



***Acacia mangium*:** **Amazonia Reforestation's miracle tree**

An e-book for tropical tree investors
by **Dexter B. Dombro**, B.A., LL.B.

Miracle tree might seem like fairly strong language to describe a tropical tree. That is why I decided to prepare this e-book. If you are a green investor, or someone funding the planting of tropical trees, then learning why our **Amazonia Reforestation** and **CO² Tropical Trees** programs use *Acacia mangium* in their activities is important. We want you, the reader, to have as much information as possible when making your investment or carbon offset decision. With luck the facts in this e-book may even lead you to share some of the passion I have for tropical tree afforestation and reforestation.



Above: Looking up the straight trunk of a 9 year old *Acacia mangium* tree.



Above: First year *Acacia mangium* plantation.

Before I get into more detail, it is appropriate to review what each of the two programs I just mentioned does. **Amazonia Reforestation** practices mixed or multi-species afforestation of tropical trees in the Orinoco basin of South America. Investors are able to purchase trees in the program and reap a significant return on investment of as much as 33% per annum non-compounded in 10 years time. One of the tropical trees that make this possible is the fast growing *Acacia mangium*. We think of *Acacia mangium* as the profitable foundation of our enterprise.

This fast growing aspect of *Acacia mangium* is equally important in our other program, called **CO² Tropical Trees**. That program allows consumers to offset the CO² emissions of their car. It also assists industry and the oil and gas business to offset their CO² emissions, by having tropical trees sequester those CO² emissions and make them part of their woody biomass. This biological solution to climate change and global warming has numerous spin-off benefits, such as expanded wildlife habitat and socio-economic benefits for local communities. So sit back and enjoy an easy read as I discuss various aspects of this “miracle” tree.



Above: Average phyllode (leaf) on a young *Acacia mangium*.



Acacia mangium: Amazonia Reforestation's miracle tree

Origins, Distribution and Climate



Above: *Acacia mangium* belongs to the legume family of *Fabaceae*.

The common names for *Acacia mangium* include black wattle, brown salwood, hickory wattle, mangium, sabah salwood, mangium wattle, mange, forest mangrove and *zamorano* in Spanish. Its original habitat is Australia (Queensland), Papua New Guinea and some of the Indonesian islands. However, because of its amazing properties it has become a plantation tree of choice in countries such as Bangladesh, Cameroon, China, Colombia, Costa Rica, Hawaii, India, Malaysia, Nepal, the Philippines, South Africa, Thailand, Venezuela and Vietnam. *Acacia mangium* is a flowering tree that belongs to the legume or pea family, called *Fabaceae*.

Part of the reason for its wide distribution is the tolerance *Acacia mangium* exhibits to a wide variety of soil types, such as tropical soils, granite soils, ferralsols (*old geomorphic tropical soils*), luvisols (*mixed clay soils*), red soils, alluvial soils, sandy and well-drained soils and deep soils. *Acacia mangium* has great tolerance to low soil fertility, and is therefore ideal for reclamation use at strip mining projects or for erosion control. **Amazonia Reforestation** is successfully growing *Acacia mangium* in areas with a soil type of volcanic gravel.



Above: *Acacia mangium* doesn't mind red volcanic gravel.



Above: Our plantation gets about 2268 mm (89") of rain a year, with a mean temperature of 25°C (77°F), which are ideal conditions for *Acacia mangium*.

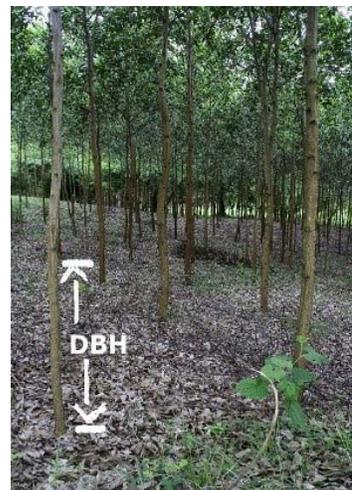
Another aspect that supports *Acacia mangium*'s wide distribution is its tolerance for a variety of tropical climate conditions. These include tropical dry to moist conditions and subtropical dry zones to wet forest zones. The best results, however, are achieved in areas with high rainfall. It does well in areas where the mean annual rainfall is between 1500 mm to 3000 mm (59" to 118" inches). *Acacia mangium* is also drought resistant, though of course prolonged dry spells will slow its growth. This makes it an important multipurpose tree for tropical low land conditions and climates. It prefers mean temperatures between 20°C to 25°C (68°F – 77°F), but does well in temperatures ranging from a low of 13°C (55°F) to a high of 33°C (92°F).



