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The Prevalence of Epiphytic Parasites (Mistletoes) on Trees in Egerton University

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Abstract: ***Relationships between plants and their environments are complex and varied. They range from parasitism, mutualism, saprophytism to competition. Technically, it is difficult to assess how harmful or beneficial a relationship may be but it is always possible to describe their effects. Parasitism is one of the harmful associations that have been studied widely. In Kenya the family Loranthaceae (mistletoes) causes considerable deaths of many indigenous, exotic and ornamental trees. This paper presents results of an exploratory survey carried at Egerton University Njoro Campus between September–November 2007 to investigate the level of infestation on trees by mistletoe. The specific objectives were to estimate and compare infestation levels on exotic and indigenous tree species. Random stratified sampling with ocular estimation was used. The results indicated that Schinus molle, Fraxinus pennyslvanica and Acacia mearnsii were the most infested. On the other hand Polyscias fulva (Hiern) Herms, Croton megalocarpus and Spathodea campanulata (Seem) were the least infested or were free of infestation. Indigenous species had the least infestation levels when compared to exotic species. We recommend further investigations into the prevalence of the parasite in natural and plantation forests with a view of determining avenues for the containment of the parasite.***

Keywords: mistletoe, infestation, trees, Egerton, University

1. Introduction

Trees or forests growing in a given area, have many and different forms of interactions within their environments. Since the environments are very complex systems, organisms existing in a given environment interact with each other at different degrees, forms and levels. Interactions include; saprophytism, parasitism, competition and mutualism.

Many plant species of the genera *Amyema*, *Dendrophthoe*, *Muellerima* and *Diplatia* of the family *Lorranthaceae* (mistletoes) are known common obligate –parasites in the crowns of many trees (Barlow 1966). Parasitism is defined as an association whereby the parasite obtains food from another living host. However, some parasites undertake their own photosynthesis through their leaves thus will not willingly kill their hosts as this would lead to their death.

Epiphytic plants in the tropical rainforests are many and ranges from lichens, algae, mosses and hepatics as well as the vascular plants (mistletoes) which grows in close associations or on tops (crowns) of flowering trees or shrubs. The leafy so-called true mistletoes are really semi–parasites and are well known for their ornamental and sentimental uses at christmas time. They occur chiefly in hardwoods, but some grow on a few conifer species especially the junipers, cypresses, and the cinders. They are abundant in the warmer regions and especially in the arid south west of U.S.A.

Some mistletoe species are also very popular by their use as presents and ornamentals during Christmas-days and valentines (James 1991). In other places mistletoes are used as food for butterfly larvae especially for the family groups *Pierdae*, and *Lycaenidae* (Hills and Brown, 1984). The mistletoes are also useful as the nesting places for many bird species.

Mistletoe infestation, prevalence, abundance and distribution varies greatly on branches and stems of different host species. The factors contributing to their host preference are not known but may be related to cell sap contents of different trees or substances excreted by their bark.

The relationship that exists between the plant parasite and the hosts is always a hostile one. The parasite is a robber for it deprives the host off its energy without compensation (Clarence, 1962). Not uncommon that the host is killed by the parasites and sometimes a species is practically exterminated from considerable periods, over extensive areas parasitism, in which forest trees are hosts for multitudes of parasites is evidence in every forest. This is of far reaching importance in forestry, particular so during the invasions by parasites as exemplified in the widespread of the cape chestnut by blight (*Endothea parasitica*). Parasitism may in some instances cause some species to be replaced by others. In the production of timber crops for commercial use, parasitic organisms reduce growth and destroy some tree stands and in Egerton University, the aesthetic values of ornamental trees in the main compound has been greatly reduced to the extent that some of the trees are dying leaving behind ugly stumps all over the compound.

Instances of mistletoes growth in high densities are common especially in Kakamega forest, Mt Kenya forest, the Mau complex ecosystem. They are also found in the plantation forests and the ornamental trees and shrubs in many homesteads and compounds of institutions (e.g. in Egerton University, Njoro campus).

In the past, damage from mistletoes infestation was considered minor, but currently their harmful effects in killing plants, reducing timber qualities and reducing trees aesthetic values are evident (Greenham and Hawkworth 1964).

