ISSN 2070-2450

KENYA FORESTRY RESEARCH INSTITUTE

Research Note No. 7

Pests and Diseases Associated with Eucalyptus in Kenya

Pests and diseases associated with Eucalyptus in Kenya.

Mutitu K. E., Mwangi L., Otieno B. and Minjire M.

RESEARCH NOTE NO 7.
JUNE 2008

KENYA FORESTRY RESEARCH INSTITUTE

.

RESEARCH NOTE NO 7.
JUNE 2008

Cover Photos
Top: Adult Eucalyptus snout beetle
Middle: GC540 attacked by Botryosphaeria Canker
Bottom: Eucalyptus hybrid clones trial turbo at 2 years

Published by:
KENYA FORESTRY RESEARCH INSTITUTE
P. O. Box 20412 - 00200
NAIROBI
Mobile: +254-0724-259781/2, +254-722-157414
Wireless: +254-20-2010651/2
E-mail: director@kefri.org
Website: www.kefri.org

Layout and Design by: C. Nyogot

Abstract

Eucalyptus trees are widely grown in the tropics having been introduced from Australia. They are fast growing and can adapt to a wide range of environments. Eucalyptus trees were introduced in Kenya early in the last century. In 1997 Eucalyptus hybrid clones were introduced in Kenya from South Africa and performance trials were set up in various sites. The trials have regularly been assessed and monitored for incidence of pests and diseases. From these surveys the major insect pests found were Blue gum chalcid (Leptocybe invasa), which is a new pest of eucalyptus in Kenya, Snout beetle (Gonipterus scutellatus) and termites. Among the diseases the major ones were Botryosphaeria canker and Mycosphaerella leaf disease. These pests and diseases could be a major problem when establishing Eucalyptus plantations in Kenya. Other pests and diseases were also found but are considered to be of minor economic importance. The surveys carried out so far indicate that there is need to continue monitoring of pests and diseases especially due to the increased planting of Eucalyptus in the country.

Key words: Eucalyptus hybrid clones, pests, diseases, Kenya

Introduction

Eucalypts have been grown for about one hundred years in Kenya, they are native to Australia and are grown in many areas as exotics. The species are highly favoured for production of poles, fuelwood and timber. They grow rapidly, are easy to cultivate and adapt to a wide range of growing conditions (Turnbull, 2000). The relative lack of pest outbreaks in mixed tropical forests is often cited as evidence for the importance of diversity in stabilizing plant communities (Speight and Wainhouse, 1989). However use of exotics in forest plantation programmes, have been associated with outbreak of insect infestations and diseases (Murphy, 1998).

According to Engelmark et al., (2001) pests and pathogens are concerns emanating from either the possible destabilizing effect of the introduced host on the indigenous host-pathogen systems, or the devastating effects of exotic pests and pathogens that may follow the introduction of their host. Pests and diseases may arise from either a complex of indigenous agents adapting to the new host or exotic pests that are accidentally introduced (Ciesla, 2001). Indigenous disease causing organisms are also capable of adapting to new hosts and causing severe damage. In Kenya, plantations of Cupressus macrocarpa an exotic tree species were severely damaged by Seiridium unicorne (Sy. Monochaetia unicornis) an indigenous stem canker causing fungus (Odera and Arap Sang 1975, 1980). Mycosphaerella are well known as important pathogens of Eucalyptus spp. (Crous, 1998). A number of fungal foliar pathogens have been reported to impact negatively on yields of Eucalyptus plantations in Australia with Mycosphaerella spp. being the most important pathogens (Park et al., 2000). The incidence and severity of these pathogens have been found to increase as the areas under cultivation expand (Maxwell et al., 2003). Exotic pest and disease agents in the absence of natural enemies in presence of a large supply of suitable host material, that may have little resistance to the new pest or disease, can build up rapidly and

cause devastating losses.

In 1999, planting of Eucalyptus hybrid clones was initiated under the Tree Biotechnology Project whose goal was to transfer clonal tree propagation technologies from Mondi Forests, South Africa to Kenya as a means of hastening large-scale improvement of plantations. KEFRI has since 1999 been involved in monitoring of pests and diseases of the Eucalyptus hybrid clones. The need for pest monitoring was emphasised by Nyeko et al., (2007) who demonstrated that Eucalyptus growers are concerned about pest and disease problems and would be receptive to innovative management measures. It is envisaged that the introduction of Eucalyptus hybrid clones might lead to large scale planting which may lead to pest and disease outbreak situation. This is through the avenues stated above. Thus the objective of the study was to find out what pests and diseases are associated with Eucalypts in Kenya and whether any pest or disease might have been introduced.

