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OCCURRENCE OF MISTLETOES ON SHEA TREES IN NORTHERN GHANA

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ABSTRACT

In an attempt to establish the cause of reported death of shea trees at Maluwe and Gindabo in the Northern Region of Ghana, a survey of mistletoes on shea trees was conducted. In August 2018, 50 shea trees were randomly sampled at each study site and inspected for the presence of mistletoes. Two species of mistletoes, *Tapinanthus bangwensis* (Engl. & K Krause) Danser and *Agelanthus dodoneifolius* (DC) Danser were identified on shea trees. *Agelanthus dodoneifolius* was the dominant mistletoe species at both Maluwe (50% infestation) and Gindabo (84% infestation). None of the mistletoe infested trees were found dead at both study sites. An epiphytic plant, *Ficus popenoei* Standl. was identified on a shea tree at Gindabo. Further studies need to be conducted to determine the distribution, severity and impact of mistletoes on the productivity of the shea trees.

Key Words: *Agelanthus dodoneifolius*, *Ficus popenoei*, *Tapinanthus bangwensis*

RÉSUMÉ

Dans le but de spécifier la cause de la mort des arbres de karité à Maluwe et à Gindabo, dans la région du Nord du Ghana, une enquête sur le gui dans les arbres de karité a été réalisée. En Août 2018, 50 arbres de karité ont été échantillonnés au hasard sur chaque site d'étude et inspectés pour rechercher la présence de gui. Deux espèces de gui, *Tapinanthus bangwensis* (Engl. & K Krause) Danser et *Agelanthus dodoneifolius* (DC) Danser ont été identifiés sur des arbres de karité. *Agelanthus dodoneifolius* était l'espèce de gui dominante à Maluwe (infestation à 50%) et à Gindabo (infestation à 84%). Aucun des arbres infestés par le gui n'a été retrouvé mort sur les deux sites d'étude. Une plante épiphyte, *Ficus popenoei* Standl a été identifié sur un arbre de karité à Gindabo. D'autres études doivent être faites pour déterminer la répartition, la gravité et l'impact des gui sur la productivité des arbres de karité.

Mots Clés: *Agelanthus dodoneifolius*, *Ficus popenoei*, *Tapinanthus bangwensis*

INTRODUCTION

The shea tree, *Vitellaria paradoxa* (C. F. Gaertn), is a deciduous tree of the Sapotaceae family and native to non-coastal areas of dry savannas, forests and parklands of the Sudan zone of Africa (Boffa *et al.*, 1996). Widely growing between Western Senegal and North-Western Uganda, shea occupies an estimated land area of 1 million Km² (Sallé *et al.*, 1991) and accounts for more than 80% of the woody plants on farmed land in Northern Ghana and Burkina Faso (Boffa, 1999; Lovett and Haq, 2000a). In Ghana, estimated land area of over 77,670 Km² in Western Dagomba, Southern Mamprusi, Western Gonja, Lawra, Tumu, Wa and Nanumba is covered by shea, with Eastern Gonja having the densest stands (Hatskevich *et al.*, 2011). The estimated 9.4 million shea trees in Ghana potentially yield 100 tonnes of shea nuts worth about US\$ 100 million per year (Dogbevi, 2009).

The shea tree offers employment to about 85% of people living in shea-growing communities, who collect the nuts and process them for the shea industry (Kavaarpuo, 2010). The industry is dominated by women (Hatskevich *et al.*, 2011) and it plays a significant socioeconomic role to support their livelihoods (Naami and Naami, 2019). The fresh fruits and butter are eaten as food, the leaves used as fodder to feed livestock; the bark, roots and leaves used in medicinal preparations for curing ailments; and the ash from the waste of the butter is used to make soap (Lovett and Haq, 2000b; Dogbevi, 2009; Hatskevich *et al.*, 2011). Shea has carbon sequestration potential (Sanogo *et al.*, 2016; Dimobe *et al.*, 2018) and improves soil fertility for millet cultivation in Burkina Faso (Bayala *et al.*, 2002).

Apart from pests (Dwomoh, 2003; Dwomoh *et al.*, 2004) and diseases (Dakwa, 1986; Akrofi and Amoah, 2009), parasitic mistletoes in the family Loranthaceae have been reported on shea (Boussim, 1991).