Unfortunately, there is no scientific study to determine the

reasons for increase in incidence and damage to trees caused by mistletoes infestation. Similarly, it is not known whether such incidences ever occurred historically before the widespread clearance of vegetation occurred. It is now believed that mistletoes are becoming a threat to trees due to human mismanagement of the environment, through activities that have interfered with the natural ecological balance, placing an unnatural stress on trees.

In this paper we document the prevalence of mistletoe on trees planted in Egerton University compound. We investigated the different levels of mistletoes attack on varied tree species. Our hypotheses were that mistletoes are hosted specific and spread on trees composed of but single species and the parasite prefers hardwoods more than conifers. The above was done in order to suggest possible avenues for; maintaining the aesthetic values of the landscaping trees and shrubs planted within the compounds of institutions and homesteads.

1.1 Study area

The study was carried out in Egerton University Njoro campus ($0^0$22'S, 36^0E). The campus is located in the central Rift valley of Kenya, at Njoro about 25 kms from Nakuru town, 180 kms north-west of Nairobi on the Njoro –Mau-Narok road. It is situated on a prime agricultural land, at an altitude of 2250 m asl. The area receives an average of about 1012 mm/yr with its peak in May and lowest in September to February. The maximum and minimum temperatures ranges are 19^0 to 22^0 and 7^0 to 10^0 respectively, with the month of July being the coldest. Soils are well drained deep to very deep and are classified as mollic anosols (Jaetzold and Schmidt 1983). The topography is flat and only two rivers (River Njoro and a seasonal stream in the botanic garden) crosses over the study area.

2. Methods

The Njoro campus compound was divided into three blocks demarcated by roads. Block 1 was the area surrounded by the Northern circle road, and the Southern circle road. Block 2 was represented by the area surrounded by Omamo road and the upper Mlamba road, while Block 3 was represented by the area surrounded by the lower Mlamba road, lower side of the Omamo road and Moi road.

A line transect was laid in each of the blocks and all tree species on the transect were sampled. Infestation was ranked based on the extent of the area of the crown infested. The percent crown infestation was estimated using ocular estimation where the crown was divided into four quarters and the average infestation of each estimated as not affected or given a range between 10-90% infestations. The proportion of individual trees per species in each category was then calculated. The sum of these values was used to derive the mean infestation per species using the proportionate value of infestation of the species in the sample. The proportionate mean infestation was converted into a scale ranging between 0.00-3.0, 3.1-6.0 and 6.1-11.1 for low, medium and high infestation respectively. Seventeen tree species; 9 indigenous 8 exotic; 15 tree species; 5 indigenous and 10 exotic and 13 species were sampled in blocks 1, 2 and 3 respectively.

Raw data collected was fed into the SPSS program for analysis. Cross tabulation was done and the weighted mean infestation calculated. A comparison of mean infestation on indigenous and exotic species was done using independent samples t-test The information got from the above steps was then presented in a bar graph in which infestation was categorized into three classes; high, medium and low.

3. Results

Results indicated that the mean infestation ranged between 0.00-11.1; (Table 1a). Apart from *Juniperus procera* and *Markhamia lutea* mean infestation on indigenous species sampled was low. High infestation mean were however, recorded for exotic species (Table 1b).