Materials and Methods

The introduced Eucalyptus hybrid clones and the commonly grown species were planted out in trials in several regions of the country (Table 1) to test their performance. Due to the importance of pests and diseases it was later found necessary to include monitoring on these and future trials. In each of the trial site, all the trees were monitored for insect and disease infection by direct observation for presence or absence. This was done after six months and thereafter on annual basis based on the planting dates of each trial. Insect and disease specimens were collected and taken to the laboratory for processing and identification. Clonal hedges, cuttings and seedlings at Karura were also monitored for diseases. Diseased materials were placed in 2% malt extract agar for the fungi to grow and these were identified using a microscope. Insect pests were identified using the reference collection at KEFRI and National museums of Kenya.

Table 1. Eucalyptus hybrid clones and species trials planted in different ecological sites

Site and Planting Date / Eucalyptus Hybrid clones/species	Karura (April 1998)	Embu (Oct. 1999)	Hombe (May 1999)	Timboroa (May 1999)	Gede (May 2002)	Yala (July 2005)	Sokoke (June 2002)	Msambweni (April 2002)	Turbo (April 2006)	Kuja River (April 2006)	Marigat (May 2002)	Meru (May 2005)	Kabage (May 2002)
ES	●	●	●	●						●		●	
EG	●	●	●	●					●	●		•	●
ET	●	●	●	●	●		●	●			●		
GC10	●		●			●			●	●		●	
GC12	●					●			●	●		●	
GC14	●	●	●	●	●	●	●	●	●	●		●	
GC15	●	●	●	●					●	●		●	
GC522	●		●			●			●	●		●	
GC581	●	●	●	●	●	●	●	●	●	●		●	
GC642	●	●	●	●		●			●	●		●	
EC		●	●	●	●	●	●	●		●	●	●	
EU					●	●	●	●		●		●	
GC784					●		●	●			●	●	●
GC796					●	●	●	●	●	●		●	
GU7					●	●	●	●	●	●		●	●
GU8					●	●	●	●	●			●	●
GU21					●		●	●		●		●	
GC584					●	●	●	●	●	●		●	
GC3				●		●			●	●		●	
GC514					●	●	●	●	●		●	●	●
GC540					●		●	●			●	●	●
TAG5												●	●
EM										●			
EP										●			
ED										●		●	
EH												●	
MAU12												●	
MAU19												●	
GC167					●	●	●	●	●	●		●	
GC785					●	●	●	●	●	●		●	
GU4													●

• – Eucalyptus hybrid clones / species planted at site.

Notes: GC – Eucalyptus grandis x E. camaldulensis, GU – E. grandis x E. urophylla EG – E. grandis, ES – E. saligna, EU – E. urophylla, EP – E. paniculata, EM – E. maculata, EC – E. camaldulensis, EH – E. henirii, ET – E. tereticornis, ED – E. daniae

Results and Discussions

The planted materials were attacked by insect pests and diseases at different sites (Table 2).EM, EP, ED, GU4, MAU12 and MAU19 were not attacked although these were only planted in single sites compared to others planted in more than one sites. The major insect pests and diseases found in the trial were Blue gum Chalcid (BGC), eucalyptus snout beetles, eucalyptus psyllid, termites, chrysomelid beetles, Leaf spot and Botryosphaeria canker(Table 2).

