Biological control of eucalyptus pests

There is a need to develop fast, cost-effective, efficient measures to counter economic loss from invasive bugs

BY ESTON MUTITU

Eucalyptus trees are the most widely grown hardwood species outside their natural habitat. The trees have been introduced in more than 50 countries and cover about 20 million hectares worldwide (excluding 11 million hectares in their native Australia).

The trees enjoy this wide acceptance because they thrive in a wide range of climatic zones, provide socio-economic and environmental benefits, and also act as an important source of commercial cellulose fibre for the paper and viscose industry.

East Africa has seen a number of human interventions geared towards growing of eucalypts and their associated clones, to meet the ever-increasing wood demand. This has led to monocultures of commercial eucalyptus plantations that replace indigenous tree species. This is done through technology transfer from countries like South Africa. The imported clones are site-matched to achieve maximum productivity.

Introduction of eucalyptus is done through seeds and cuttings (scion) transfer, a method that leaves pests of the species in the countries of origin. However, the uniformity of eucalyptus trees and their planting from country to country make the species prone to attack by pests. The pests escape from their native host range, leaving behind the natural enemies that regulate them.

Major invasive pests of eucalyptus trees

Eucalyptus plantations and woodlots in East Africa and particularly Kenya have been threatened by increasingly devastating invasive pests. These include **Blue Gum Chalcid** (BGC) (*Leptocybe invasa*), **Bronze bug** (*Thaumastocoris peregrinus*), **Red gum lerp psyllid** (*Glycaspis brimblecombei*) and **Eucalyptus snout beetle** (*Gonipterus scutellatus*).

These pest species are endemic to Australia, the native home for *Eucalyptus* species. Most of these invaders are spreading very fast. For example, it is reported that BGC attained global status in eight years compared to older (more than 80 years) invasions like Snout beetle that took 104 years. In Kenya, BGC was reported in all host tree-growing areas of the country within two years after its invasion.

Damage symptoms caused by BGC on leaf midrib and petiole. (Photos: KEFRI)

Factors associated with this intensified pest invasion and fast rate of spread include increased monocultures, trade, human movement and poor phytosanitary measures. Therefore there is need to develop fast, cost-effective, efficient mitigation measures to counter economic loss associated with such invasive pests. Such measure will also make commercial *Eucalyptus* species growing in Kenya a viable farming activity.

Biological control of eucalyptus pests

Biological control, or biocontrol, is the use of living organisms such as predators or parasitoids to manage pests. Such organisms may be indigenous, in which case the numbers of the natural enemies need only to be increased or translocated from one area to another. This is simply termed as Augmentative Biological Control.

In another case, exotic biocontrol agents are introduced purposely. This involves searching for the potential biocontrol agent in the pest endemic area, screening for host specificity, efficacy testing, and releasing as well as monitoring the establishment and spread in the area of pest invasion. This method is commonly applied for the management of exotic pest species and is called Classical Biological Control (CBC).

A classic example of a recent successful CBC programme in Kenya is the management of the exotic Cypress aphids *(Cinara cupressivora)* that caused serious damage on Mexican cypress countrywide in the early 1990s. *Pauesia juniperorum*, a Mediterranean parasitoid, was introduced in aphid infested areas in the mid 1990s. After a short duration, this biocontrol agent spread in all major host tree growing areas, diminishing economic loss caused by this pest.

Other countries in East Africa such as Uganda and Tanzania also introduced the same parasitoid from Kenya, and similar successful results were recorded. As all the above-mentioned eucalypts pests are exotic, a similar strategy is being implemented to manage these pests in Kenya and many other parts of the world.

TheBGC is a gall-forming wasp native to Australia. It was first reported outside its native range in 2000, attacking *Eucalyptus* species in the Middle East and the Mediterranean region. Currently, it has been reported in all major eucalypt growing regions of the world and has thus gained global significance.

In Kenya, BGC was first reported in November 2002 in the Western region. It spread very fast covering the whole country within three years. It is believed to have invaded Kenya from neighbouring Uganda. The rapid countrywide spread can be attributed to its capability to be

Invasive pests of Eucalyptus species in Kenya. From left to right Eucalyptus snout beetle, Blue gum chalcid, Bronze bug and Red gum lerp psyllid. (Photos: KEFRI)

carried by air currents (wind), its thelytokous[1] reproduction (only females are produced asexually), multi-voltine (many generations per year) development, absence of principal natural enemies, and the large tracts of almost contiguous host plants in Kenya.