Table 1a: Results of mean infestation per species encountered

Species	Mean Infection	Species	Mean infection
Block 1 Indigenous		**Block 1 Exotic**	
Juniperus procera	*11.11*	*Schinus molle*	*11.11*
Markhamia lutea	*5.56*	*Fraxinus pennyslvanica*	*10.61*
Acacia xanthopholea	*0.00*	*Calistemon citrinus*	*9.26*
Podocarpus sp.	*0.00*	*Grevillea robusta*	*8.89*
Prunus Africana	*0.00*	*Cupressus lusitanica*	*6.67*
Spathodea campanulata	*0.00*	*Ficus benjamina*	*3.70*
Waburgia ugandensi	*0.00*	*Eulycaptus sp.*	*3.33*
Acacia abyssinica	*0.00*	*Casuarina equisetifolia*	*1.59*
Croton megalocarpus	*0.00*		
Block 2 Indigenous		**Block 2 Exotic**	
A. xanthopholea	0.00	*Jacaranda mimmosifolia*	11.11
S. campanulata	0.00	*F. pennyslvanica*	9.26
Polycias fulva	0.00	*C.citrinus*	3.70
Acacia abyssinica	0.00	*C. spicata*	0.00
C. megalocarpus	0.00	*Eulycaptus sp.*	0.00
Block 2 Exotic		*C. equisetifolia*	0.00
Acacia mearnsii	11.11	*Acacia saligna*	0.00
Schinus molle	11.11	*C. lusitanica*	0.00
Block 3 Indigenous		**Block 3 Exotic**	
S.campa-nulata	0.00	*A. meansii*	9.26
Croton macrostachyus	0.00	*C.citrinus*	5.05
Celtis africana	0.00	*J. mimmosifolia*	4.44
Euclea divinorum	0.00	*C. lusitanica*	0.00
A. abyssinica	0.00	*F. pennyslvanica*	0.00
Block 3 Exotic		*Eulycaptus sp.*	0.00
S. molle	11.11	*C. equisetifolia*	0.00
F. pennyslvanica	10.34		

Table 1(b): A comparison of levels of mistletoe infestation on individual trees between exotic and indigenous species

Species	Infestation		Species	Infestation	
	Mean	status		Mean	Status
Indigenous			Exotic		
J. procera	11.11	High infestation	*F. pennyslvanica*	10.21	High infestation
M. lutea	5.56	Medium infestation	*A. mearnsii*	9.26	High infestation
S. campanulata	0.00	Low infestation	*C.citrinus*	9.26	High infestation
A. xanthophloea	0.00	Low infestation	*G. robusta*	8.89	High infestation
W. ugandensis	0.00	Low infestation	*C. lusitanica*	6.67	Medium infestation
Podocarpus spp	0.00	Low infestation	*C.citrinus*	5.05	Medium infestation
C. macrostachyus	0.00	Low infestation	*J. mimmosifolia*	4.44	Medium infestation
P. Africana	0.00	Low infestation	*C. citrinus*	3.70	Medium infestation
C. Africana	0.00	Low infestation	*F. benjamina*	3.70	Medium infestation
E. divinorum	0.00	Low infestation	*Eulycaptus sp.*	3.33	Medium infestation
P.fulva	0.00	Low infestation	*C.equisetifolia*	1.59	Low infestation
A. abyssinica	0.00	Low infestation	*C. equisetifolia*	0.00	Low infestation
C. megalocarpus	0.00	Low infestation	*C. lusitanica*	0.00	Low infestation
Exotic			*A. saligna*	0.00	*Low infestation*
S. molle	11.11	High infestation	*Eucalyptus sp.*	0.00	Low infestation
A. mearnsii	11.11	High infestation	*C. spicata*	0.00	Low infestation
J. mimmosifolia	11.11	High infestation	*F. pennyslvanica*	0.00	Low infestation

Further results indicated that 27 of the sampled individuals were rated under low infestation according to the parameters used whereas 7 were rated as having medium infestation and 12 had high infestation level (Table 2). A comparison of mean infestation between indigenous and exotic species using independent samples t- test indicated significant higher mean infestation for exotic species (Table 2).

Table 2: Comparison for mean infestation between exotic and indigenous species

Species type	N	Mean Infestation	S.D	SE	
Indigenous	19	0.88	2.79	0.64	
Exotic	27	5.258	4.64	0.89	
T test	T-statistic	Df	Sig.	Mean Difference	S. E
Equal variances assumed	-3.658	44	0.001	-4.37	1.19
Equal variances not assumed	-3.977	43.110	0.000	-4.37	1.10

The mean infestation level of mistletoes was 4.22, 3.09 and 2.87 in blocks 1, 2 and 3 respectively. In all the blocks, the highest number of the individuals sampled had low infestation, a relatively lower number had high infestation level, whereas the lowest number among the sampled individuals had medium infestation levels. The relative infestation levels are shown in Figure 1.

