

GROWING THE FOREST IN SOUTH AFRICA

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HYBRIDS ALLOW SAPPI AND MONDI TO INCREASE PRODUCTION OF PINE AND EUCALYPTS

FORESTRY IS A RELATIVELY NEW CONCEPT TO SOUTH Africa. For commercial purposes, in fact, the primary species grown are not native.

The country itself varies geographically from low coastal areas to high mountains. As a whole, it is a dry land, where only a relatively small percentage of the total is well suited to forestry. Through cloning and hybrid programs, however, South Africa's two major pulp and paper companies—Sappi and Mondi—have been able to expand their tree plantations to previously unusable sites.

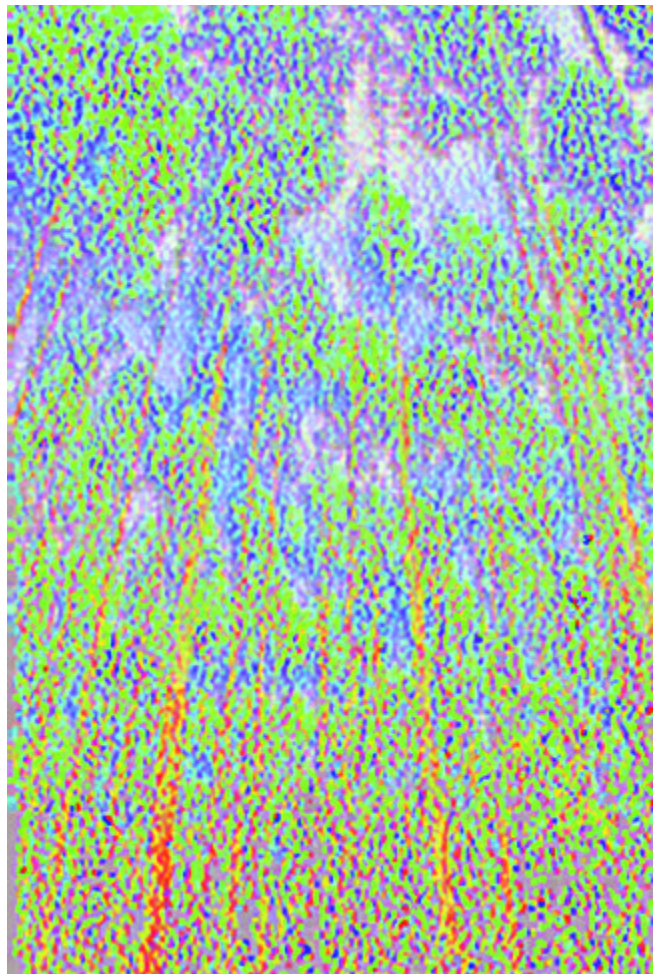
South Africa is reported to have about 1.5 million hectares of forest plantations (24% of which is owned by private individuals), with slightly more softwoods planted than hardwoods. *Pinus patula* and *P. elliotti* are the predominate softwood species; *Eucalyptus grandis* is the main hardwood. Most of the hardwood is used to produce pulp.

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Sappi's efforts focus on three tree-growing regions: Mpumalanga, Kwazulu Natal Midlands, and the Northern Kwazulu Natal coastline. Mpumalanga is a mostly highveld area. It's cooler than the other two areas, notes Martin O'Donovan, nursery manager at Sappi Fiber Logistic's Ngodwana nursery. The main species grown on the company's plantations in Northern Kwazulu Natal coastline are eucalypts. Pine trees and eucalypts are grown in Mpumalanga and the midlands.

Sappi also assists with the management of the Usutu pulp mill in Swaziland and has forestry operations there, as does Mondi (see related story, p. 65).

Forest research is based at the Shaw Research Station near Pietersmaritzburg in Natal and services the three main growing areas and Usutu. The bulk of the work is breeding. The researchers identify individual trees that perform well, based on factors such as growth, disease resistance and fiber quality.



A stylized view of mature eucalypts.

Following trials, the most promising material (could be seed or material for vegetative propagation) is given to the appropriate nurseries for propagation. Which trees are grown and where is ultimately determined by the company's land management and planning staff.



Examples of seeds grown at Sappi's Ngodwana nursery

The two main pine species are *Pinus patula* and *P. elliottii*. Among varieties of the eucalypts grown are *Eucalyptus nitens*, *E. grandis*, and *E. macathurii*.

Hybrids of mainly *E. grandis* and *europhylla* are grown on the Northern Kwazulu Natal coast line, because they are good growers and heat tolerant, O'Donovan explained.