Insect Pests

Blue gum chalcid (Leptocybe invasa)

Leptocybe invasa was not found in Meru, Kabage, Hombe, Embu, Timboroa and Karura trials. GC540, GC581, GU7 and GU8 were not attacked by L. invasa in the sites where they were planted although other germplasm at the site has this pest infestation. This is a small gall-forming wasp that has been reported on several Eucalyptus species in Algeria, Iran, Israel, Italy, Jordan, Morocco, and Uganda (Mendel at el, 2004). Leptocybe invasa was first recorded in Kenya in year 2002 (Mutitu et al., 2005). Within a period of four years the pest had spread covering large areas of the host species in the country. Several districts in Nyanza, Western, Rift valley, Coast, Central and Eastern provinces have been invaded by BGC (Mutitu et al., 2007). Leptocybe invasa attacks mostly seedlings and field saplings causing damage on its host by forming massive typical bump-shaped galls on tree canopy, specifically on the leaf midribs, petioles and stems of new growths. Laboratory studies conducted by Mutitu et al., (2005) categorized the susceptibility of the Eucalyptus hosts into; non-preferred, less-preferred, less-preferred to moderately preferred, moderately preferred, and highly preferred. This is an indication that host plant resistance is a highly promising management option that needs further research. Another management option includes classical biological control, which is being investigated in Israel and Turkey (Mendel, pers. com). The biological control agents that have been released and acclimatized in Israel and Turkey are Aprostocetus sp. and Megastigimus sp. This method has been

found to work in Africa in the recent past as for cypress aphid in eastern and southern Africa, and thus can be used as most appropriate option for this pest (Day et al., 2003). The use of chemical control has the disadvantage of being environmentally unfriendly and economically unviable. Pesticides which are systemic eg Confidor and Methomex need to be tested against this pest for use in high value crop only.

Table 2: Major pests and diseases associated with Eucalyptus trials planted in Kenya

Site/ Planting Date / Eucalyptus hybrid clones/species	Karura (April 1998)	Embu (Oct. 1999)	Hombe (May 1999)	Timboroa (May 1999)	Gede (May 2002)	Yala (July 2005)	Sokoke (June 2002)	Msambweni (April 2002)	Turbo (April 2006)	Kuja River (April 2006)	Marigat (May 2002)	Meru (May 2005)	Kabage (May 2002)
EC		♣		♦♣	√♣	√♦♣♣♣	√♠	√♣		√♣	♣		
ED													
EG	■	♦♣	♦♣	♣■					√♦♣♣	√♣		■	♦♣
EH												♦♣	
EM													
EP													
ES			♦♣							√		♠■	
ET	♠	♣		♣	√♣♠		♠	♣♠			♦♣		
EU					√	♦♣	♦♠	♣♠		♣		♦■	
GC10						√			√♣	√		♦	
GC12						√♣			√	√		♦	
GC14						√	√♠x	√	√	√			
GC15				♦					√♣	√			
GC167						√♣	√	√	√	√			
GC3				♣■		√♣			√♣	√♣		■	
GC514					√x	√♣	√♦	√	√	√			♦♠
GC522	♠					√♣			√	√		♦	
GC540					x		♠x				♣		♦
GC581	♠■	♦		■	♦♠x		♦♠x	♦				■	
GC584						√	√	√	√	√			
GC642						√							
GC784					√						♣	♦	♦♣♠
GC785					♣	√	√♠	√	√	√		♣	
GC796						√	√♦	√	√	√		■	
GU21					√								
GU4													
GU7					♣		x						
GU8					♣x	♣	♦♠						♣♠
MAU12													

MAU19													
TAG5													♦♣♠

Symbols for Pests: Blue gum Chalcid (BGC) - √, Eucalyptus Snout Beetle - ♠, Termites - ■, Chrysomelid beetles - x, Botryosphaeria canker - ♦, Leaf spots - ♣

Eucalyptus snout beetle

Eucalyptus snout beetle, Gonipterus scutellatus attacked ES, ET, EU, GC14, GC514, GC540, GC581, GC785, GC784, GU8, TAG5 and GC522. However it was only found in Kabage, Meru, Sokoke, Gede, Msambweni and Karura trials. The beetle has also been observed to be widespread in the Kenya highlands where Eucalypts are grown. G. scutellatus is a significant insect pest of eucalypts in most countries where the genus has been introduced, but is usually of minor significance in its native country, Australia. In part of its native range, in Tasmania, oviposition of G. scutellatus was recorded on seven naturally occurring Eucalyptus species including the economically important species, E. globulus and E. viminalis, which have been previously reported as highly preferred hosts. Adult and larvae causes damage to Eucalyptus trees. Adults feed along the edge of the leaf as compared to the feeding by the larvae, which devour the entire epidermis of the leaf causing the greatest damage. A successful biological control programme was implemented in 1945 where an egg parasite, Anaphes nitens was introduced into Kenya from South Africa to control the pest (Greathead, 2003). Since then, only minimal sporadic outbreaks of the pest have been observed.