BGC attacks new plant growth (leaves, petioles and stems), including nursery seedlings. Heavy galling (abnormal outgrowth in plant tissue) causes the leaves to warp. This causes malformation and stunted growth of the tree and in extreme cases, tree death. Heavy infestations by BGC can severely affect the productivity of commercial eucalypt plantations, ultimately adversely affecting the revenue generated from this economic activity.

Studies on various management strategies indicate that chemical application is not a viable option. Applications of insecticides have undesirable effects, particularly if applied on a large scale. Planting eucalyptus material resistant to BGC is a potential management strategy. However, the trade-off between resistance and growth and other factors that necessitate the planting of certain susceptible species makes this management option insufficient by itself. Biological control is the most appropriate viable management option.

Recent studies (the writer of this article participated in this research programme) carried out in South Africa and Brazil have identified a suitable biocontrol agent, *Selitrichodes neseri*, for the management of BGC. This parasitoid is native to Australia.

Further studies have established that *S. neseri* is host specific to BGC. Laboratory parasitism rates of more than 70 per cent have been recorded and a cost-effective laboratory mass-rearing method has been developed to produce appropriate parasitoid numbers for field releases. This biocontrol agent has recently been released in South Africa, Brazil and Chile, with promising results.

Kenya Forestry Research Institute (KEFRI) applied and has been granted permission by the authorising body - Kenya Standing Technical Committee for Import and Export (KSTCIE) - to import *S. neseri* from South Africa and release it in eucalyptus growing areas. This very important process is currently being undertaken to help mitigate economic losses caused by this pest.

The **Bronze bug**, another Australian insect pest, was first reported outside its native home range in South Africa in 2003. It has been reported in South America and Europe. In Africa, it has been reported in other countries, including Zimbabwe, Malawi, Mozambique, Tanzania and Uganda. In Kenya, it was reported in October 2009 in Kajiado County, attacking a wide range of *Eucalyptus* species and hybrid clones.

This is a small sap-sucking insect that mainly infests the fully expanded leaves of host trees. Infested trees display a yellowing and then reddening of leaves, sometimes followed by early leaf senescence. Although the bug infestations seldom result in tree death, highly infested trees become stunted and open to other pests and diseases.

The bug causes economic loss similar to BGC and is thus considered one of the most devastating pests of eucalypts in the country. A management strategy is being put in place by KEFRI with the help of quasi-related international institutions.

Systemic insecticides such as imidacloprid have been used to manage this bug in Australia. However, this has been found not to be feasible due to the high cost and likely negative impact on the environment after long use. Host resistance is also not currently a viable option as the bug attacks a broad range of *Eucalyptus* species and hybrid clones (over 30 species currently reported), and there is yet no *Eucalyptus* spp. that has shown to be resistance to infestation.

Exploration in Australia identified a wasp, *Cleruchoides noackae*, which attacks the eggs of the Bronze bug. Research studies carried out by the writer of this article in a South African quarantine facility showed *C. noackae* as a suitable potential biocontrol agent that can help to ease the damage caused by this bug.

Using the laboratory research results, South Africa, Brazil and Chile governments have granted permission for the release of this natural enemy in their infested eucalypts plantations, with great success. Recent field assessments show parasitism levels have already reached up to 48 per cent in some areas in these countries.

In Kenya, KEFRI has compiled a dossier for submission to KSTCIE requesting permission to import and release this parasitoid to help mitigate damage caused by the bug.

These successful programmes provide impetus to the implementation of other similar classical biological control procedures for the other *Eucalyptus* pests in Kenya. Other such programmes in the pipeline include that of the Red gum lerp psyllid and the eucalyptus snout beetle.

Implementation of classical biological control programmes is challenging and requires co-operation with other research institutions to reduce duplication of efforts. KEFRI continues to strengthen its capacity in trained and experienced staff and acquiring facilities to help hasten the implementation of such programmes.

Recently, KEFRI built a state-of-the-art quarantine facility at its Muguga headquarters to carry out both pests and exotic biocontrol agents research work in a controlled environment. The facility will also help in multiplication of the required numbers for field releases. Networking with relevant institutions to help the exchange and sharing of mutual research information is being accelerated through signing of memoranda of understanding.

Biological control agents. From left to right S. neseri for BGC, and C. noackae for bronze bug. (Photos: KEFRI and FABI)

The writer is Principal Forest Entomologist, Central Highland Eco-Region Programme (CHERP), Kenya Forestry Research Institute (KEFRI)
Email: estonmutitu@gmail.com

[1] *Females produced from unfertilised eggs.*