Acacia mangium: Amazonia Reforestation's miracle tree

Growth Rates and Density

To determine growth rates and other useful information we first have to know the DBH. DBH means the tree's *diameter at breast height*. The DBH is the spot on the tree that foresters use to measure and calculate things such as growth, volume, yield and amount of CO² sequestered. A diameter tape or tree calliper is used to measure the outside bark diameter of a tree. Breast height is defined as 4.5 feet (1.37 m) above the forest floor on the tree's uphill side. The forest floor is determined to be the ground level including the usual mulch on the forest floor, but not pieces of wood protruding above ground level. The forester takes the number of trees planted on 1 hectare (100 m x 100 m), or 2.47 acres, and then uses the DBH and tree height taken once a year on the same date to determine the increase in cubic meters of wood.



Above: Knowing where to measure is important.



Above: Hugs help the growth rate, too!

Acacia mangium has an excellent growth rate, and is generally considered ready for harvest in 10 years time. Based on average conditions, this table illustrates growth:

Age	Height	DBH	m ³ /ha/yr
2 years	7 m (26.25 ft)	9 cm (3.5")	14
3 years	10 m (32.8 ft)	14 cm (5.5")	25
4 years	15 m (49.2 ft)	35 cm (7.8")	30
9 years	21 m (65.6 ft)	50 cm (19.7")	46

Another table to understand growth by cubic meter:

Soil Conditions	Average m ³ per hectare per year
Poor soil and rain conditions	13.8 – 30.0
Well drained average soil	25.0 – 35.0
Well drained good or fertilized soil	35.0 – 50.0+

Acacia mangium is a hardwood tree with a density of between 520 - 690 kg/m³ at 12% moisture. To understand this we need to know that 1,000 kg of pure water = 1 cubic meter, so materials with a density under 1000 kg/m³ will float, while those that are more dense (weigh more than 1,000 kg/m³) will sink. Another way this is expressed is as 1.0 specific gravity. *Acacia mangium* has a specific gravity of 0.520 to 0.690, or less than 1.0 specific gravity, so it floats. Wood changes its size based on moisture content. Each tree species is different. It also makes a difference whether wood is kiln dried (*best*) or air dried (*may cause stress due to differential rates of drying from outside to inside*).



Above: Soon, these *Acacia mangium* trees will be measured for their growth rates, expressed as how many cubic meters of wood per hectare per year.



Acacia mangium: Amazonia Reforestation's miracle tree

Acacia mangium Products and Uses 1



Above: The wood can be kiln dried, with only a 2.5% radial and 8.5% tangential loss of volume.

The obvious primary use for *Acacia mangium* is wood. This straight trunk tropical tree is a hardwood with an extensive product range, including sawn or hewn building timbers, heavy construction uses, beams, boat building, containers, crates, boxes, industrial and domestic wood ware, tool handles, brushes, turnery, furniture, cabinets, flooring, decking, veneers, wood based materials like particleboard, fibreboard, medium density fibreboard, wood wool or excelsior, pulp and paper, charcoal and firewood. *Acacia mangium's* density and fibre length allows the wood to be sawn, polished, drilled, glued and washed without problems.

Besides its timber value, this tropical tree's fast growing nature is ideal for carbon sequestration programs. As we saw from its significant annual cubic meter growth this means that *Acacia mangium* can sequester an average of 50 lbs or 22.6 kg of CO² per tree per year. Since more than 50% of the average tropical tree's woody biomass is carbon, this is an excellent long term storage solution, as the carbon remains trapped in the wood even after harvest for uses like building material and furniture. Industries like oil and gas requiring carbon offsets, regardless of where they are located, can make use of *Acacia mangium's* excellent carbon sequestration properties. Atmospheric carbon is a global problem that can find a significant partial solution with tropical trees.



<http://www.co2tropicaltrees.com>



Above: 100 Africanized killer bee stings may cause death if not treated in time due to muscle paralysis. The author has suffered 70 stings at once, requiring an injection of muscle relaxants.

One surprising use is honey production. Africanized and other bees are attracted to *Acacia mangium*, because its petioles or leafstalks exude extra floral nectar year round, which allows for ongoing honey production. The bees also enjoy the flowers and are the primary pollinator for the tree. Beehives in *Acacia mangium* plantations produce up to 110 kg or 242.5 lbs of honey per hive per year, which is important for local economies and employment. The only disadvantage is the aggressive nature of Africanized killer bees, which means plantation workers and others need to take extra care when gathering honey or confronting bees.