Termites

Attacks on EG, ES, EU, GC3, GC581, and GC796 were observed in Meru, Timboroa and Karura by termites particularly Odontotermes spp and Macrotermes spp which have been commonly associated with damage to eucalyptus in the field in Kenya. Observed damage included ring barking

and mortality of seedlings. However, high incidence was only observed in Meru trial.

Termites can have a significant impact on plantation and urban forestry, as well as on agricultural tree crops. Some termite species, however, are able to kill apparently healthy trees and, therefore, have the potential to cause great losses. Where termites do not cause death of the tree, they may cause damage to the bole, by consuming the heartwood and, thereby hollowing the trunk and reducing the value of the tree as a source of timber. Farmers in drier areas of the country have reported mortality of upto 60 % (Amadalo, 1992).

A number of chemical control methods are currently used to protect trees against attack by termites. Soil treatment involving the application of chemicals particularly Regent 3G (Fipronil – active ingredient) to the soil surrounding the base of the tree is recommended.

This may be done at the time of transplanting seedlings from the nurseries into the field, or on trees where treatment is by removing the soil at the base of the tree to form a cavity or trench around the tree, and liquid-based chemicals poured in and allowed to seep into the ground by gravity and capillary action. The cavity or trench is then filled over with the soil originally excavated from around the tree, and treated as well. Insecticides currently used include Chloropyrifos, and Fipronil (Gitonga, 1992).

Chrysomelid beetles (Colasposoma species)

These beetles were found to defoliate GC514, GC540, GC581 and GU8 in Gede while GC14, GC540, GC581 and GU7 were attacked at Sokoke. The population and damage was generally very low. According to records at KEFRI insect collection reference, the insect was first noticed in Tanzania on mixed species in June 1959 but no damage was associated it.

Other Insects

Blue gum psyllid Ctenaritaina eucalypti was found attacking GC522,

GC581, E. grandis and E. tereticornis in Embu and Machakos. The psyllid originated from Australia and has been found attacking eucalyptus in Europe, North America, New Zealand and Africa (Wylie and Floyd, 2002). Adults and nymphs feed by sucking plant juices. Adults are strong fliers and nymphs may be dispersed by air currents. The insect can be transmitted via rooted cuttings. Host damage includes distortion, wilting of foliage, mostly at the tips followed by leaf drop. Dieback of twigs and branches can occur during heavy infestations and reduction of growth in young plants may occur due to foliage loss. The Nymphs and adults excrete honeydew, which provides a medium for growth of sooty mould. Nymphs exude filaments of white, waxy secretion or 'lerp' under which they shelter. Possible management option is to destroy infested germplasm.

Other insects found attacking the eucalyptus in the trials included unidentified species of scale insects on GU7, GU8 in Gede and Apate sp. on GU8 in the Meru trial. These are pests with a wide host range and could have originated from the neighboring non-eucalyptus hosts.

Diseases

Botryosphaeria canker

This was the most common disease and this supports the report by Roux et al., (2005). However, while that report showed that the disease is mainly associated with stress or offsite planting the present study showed that the disease was also found at high elevations above 2000m in Timboroa and Kabage with no apparent stress on trees. Symptoms of Botryosphaeria disease included formation of stem cankers, production of gum and stunted growth. In some cases, sections of infected stems showed a brown ring in the sapwood. The most affected material were GC581, GC514, EG, EC and EU. Other material also affected were: Kabage GC584 and TAG5, Gede GC581, Msambweni GC581, Meru GC522, GC12, GC10, GC784, EH and Marigat ET. At Kabage, site 10 (20%) infected trees of GC540 became

stunted and died after two years. The main Botryosphaeria species found was B. obtusa. The disease has also been observed in Kenya mainly on E. grandis.

