to multiply on a non-stop, 24-hour basis. The soil is on its way back to a dynamically alive micro-universe, where just a handful of soil may contain millions of microbes.

Figure 4: *Paulownia kawakamii* blossoms

You might be saying, "Why sure, all trees perform this function in nature." However, the quality of the Paulownia leaf-drop is unlike that of many other tree and shrub species. Let's take for an example the eucalyptus tree. The eucalyptus is an invasive species that completely dominates the area around it. In order to prevent competition from other plants, the eucalyptus drops a toxic resin, making the soil uninviting to other plants (a process called allelopathy).

Many plants develop a beneficial or symbiotic relationship with a type of microscopic root fungus called "mycorrhizae," to help gather moisture and nutrients from the soil. It is known from fossil records and genetic evidence that soil fungi were present at the time when plants first colonized land. These fungi have co-evolved with plants to the present state. The fungi form a symbiotic association with the cells of roots. The host plant benefits from the presence of its fungal partner, in that mycorrhizal roots are more efficient than non-mycorrhizal roots. With the help of these fungi, plants can take-up far more of certain minerals than they otherwise would.

By inoculating our Paulownia roots with mycorrhizae fungi at the nursery stage, we can reduce disease, increase growth, improve stress resistance, and decrease transplant mortality. The result is a stronger plant, and of course stronger plants are much less likely to be bothered by pests and diseases. This research is based, in large part, on the work of Dr. Robert Linderman, a world-renowned USDA pathologist, whom I have had the pleasure of getting to know personally.

Air

When it comes to improving air quality, Paulownia is a star! It is an excellent plant for the sequestration of carbon and giving off of oxygen. As noted earlier, the plant is a fast grower, and the faster it produces wood (where carbon is stored) the more carbon will be taken up.

Selected Uses of the Wood

There are hundreds of established uses of Paulownia wood, and most likely an equal number of as yet undiscovered uses. In Table 1 I have provided a list, which is by no means exhaustive, of ways Paulownia has been used and is being used.

A friend of mine who lives in Arizona is a master flautist. I shared some small-diameter branches with him so he might test the wood. I thought the characteristic hole down the middle would help the process. He later wrote back to me, and I quote: "I have worked on my Bass Paulownia until it has become the pride of my collection. Without reservation, the Paulownia instruments are superior to any materials I've ever used. I recently played a gig where the acoustics were very live. People reacted as though it were a 'creature' sublime. I think it has been a turning point in my flute making journey/ experience." Maybe Paulownia could be just as successful in the construction of guitars and other musical instruments.

With all of the wonderful properties and uses of Paulownia—those known throughout the centuries and those recently discovered—this tree definitely merits further examination and experimentation. Its potential benefits in agriculture, environment, and industry have only just begun to be explored and utilized. Who knows how many other areas of human society and our world may benefit in the future from this "agroforestry gem."

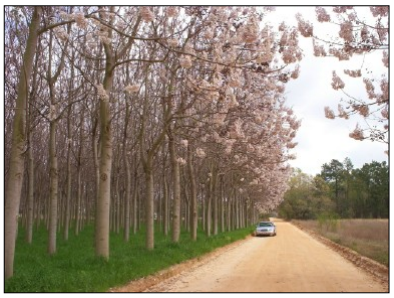

Figure 5: *Paulownia elongata* in Georgia, approximately 10 years old

Table 1: Uses for Paulownia wood	
Construction	Interior framing, including door and window frames
	Architraves
	Cabinet making
	Wall paneling and folding partitions
	Plywood, particleboard, and flake-board
	Furniture, especially with doors and drawers
	Automobile and yacht interiors
	Paneling and partitions in airplanes and ships
	Boat construction and paddles
	Beehive construction (resistant to cracking and warping, good insulation qualities, lightweight)
Containers	Decorative containers (pails, jewelry boxes, bowls, etc.)
	Humidors and cigar boxes
	Lining for safe deposit boxes
	Coffin construction.
	Pallets, boxes and crates (lightweight airfreight crating minimizes shipping costs)
	Packing material (natural insulation, biodegradable packing, no odor or taste)
	Food and gift packing (cuts thin, light and strong, free from odor or flavor: could pack specialty foods such as cheese, fruit, coffee, etc.)
Other uses	Arts and crafts: small stock (from crown of tree) used for paint brush handles, pencils, charcoal bars for sketching, etc.
	Shoe and sandal manufacturing
	Inscription plaques
	Filtration material for evaporation coolers

References

1. Chinese Academy of Forestry Staff (1986) *Paulownia in China: Cultivation and Utilization*, Asian Network for Biological Sciences.
2. Smiley CJ (1961) A Record of Paulownia in the Tertiary of North America, *American Journal of Botany* 48(2): 175-179