Acacia mangium: Amazonia Reforestation's miracle tree

Acacia mangium Products and Uses 2

It has been suggested that *Acacia mangium* may offer a partial solution to ecological and human problems in sub-Saharan Africa due to 2 factors. The first is the tree's long history of doing well in reclamation and erosion control projects with poor soils. The second factor is its food value. The germinating seeds can be cooked and eaten as a vegetable. Studies indicate that the seeds are high in crude protein content. *Acacia mangium* shoots and phyllode leaves have also proven themselves as a crude protein fodder source for sheep and goats, though with low *in vitro* dry matter digestibility, so best eaten fresh. Together with honey production this offers opportunities for rural subsistence economies.



Above: Viable *Acacia mangium* seeds can be harvested after the second year of growth.



Above: *Acacia mangium* log

The tree's versatility can be determined from other facts as well. As a fuel *Acacia mangium* has a calorific value of 4,500 to 4,900 kcal/kg (8,098 to 8,818 Btu/lb). This makes it an excellent source for charcoal briquettes and artificial carbon where ecological fuels are required. Where paper making is concerned, the pulp is easily bleached to high brightness levels. The potential pulp yield of *Acacia mangium* is higher than that of other popular species, like Eucalyptus. The pulp and paper industry considers *Acacia mangium* ready to harvest after just 6 years of growth. Commercial exploitation of *Acacia mangium* for organic dyes is justified due to the tree's high tannin content, ranging from 18 to 39%.

Other promising products include particleboards and medium-density fibreboards (MDF). *Acacia mangium* can be used to make veneers and plywood with no special processing requirements. Wood wool or excelsior made from *Acacia mangium* is an excellent and affordable organic packing material. Recent research shows that wood wool cement boards made with *Acacia mangium* have significantly less swelling when immersed in water than do other types of boards. Yet others have discovered that *Acacia mangium* sawdust provides a good quality substrate for the lucrative production of shiitake mushrooms.



Above: *Acacia mangium* lends itself to the making of numerous products.



Acacia mangium: Amazonia Reforestation's miracle tree

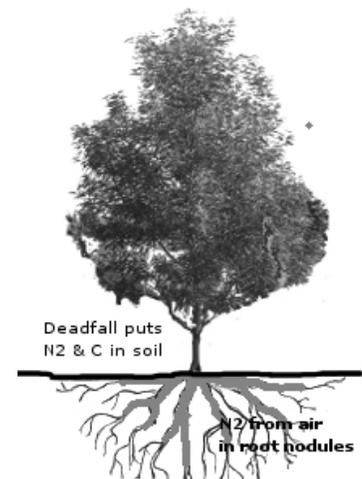
Acacia mangium Services and Applications



Above: *Acacia mangium* getting established in a reclamation area.

If you thought that is it, then you are in for a surprise. *Acacia mangium* is proving to be extremely useful in a number of settings. A significant application for this tropical tree is its adaptability to marginal and poor soil conditions. Numerous studies have touted *Acacia mangium* for serious land reclamation use. Examples include the extremely poor soil conditions found from open pit mineral mining and clay retrieval operations, or in situations where erosions has stripped away the top soil. It gets better. The tree has also shown itself, once it is a few years old, to be a reliable fire control barrier, something that is important to **Amazonia Reforestation**, because of our afforestation efforts in open savannah or prairie-like conditions.

Most importantly, *Acacia mangium* is renowned for its service as a nitrogen fixing tree (NFT) for agroforestry and for land reclamation. As a member of the legume family, *Acacia mangium* is one of the foremost NFT's in the world. Plantation studies suggest that *Acacia mangium* deposits about 50 - 400 kg of nitrogen per hectare per year (or 45 - 350 lbs per acre) in the soil, depending on climate, rainfall and soil conditions. Our atmosphere is 79% nitrogen gas (N^2), normally not easily accessible to plants. In fact, without nitrogen in the soil many plants stop growing. However, tropical NFT's like *Acacia mangium* work with a group of bacteria called *rhizobia* to extract nitrogen from the air and deposit it biologically in the soil, both through deadfall and along their root systems in nodules.



Above: Nitrogen Fixing Tree NFT



Above: *Acacia mangium* studies show it to have higher organic carbon accumulation in the soil than other species.

Another biological service provided by *Acacia mangium* is the accumulation of pollutants. Studies show that *Acacia mangium* is able to accumulate large amounts of heavy metals such as lead (Pb), cadmium (Cd), arsenic (As) and mercury (Hg), something that is very important for environmental health when reclaiming old mine and industrial sites. One study compared *Acacia mangium* to 3 other trees and found it to be one of the best species, producing the highest yield of timber, carbon content and pollutant accumulation in mine reclamation sites.