Leaf spots

The other common disease on most trees especially at an early age in all the trials was Mycosphaerella leaf disease. This was mainly found on older leaves. The symptoms of the disease were mainly blackish appearance on the under side of leaves and purplish or brown spots on the upper side. From the appearance of the spots, it is possible that several species of Mycosphaerella are present. However, one species of Mycosphaerella M. keniensis have been identified in Kenya on E. grandis (Crous, 1998). Although leaf spots were common on most clones and species, the most affected were E. tereticornis, E. camaldulensis and E. urophylla and a few GC clones. At Gede and Msambweni, infected trees of E. tereticornis were defoliated and stunted. This disease is known to be serious on some Eucalyptus species such as E. nitens in other countries (Roux et al., 2005). The disease was however not serious in Kenya.

Powdery mildews

The main disease found on the clonal hedges was powdery mildew at Karura. Some clones were more susceptible to the disease such as GC785 and GC12 than others. The fungi that cause powdery mildrew are obligate parasites. The symptoms are whitish coating and curling of young leaves which has at times affected production of cuttings. However, this has been managed through regular spraying with Ridomil (Benlate) and Milraz.

Phytophthora root rot

Several hedges at Karura died due to attack by Phytophthora root rot disease. The fungus attacks the roots causing rotting. Initial symptoms of the disease include wilting of leaves followed by death of leaves, stem and roots.

Cylindrocladium diseases

Cylindrocladium sp. was found attacking GC cuttings during rooting and also causing cankers on young seedlings of E. grandis. In most cases, the disease was associated with high humidity. Several species of the genus are known to cause leaf spots, seedling blights, cutting rot and stem cankers, especially in nurseries (Crous et al, 1991). In Kenya the species responsible have not yet been identified. In other countries C. scoparium has been the main species associated with Eucalyptus (Bernard, 1984).

Conclusions and Recommendations

This study indicates that several pests and diseases are associated with the Eucalyptus and that no new pests or diseases have been introduced with the germplasm. It was generally observed that most insect pest species attacked GC522, GC581, and E. tereticornis. Among the insect pests observed, L. invasa is likely to be a major pest on Eucalyptus as it was observed in most trial sites. The pest has no known natural enemies associated with it in Kenya and thus warrants implementation of a management strategy such as classical biological control. Since termites were also frequently observed, it is important that appropriate termiticides be used during establishment in high termite prone areas.

Botrosphaeria was the only major disease that needs development of a management strategy and selection of resistant material could be an important approach. Continued regular monitoring of these trials is important in order to detect outbreaks. Quarantine measures should also be strengthened in order to avoid introduction of serious pests and diseases from other countries.

Acknowledgements

The authors would like to thank Mondi Forests, of South Africa for the provision of clones and the Tree Biotechnology Project for provision of planting material for establishment of trials. We thank Gatsby Charitable Trust and KEFRI for the financial assistance in monitoring the trials.

References

Amadalo. B. A. 1992. Termite (Isoptera) pests in small-holder agroforestry farms in western Kenya. Proceedings of the first regional workshop on termite research and control, Nairobi Kenya. pp. 93-95

Bernard, E. L. 1984. Occurrennce, impact and fungicidal control of girdling stem cankers caused by Cylindrocladium scoparium on Eucalyptus seedlings. Plant diseases Vol. 68: pp 471 – 483.

Ciesla, M. William. 2001. Planted Forests and Trees Working Paper No. 010 protectingforests from pests and diseases. Forest Plantations Thematic Papers Series. FAO

Crous, P. W., Phillips A. J. L., and Wingfield, M. J., 1991. The genera Cylindrocladium and Cylindrocladiella in South Africa, with special reference to forestry nurseries. South African forestry Journal Vol. 157 : pp. 69 -85.

Crous, P.W. 1998. Mycosphaerella spp. and their anamorphs associated with leaf spot diseases of Eucalyptus. Mycologia Memoir 21:1-170

Day, R.K., Kairo, M.T.K., Abraham, Y.J., Kfir, R., Murphy, S.T., Mutitu, K. E. and Chilima, C. 2003. Biological control of Homopteran pests of conifers in Africa. In: Biological control in IPM systems in Africa (Ed.P. Neuenschwander, C. Borgemeister & J. Langewald). CAB International, Wallingford, UK. Pp. 101-112.

