ENVIRONMENT

How Much Water do Trees Take?

A new technology to measure trees water uptake has been unveiled

For many years a debate has been ranging among researchers and farmers alike in the tree and forestry science. The heated debate has revolved around the amount of water the eucalyptus tree consumes.

Those against the growing of eucalyptus, an increasingly important tree in Kenya, have argued that it consumes more water than the ecology can sustain. This has however been challenged by a section of scientists who argue that its water consumption is not more than that of a cowpea plant.

Scientists have however moved to present the factual details of water consumption both by the eucalyptus as well as other trees. Using a modern water infiltration measuring technology, researchers at the International Agro forestry Centre (ICRAF) are providing a unique way of determining how individual trees consume water.

The researchers are using a method that entails calibrating the duration at which plant sap flows up a plant stem as well as the reverse flow. This, measured against the plant size gives the amount of water a plant is consuming.

The hand-held Sapflow device being used in a tree to determine the amount of water it consumes.

The Heat Ratio Method (HRM) a modification of an earlier method known as the Compensation Heat Pulse Method (CHPM) works on the principle of allowing the recording of extreme slow flow rates and reverse sap flow in a plant's stem. This is done in both stems and roots of a wide range of different species, sizes and environmental conditions including, drought and water strained environments.

The method has been developed through partnership with the University of Western Perth, Australia and partner organizations. It was designed originally at ICRAF but Australia partners have further improved it. ICRAF did not wish to own the Intellectual Property Right (IPR) as the idea was not new and could be found in existing literature.

Although it was invented 50 years ago, recent progress in digital technology has made it more robust and user-friendly

The HRM sensor commonly known as the Sap flow device consists of three long needles carefully inserted into the plant and connected to a 16-bit micro-processor computer. The top and bottom needles contain two sets of very fine Copper-Constantan heat sensitive plates. The third needle is a line heater that runs the full length of the poke to deliver a uniform pulse of heat through the sapwood.

The integrated micro-processor forms the heart of the HRM sensor making it a fully autonomous, smart sensor. All areas of the sensors operation and calculations are controlled by the microprocessor which automatically converts the analogue nanovolt signals to a calibrated output. It is here that variables such as heat pulse interval, energy input, probe spacing, and measurement frequency are all stored in memory chip.

Due to varying responses to the needle implantations and the usually slight inaccuracies caused by installation procedures, heat ratios vary over time. For this reason readings are sampled multiple times between 60-100 seconds when heat ratios are stable and linear.

The multiple sampling and the use of the 16-bit micro-processor with very low noise preamplifier which eliminates all signal noise resulting in highly accurate measurements.

According to Dr Chin Ong a lead researcher at ICRAF, the method presents scientists with an accurate means of determining trees to plant in a particular location. He notes that water consumption among different trees varies with some trees consuming between 10 and 100 litres per day depending on weather conditions.

Using the method, researchers have been able to confirm that the eucalyptus tree is the thirstiest amongst all. Dr Chin notes that a eucalyptus tree can consume 10 litres of water on a dry day.

The device has been tested on both giant bamboo and eucalyptus at the ICRAF campus with results indicating that both species have a similar water uptake rate but the shallower roots of the bamboo make it less likely to deplete groundwater levels.

The eucalyptus is seen as a thirsty tree due to its deep roots that reach down for water draining the aquifers. This has led ecologists to question the wisdom to grow the tree on a commercial basis.

According to Dr Chin, the authorities around East African region should device means of developing policies that strike a balance between the popularity of the tree with farmers and the need to conserve water uptake. This he says can be achieved by introducing alternative trees like bamboo.

"If you use a credit card to shop and you use more than you are earning, you will be in problems. This is the same with the eucalyptus tree as demonstrated by the sap flow method as it uses more water than the ecology can provide."

Eucalyptus tree has gained popularity in the region due to its ability to grow fast providing fast returns compared to other cash crops in the region. A ban on logging has increased the demand for timber and its products making more farmers opt for the tree.

ICRAF scientists are promoting the use bamboo because of its ecological and income generation benefits. Bamboo, the world's strongest and fastest growing woody plant remains an unexploited resource in Africa, largely due to lack of awareness.

Dr Chin a lead agroforestry researcher.

Recent innovations to replace timber have led to an increase in the global trade of modern bamboo products such as floor tiles, plywood, furniture and carvings - estimated at 2 billion dollars annually.

In Asia, Bamboo has a multitude of uses ranging from chopsticks to house construction. In Kenya, bamboo has the potential to replace the acute shortage of hardwood and softwood used by wood carvers.

"Commercial bamboo species usually mature in just three years, after which multiple harvests are possible every second year for up to 120 years. No other living plant grows so tall, so fast."

This species is, however, difficult to cultivate, and highly sensitive to global warming.

ICRAF will use the equipment to monitor both bamboo and eucalyptus and compare their seasonal water use in the headwaters of the Mara River in Kenya and Kagera Rivers in Rwanda in order to predict their impact on river flow into Lake Victoria. Hopefully, this study will help determine whether bamboo can replace eucalyptus as a timber species and as a cash crop - without depleting water resources.

He however says governments in the region can use findings from these modern technologies as basis of setting regulations of tree growth. One sap flow equipment costs Ksh.50,000.

"This equipment is designed for scientists and research institutions. Scientists can use it to advice farmers on which trees to plant and farmers need not to worry about the cost."

Giant bamboo trees and eucalyptus. Data from the sap flow technology shows that the latter is a threat to ground water.