Acacia mangium: Amazonia Reforestation's miracle tree

Planting *Acacia mangium*

In a plantation setting *Acacia mangium* starts out as certified seeds from a reputable source. Once cleaned and treated, there is an average of 80,000 to 100,000 seeds per kilogram (2.2 lbs). Plantation workers put the seeds into a sprouting tray. Once sprouted (3 days), healthy seedlings are transplanted into planting bags. Groups of planting bags are usually kept in rows in the nursery for 2 to 3 months, during which the seedlings grow to an average of 8 - 10 inches or 20 to 25 cm, before they are moved to the planting site. While in the nursery they are watered with a light mist. Depending on the season they may be shaded with a woven nursery material to protect against sun.



Above: While the seedlings are getting ready, the ground is being prepared at the afforestation site.



Above: The ground is ploughed to a depth of 70 cm or 27.5 inches, which requires tractors that are over 100 HP in size.

The ground is deep ploughed, because most tropical trees set deep rather than wide roots, so loosening the soil assists seedlings in getting established. It also allows additional items to be added to the soil. Lime is added to make soil less acidic. *Acacia mangium* likes soil with a pH of between 4.5 to 6.5. Lime will also keep the soil soft in areas where it tends to harden. Usually a phosphorus fertilizer (chemical symbol P) is sufficient for *Acacia mangium* plantations, as it promotes growth and nitrogen fixing by the trees. The last ingredient is boron (chemical symbol B), which promotes timber and root growth and prevents diseases like leaf rust. In some instances, the use of boron results in smaller branches, meaning less knots and better quality wood.

The last step is the actual planting of the seedlings. At **Amazonia Reforestation** that is done in mid-rainy season, so that the seedlings don't get swamped, but at the same time have lots of water to give them a good start. The result is a fairly high survival rate and a robust seedling right through the dry season and into the next wet season. Seedlings are planted in long rows. Some plantations plant different species in each row to encourage competition for faster growth and healthier trees. A string is used to establish straight lines. *Acacia mangium* is usually planted 2.8 meters or 9 feet apart in a grid pattern, with some 1,200 trees to a hectare or 475 trees to an acre.



Above: Tropical tree planters work quickly. Within a week of planting *Acacia mangium* already shows growth and settles in to its new home.



Acacia mangium: Amazonia Reforestation's miracle tree

Harvesting *Acacia mangium* and Conclusion



Above: We encourage investors to visit their trees in Colombia.

Amazonia Reforestation and **CO² Tropical Trees** both work on a 10 year cycle. There are a few reasons for this. *Acacia mangium*, once older, is susceptible to heartwood rot (*Phellinus noxius*). This may occur in trees that are 12 years old and up. However, as the tree is fully mature and ready for harvest and commercial sale after only 10 years, there is no benefit in delaying harvest. It also means that investors who participate in **Amazonia Reforestation's** joint venture program can anticipate an ROI (return on investment) after only 10 years. For example, an investor who buys \$4,000 worth of trees can anticipate an ROI of \$17,000, which works out to a low risk high return annual gain of 33% non-compounded over the 10 year growth period.

Botanists have also noticed that like many other tropical trees, *Acacia mangium* is most effective at sequestering carbon in its woody biomass during the first 10 years of its life. That means when *Acacia mangium* is planted for the purpose of carbon offsets, it makes sense to rotate the trees in a 10 year cycle. More information on CO² sequestration can be found at www.co2tropicaltrees.com.

It should be noted that there are other diseases that may affect *Acacia mangium*, but they are generally not an issue when trees grown within a 10 year cycle receive boron, lime and fertilizer and are cared for using modern forestry practices. Any risks associated with disease are easily mitigated and managed in responsible plantation settings.

CO₂



Above: A helping fertilizer hand.



Above: The author at an *Acacia mangium* plantation in Colombia. His blog is at <http://www.co2tropicaltrees.blogspot.com>

It is my hope that this e-book will encourage you to get involved with tropical tree afforestation and reforestation, whether for profit, or to make your car carbon neutral, or to help us expand habitat for endangered wildlife. *Acacia mangium* is perhaps one of the most important tropical plantation trees in the world, with amazing properties that should whet your appetite to learn more about why we are so passionate about tropical trees and their role in stopping climate change. Please e-mail me, **Dexter Dombro**, at trees@myreforestation.com, or call me at **1-780-628-7281**.