Engelmark Ola, Kjell Sjöberg, Bengt Andersson, Ola Rosvall, Göran I. Ågren, William L. Baker, Pia Barklund, Christer Björkman, Don G. Despain, Björn Elfving, Richard A. Ennos, Margareta Karlman, Magnus F. Knecht, Dennis H. Knight, Nick J. Ledgard, Åke Lindelöw, Christer Nilsson, George F. Peterken, Sverker Sörlin, Martin T. Sykes. 2001. Forest Ecology and Management. Vol. 141, Issues 1-2. Pp 3-13

Gitonga W. 1992. Termiticidal screening and assessment of termite damage in agriculture and forestry in Kenya. In: Proceedings of the 1st Regional workshop on Termite research and control. 1992. Nairobi, Kenya. pp. 25-43.

Greathead D. J. 2003. Historical overview of Biological control in Africa. In: Biological control in IPM systems in Africa (Ed. P. Neuenschwander, C. Borgemeister & J. Langewald). CAB International, Wallingford, UK. Pp. 1- 26.

Maxwell, A., Dell, B., Neumeister-Kemp H., and Hardy, G.E.S. 2003. Mycosphaerella species associated with Eucalyptus in southwestern Australia – new species, new records and a key. Mycology Research Vol. 107: pp. 351–359.

Mendel, Z., Protasov, A., Fisher, N., and La Sallae J. 2004. Taxonomy and biology of Leptocybe invasa. General and SP.N (Hymenoptera: Eulophidae), an invasive inducer on Eucalyptus. Australian Journal of Entomology, Vol. 43: pp 51-63.

Murphy, S.T. (1998). Protecting Africa's trees. Unasylva 49, 57-61.

Mutitu, K.E., Otieno, B. Oeba, V., Nyeko, P. and Day, R.K. (2007). Spatial distribution of Blue Gum Chalcid, Leptocybe invasa on Eucalyptus species in Kenya. Discovery and innovation, 19(4): 369-394.

Mutitu, K. E., Otieno, B., Muchiri, M. N., and Musyoka, R. 2005. Effect of Leptocybe invasa (Hymenoptera: Eulophidae) attack on different Eucalyptus species. In: Recent advances in forestry research and technology development for sustainable forest management. (Ed. M.N. Muchiri, B. Kamondo, P. Tuwei and J. Wanjiku) Proceedings of the 2nd Kenya Forestry Research Institute's scientific conference held from 1-4 November 2004 at Muguga, Kenya. pp. 86-88.

Nyeko, P., Mutitu, K.E., and Day, R.K. 2007. Farmers' knowledge, perceptions and management of the gall-forming wasp, Leptocybe invasa (Hymenoptera: Eulophidae), on Eucalyptus species in Uganda. International Journal of Pest Management, Vol. 53: pp. 111-119.

Odera, J.A. and Arap Sang, F.K. 1980. Quarantine as a tool of pest and disease control with reference to the Kenya situation. Paper presented at the Commonwealth Forestry Congress, Trinidad and Tobago.

Odera, J.A. and Arap Sang, F.K., 1975. Damaging insect pests and diseases of softwood in Kenya. Paper presented at the Second FAO/IUFRO World Technical Consultation of Forest Diseases and Insects, New Delhi, India.

Park, R.F., Keane P.J., Wingfield, M.J. and Crous P.W. 2000. Fungal diseases of eucalypt foliage. Diseases and Pathogens of Eucalypts (Keane PJ, Kile GA, Podger FD & Brown BN, eds), pp. 153–240. CSIRO Publishing.

Roux J., Meke, G. Kanyi, B. Mwangi, L. Mbaga, A, Hunter, G.C. Nakabonge, G. Heath, and Wingfield M.J. 2005. Diseases of plantation forestry trees in Eastern and Southern Africa. South African Journal of Science Vol. 101: pp. 409 – 413.

Speight, M.R. and Wainhouse, D. 1989. Ecology and management of forest insects. Clarendon Press, Oxford, UK. pp. 374.

Turnbull, J.W. 2000. Economic and social importance of eucalypts. Diseases and Pathogens of Eucalypts (Keane PJ, Kile GA, Podger FD & Brown BN, eds), pp. 1–10. CSIRO Publishing.

Wylie, F.R and Floyd, R.B. 2002. The insect threat to eucalypt plantations in trocalareas of Australia and Asia. In Pest management in Tropical forest plantations. Proceedings of the IUFRO/FAO workshop of May 1998 at Chanthaburi,Thailand.