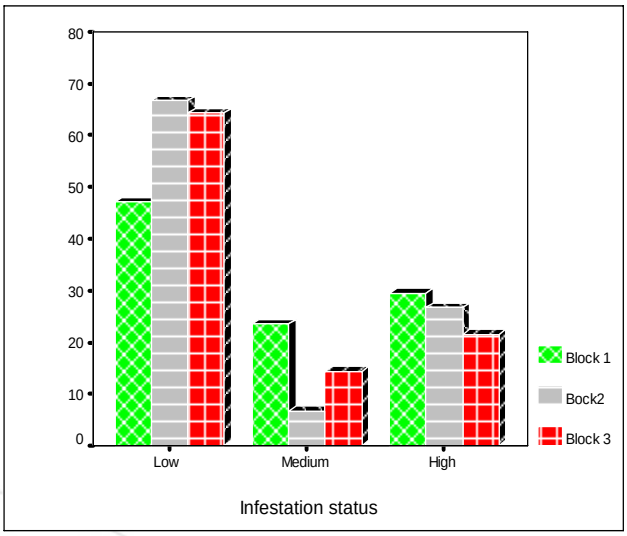

Figure 1: A comparison of the mean percent infestation status among the study blocks.

4. Discussion

From the results of the survey, 46 individual trees belonging to 24 genera were sampled. From the mean infestation it was found that *Schinus molle, Fraxinus pennysilvanica, Acacia mearnsii,* and *Jacaranda mimmosifolia* were the most infested species with their mean infestation level ranging between 9.26 to11.11 (Table 1). C*allistemon citrinus, Cupressus lusitanica, Markhamia lutea,* among others, were found to have medium infestation, and *Eucalyptus sp, Polyscias fulva, Acacia saligna, Spathodea campanulata* and *Croton megalocarpus,* among others, were rated as lowly infested. In this last category, some species were totally not infested e.g. *Croton megalocarpus* and *Acacia xanthophloea*. This means that the parasites preferred some tree species and avoided others for reasons not known presently.

From the survey results it is apparent that the ornamental trees on the compound are infested almost equally by the parasite. Therefore we propose the following management options to curb further spread of the parasite in order also to maintain the aesthetic quality of the trees planted on compounds and also in plantations.

Choice of silvicultural methods **(**Schwaldt 1984) depends upon the management goals for the stand, keeping in mind the stage of the cutting cycle, and the damage caused by the mistletoe infestation on the trees. With young stands, the objective is generally to protect them from infestation. Within young stands, efforts should be directed towards reducing infestation levels and halting the spread. When the stand has reached the harvesting –stage, the objective is to eliminate mistletoe and thus prevent the subsequent crop from becoming infested. Therefore, depending on the composition and the level of infestation/damage, the following management strategies can be applied to control mistletoe infestation on trees.

Light sanitization is a good option if the stand is made up of less than 50% of the host species, and half of the host species are affected. Removal of the infected individuals to halt the spread may be an option for consideration. This can be done by combining sanitizing with periodic thinning or selective harvesting operations. If the stand is made up of less than 50% of the host species, but more than half of them are infected. It would be best to convert the stand to another species by cutting all the trees of the infected species including the regeneration. (Schwandt 1984). This can be done in a thinning or partial harvest.

If the stand is made up of 50% of the host species, and more than half of them are infected, and the stand is still young (i.e. less than 20 years) clear cutting and starting all over again may be the best option. If the stand is middle–aged, it may be best to cut the most seriously infected and leave the lightly infected.

Under-growth burning is also a useful tool that can be economically used to kill some dwarf mistletoe near the ground. When opportunity presents itself to prune infected branches, remove heavily infected trees or under burn the forest. This may only be an option in plantation crops. (Hartigan 1949, Greenham et al., 1951, Hartigan 1958).
Mistletoe infestation on trees can be controlled by trunk injection and spraying the infected tree crowns with herbicide that is specific to the parasites (Hartigan 1949, Greenham et al., 1951, Hartigan 1958). The two management practices combined are almost 90% effective in eradication of the dwarf mistletoes in the plantations of eucalyptus in Australia.

5. Conclusions

Mistletoes found in Egerton University compound had a wide host range. Exotic species were more preferred by the parasitic mistletoe than the indigenous species. Mistletoe did not attack youthful trees of all species. In order to retain the aesthetic beauty of the university, it is recommended that trees that are highly infested should be cut and sold for economic gains and planting of seedlings of such species should be avoided. More research on tree parasites is needed to safe guard the future of ornamental trees.

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