The selection of material for vegetative propagation of pines is based mainly on performance of the family in trials. Seed from selected families is used to establish hedge banks to supply cutting material for propagation. Selection of material for vegetative propagation eucalyptus is based on performance of individuals. Cuttings are made of these individuals for the establishment of clone banks for the supply of cutting material for propagation. Sappi imports some of the seeds it uses for production. Pine comes from Zimbabwe and small amounts from Central America, eucalypts from South America and Australia. When shipments arrive, the seeds are put into cold storage -- averaging 4°C -- as soon as possible.



Sappi's Ngodwana nursery shelters its seedlings from rain and sun during their early development. A manually operated watering system is used to control the amount of water the plants get and reduce the potential spread of diseases.



Martin O'Donovan holds a packet of seeds being stored in the cooler at Sappi's Ngodwana nursery.

O'Donovan estimated that a kilogram of pine seeds might yield 20,000 to 40,000 trees. A kilogram of clean eucalyptus seeds might equal about half a million trees. The number of trees started each year is astounding: 10-13 million pine, eucalyptus and mearsii seedlings at Richmond in Natal, 17 to 20 million pine and eucalyptus seedling at Ngodwana, 5 million eucalypt cuttings at KwaMbonambi, and 2 million pine cuttings from Escarpment.

Before sowing, the seeds are placed in a bag and suspended in aerated water heated to about 25°C (77°F) for a day or two.

Hygiene is a critical factor in growing the seedlings, the water is chlorinated and pH adjusted. When necessary spraying helps get rid of disease vectors, amongst other things. The nursery uses a "curative" spray program rather than "preventative" spraying, O'Donovan said. It was begun as an environmental approach to reduce the use of pesticides, but it also makes economic sense, he said. Planting trays are also soaked in 74°C water for three minutes before being filled with medium.

The nursery at Ngodwana uses white plastic trays in which to grow seedlings. The plugs have a large hole at the bottom, giving roots more freedom to grow when

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One of Sappi's workers uses a pneumatic device to place seeds in growing trays.

planted in the field. The white trays are preferred because, amongst other things, they are easier to heat sterilize.

The plugs each hold about 90 cc of medium. They are filled by hand and arranged 49 to a tray. An operator using a vacuum-assisted device plucks individual seeds from an aerated tank. Seeds are dropped one to a plug from the tip of a needle, followed by a squirt of water. A light covering of medium is capped over each tray. When all the plugs have seeds, the trays are watered, covered and stacked inside for about five days. That allows the seeds to stay moist in a relatively warm environment to begin growing. On average, about 90% of the seeds will germinate, O'Donovan indicated.

Eucalypts take about four months from planting before the seedlings are ready for transfer to the forest; pine takes seven months.



Pine seedlings growing in a sheltered area at Sappi's nursery.

In addition to seedlings, the Ngodwana facility produces a high quality growing medium using bark recovered from the debarking drums at Sappi's nearby pulp mill. The first stage of the process is to simply pile the bark into mounds and allow it to sit for a minimum of 12 months. The bark is then milled into 25 mm lengths, saturated with water and Urea is added, then stacked about 3-m high. Every two or three weeks over the course of about nine months, the piles are shifted to promote aerobic activity. Temperatures inside the stacks may reach 70°C (158°F), effectively rid it of most harmful organisms. The finished product is one of the best available, O'Donovan asserts.

Part of the effort in developing trees has also been to evaluate the fiber qualities of the various hybrids. Charlie Clarke, program leader (eucalypts) at Sappi Forests' Shaw Research Centre at Howick, near Pietermaritzburg, has identified a number of differences between eucalypts that significantly influence variations in pulping. At last fall's TAPPSA conference in Durban, South Africa, Clarke presented his findings on variations in cooking rates for



The perfect seedling.

different types of eucalypts. He noted that "Differences in cooking rate of wood entering the digester are likely to result in loss in production and fiber quality. Classification and separation of timber before cooking may improve uniformity and allow greater precision in cooking." (An earlier study by Clarke on factors affecting pulp properties is reported on p. 89 of this issue of *TAPPI JOURNAL*.)

Various eucalypt breeding and genetic improvement studies have also been reported through the University of Pretoria and the Institute for Commercial Forestry Research (see <http://www.icfrnet.unp.ac.za>).

In addition to its tree research programs, Sappi conducts an annual environmental audit for each of its facilities. It is also involved in a number of environmental and conservation projects. One of those is the forest raptor research project. "By knowing more about raptors, we can manage their habitats better," the company explains in brochures available to the public. The five-year project

was begun in 1994 at Sappi's Venus tree farm in Mpumalanga. It has been conducted by the Raptor Conservation Group, an affiliate of the Endangered Wildlife Trust. The full study will consider "population densities, territorial sites, breeding information, habitat information, and ways in which to manage breeding sites."

Sappi also sponsors courses and programs about birds, supported the publication of a bird guidebook (*Sappi/Newman's Birds of South Africa*), and annually commissions wildlife artists for limited edition prints to raise money for the World Wildlife Fund in South Africa.

The company has registered a number of sites under the South African Natural Heritage Programme. It also encourages the use of hiking trails and bird hides on its lands.

MONDI FORESTS

Mondi Forests manages about 684,000 ha in South Africa, from which it harvests 4.5 million metric tons of



Errol Duncan among the eucalypt clonal hedges at Mondi Forest's KwaMbonambi tree improvement nursery.



A eucalypt coppice growing at Mondi Forest's KwaMbonambi nursery. The plastic covering retains moisture and stops weeds.

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A closer view of a eucalypt.



Eucalypt seedlings are protected from direct sun during their early development.

wood annually. Last year its seven nurseries had an annual growing capacity of 58 million plants, split evenly between clonal plants and seedlings.

Research and development at its KwaMbonambi nursery, not far from Richards Bay in KwaZulu-Natal, is primarily concentrated on subtropical eucalyptus species, especially *E. grandis*, *E. urophylla*, *E. camaldulensis* and *E. tereticornis*. The last two are the more drought tolerant, notes Errol A. Duncan, tree breeding manager for Mondi Forests at KwaMbonambi in Zululand. The nursery produces 12-12.5 million plants annually.

In the 1980s and 1990s, a small recolonization took place in Zululand. Sappi, Mondi, and Shell forestry competed against each other to acquire land in the region that they could use for forest plantations. Much of the land Mondi was able to acquire was from sugar cane farms.

Eventually Mondi owned 70,000 ha in Zululand. For the most part, though, the land was marginal for *E. grandis*, so Mondi set to work to develop hybrids better suited to these lands. The first efforts crossed *E. grandis* with *E. camaldulensis* and with *E. tereticornis*.

E. grandis is still the preferred tree for certain applications. Where it can't be grown, Mondi uses hybrids to obtain grandis-type fiber qualities. As it turns out, the hybrids can also give better overall efficiency and better density.

About 2% of the the trials yield the qualities the researchers seek, ranging from disease resistance to pulp yield to extractives. The challenge for the company's foresters is to also supply wood for mining timbers and lumber, as well as for pulping. In addition, the forest land ranges from coastal areas to elevations of 2000 m.

As part of its research, Mondi has established one of the single largest databases on eucalyptus clones, with profiles on more than 6000 clones tested.

In evaluating clones, the researchers look at physical characteristics such as the crown, the branches, the stems. A good crown will inhibit the growth of grasses and weeds, reducing the cost of using chemicals for that task. Reasonably small branches at right angles equate to smaller knots and less wastage and breakage for pulping. A good straight trunk allows more trees to be loaded on each truck for more cost effective transport.

Before planting any area, the researchers do soil surveys. Samples for research areas are taken every 30-50 meters on a grid, compared to every 150 meters for commercial areas. The data is entered into a CAD system and used to generate a soil map of the whole plantation. A committee then establishes a land use plan, plotting roads to follow contours and soil type boundaries.

In 1996, Mondi acquired the hardwood forests business of HL&H Timber. It brought two new markets to Mondi: mining support timbers and wood chips for export, primarily to Asian pulp mills.

A further benefit was the integration of HL&H's tree improvement program into Mondi's programs. That included the tree breeding center at White River, Mpumalanga and work HL&H had conducted on eucalypt hybrids, particularly cold-tolerant varieties such as *E. grandis* + *E. nitens*.

Mondi was a founding member of the Natural Heritage program. It follows a stringent environmental management system (EMS) based on an environmental self-assessment program (ESAP). About a third of Mondi Forest's land in South Africa will never be used for commercial forestry. Alternate uses that focus on conservation and preservation are being adapted. Those include game farming, propagation of rare plants, eco-tourism and trout farming.

Mondi encourages the neighboring communities to grow eucalypt hybrids. Because the trees are "self-pruning" (they drop their lower branches as they grow) they



Local women trim eucalypt cuttings at Mondi's nursery.



Eucalypt cuttings are set in medium and watered.

SWAZILAND HELPS FILL SOUTH AFRICAN FIBER NEEDS

The kingdom Swaziland lies directly between Mondi's mill at Richards Bay and Sappi's mill at Ngodwana. In an effort to expand their fiber resources, the South African pulp and paper companies have both undertaken forestry operations in this neighboring country.

"Commercial forestry in Swaziland is dominated by two companies: Mondi in the Pigg's Peak area and Usutu Pulp around Bhunya," the Swaziland government reports in its Economic Planning Office's Development Plan for 1997-2000 (<http://www.realnet.co.sz/devplan/contents.html>). "Mondi exports most of the wood from its forests to South Africa for pulp production, a small proportion as mining timber to the mines in South Africa, and the rest is sold locally to the sawmills."

"The forest around Usutu Pulp company is used for pulp production only and this mill supplies around 15% (following the expansion programme) of the world market for 'unbleached kraft pulp' (UBK). The wood can be grown fast (17 years between planting and felling) and does not require thinning and very little pruning. The comparatively short time required for growing wood in Swaziland puts it amongst the lowest cost locations for pulp production in the world," according to the Development Plan.

The bulk of the pulp wood grown in Swaziland's man-made forests is processed locally, the government report notes.

According to the 1999 *Swaziland Business Year Book* (<http://www.swazibusiness.com/sbyb/sbyb.html>), "About 36% of Swaziland's area is under indigenous or man-made forests." Forestry "accounts for about 17% of formal employment and 13.7% of export revenue, provides raw materials for many value added

products which between them account for a significant proportion of Swaziland's export commodities."

During 1997, the majority of shares in Swaziland's Usutu Pulp Company were purchased by Sappi and the name was changed to Sappi Usutu.

"The 70,000 hectare Usutu Forest, containing some 70 million trees and comprising 4% of Swaziland's area, is one of the largest man-made forests in the world while the mill is the third largest producer of unbleached kraft pulp (UBK), supplying about 12% of the world's requirements," the Year Book reports.

"Construction of the pulp mill at nearby Bhunya began in 1960 and today capacity has increased to 220,000 metric tons/year. The flash-dried, unbleached soft wood kraft pulp is used to manufacture brown paper, cardboard, cement sacks and certain types of tissue paper, among other products. Advanced silvicultural techniques allow for average growth of 25 m³/ha each year with trees maturing at between 15 and 20 years."

"Usutu Pulp Company is the kingdom's largest single employer with a staff of around 1800 people. It is also one of the largest foreign exchange earners with markets mostly in the Far East, where its marketing arm also operates, as well as in Europe and the United States."

"Sappi Usutu has also recently launched the Tiphilise Ngelihlatsi project—an outgrower scheme aimed at involving local farmers in the commercial tree-growing industry. Sappi provides the growers, farming on land as small as one acre, with free seedlings, technical advice and financial support, as well as a guaranteed market for their timber when the trees reach maturity in 16-18 years. Since the project started in 1996, over 40 growers have joined the scheme and a total of about 220 ha has been planted," the Year Book reports.

— Don Meadows

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Seedling thriving at Mondi Forest's nursery.



A eucalypt seedling.



Mondi's guest house for visitors to the KwaMbonambi nursery and area plantations.

"that intensive research into the development of cold-resistant strains of eucalyptus species is being undertaken. If this research is successful it could mean that vast tracts of the interior which presently consist of grasslands and grain production farms, could fall victim to tree plantations."

To obviate such potential problems, tree planting is conducted under a permit system. Permits are issued by a review committee representing catchment management councils and the government (in the form of the Department of Water Affairs and Forestry). TJ

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serve a source of firewood for the villages and can be cut and sold to the mill when they mature.

Sappi also promotes such community woodlots, although some environmental groups, such as the World Rainforest Movement, are critical of the programs (see <http://wrm.org.uy/english/bulletin/bull13.htm>). WRN is also critical of the effects of plantations on local populations and the environment. The organization is concerned

A VISIT TO A TREE FARM

Once upon a time, Steven Rennie raised as many as 8000 sheep on his farm in South Africa. His father had come from York, England to settle the land in southernmost KwaZulu-Natal in the mid-1870s and had also raised sheep.

But sheep can wander off, and sheep can be carried off. At one point, Rennie employed three full-time helpers to keep his fences mended to stop those sheep from wandering off, though sometimes they would still be carried off.

Eventually, Rennie decided that raising trees made more sense. So he planted some pine and he planted lots of eucalypts on his 100,000-acre farm. The trees do use a lot of water, but the eucalypts have a deep tap root, he says.

There are still risks, such as fire. And there's a longer wait before trees can be sent to market. It takes 5-7 years if the trees are to be used for poles and 10-15 years if they will be sold to the Saiccor mill for pulp.

When it comes time to harvest the trees, Rennie hires the work out. The contract workers stay on the property, living in a small compound among the trees.

Outside the Rennie property, small traditional farms dot the golden hillsides. Livestock are the mainstay. Cattle are sometimes herded to the stream that runs through Rennie property, if the herdsman thinks he can do it unnoticed.

The Rennie farm is in an idyllic setting, but times have changed. An electrified fence now surrounds the house Rennie has added onto over the years.



Steve Rennie (above) and a partially harvested stand of eucalypts on his tree farm (below).

- Don Meadows



A traditional-style hut used by contract workers hired to harvest trees on the Rennie farm.



Traditional farmland outside the Rennie tree farm