Infestation rates are reportedly high in West African parklands estimated at 81% in Nigeria (Odebisi *et al.*, 2004) and 95% in Burkina Faso (Boussim *et al.*, 1993), causing stunted growth, withering of tree parts and eventual tree death. In June 2018, inhabitants of Maluwe and Gindabo in the Northern Region of Ghana reported of shea tree deaths and partially attributed it to mistletoe infestation. The objective of this study was to assess the occurrence of mistletoes on shea trees and ascertain their role in the reported shea tree deaths.

MATERIALS AND METHODS

Study area. A survey was conducted in August 2018 in two communities, Maluwe (N 08°41.529' W 002°15.981' and N 08°41.146' W 002°16.385') and Gindabo (N 09°38.600' W 002°25.669' and N 09°38.639' W 002°25.310') in the Bole and Sawla-Tuna-Kalba districts, respectively, in Northern Ghana. This region falls within the Guinea Savannah agro-ecological zone, with a single rainy season (between 1,000 and 1,500 mm annually) that lasts from June to October each year. Temperatures are high (about 36 to 38°C) between March and April and relatively low (about 28 to 30°C) between November and February which brings about the harmattan.

Sampling and survey. The survey involved a traverse of the area falling within the boundaries of the parklands, where the shea trees were reported dead in Maluwe (3.15 Km eastwards of the Maluwe-Bole road) and Gindabo (5.36 Km eastwards of the Gindabo-Wa road). Fifty shea trees were randomly sampled from each location and inspected for the presence of mistletoes. Mistletoe infested trees were counted. The condition of each assessed tree was noted and classified as alive, dying or dead. The diameter of trees at 50 cm above ground (D_{50}) was measured.

Coordinates of the area within which the trees were selected for inspection were recorded for reference purposes.

Data analysis. The proportion of trees with mistletoe infestation was computed. Correlation analysis was performed to determine the relationship between mistletoe infestation and tree diameter using IBM SPSS ver. 20.

RESULTS

Shea trees in Maluwe were smaller (Mean D_{50} =100.8 cm) than those in Gindabo (Mean D_{50} =123.4 cm); and a few of the trees in Maluwe were dead (4%) or dying (8%) compared to Gindabo where none was dead or dying. Two types of mistletoes, *Tapinanthus bangwensis* (Engl. & K Krause) Danser (Fig. 1) and *Agelanthus dodoneifolius* (DC) Danser (Fig. 2), in the family Loranthaceae, were identified on shea trees at Maluwe and Gindabo. An epiphytic plant, *Ficus popenoei* Standl. (Fig. 3) was also identified on a shea tree at Gindabo. *Agelanthus dodoneifolius* was the dominant mistletoe species especially at Gindabo (84% infestation) (Fig. 4). All *A. dodoneifolius* infested trees at Gindabo were alive compared to Maluwe where 6% were dying; but none was dead (Fig.



Figure 1. *Tapinanthus bangwensis* on shea tree.



Figure 2. *Agelanthus dodoneifolius* on shea tree.

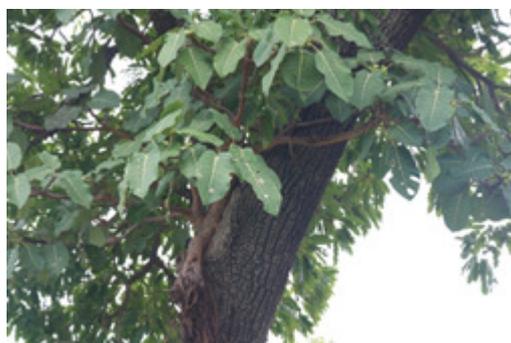


Figure 3. *Ficus popenoei* on shea tree.

5). Mistletoe infestation correlated positively with tree girth (diameter) and this was significant at both Maluwe ($r=0.6$, $P<0.01$) and Gindabo ($r=0.3$, $P<0.05$). Comparatively large shea trees hosted mistletoes at both study sites (Fig. 6).

DISCUSSION

In this study, *A. dodoneifolius* and *T. bangwensis* in the family Loranthaceae were identified on shea trees at Maluwe and Gindabo in the Northern Region of Ghana. As parasitic evergreen plants, mistletoes obtain water, nutrients and organic solutes from their hosts (Reid and Yan, 2000), including coniferous trees (Hawksworth, 1983; Hawksworth and Wiens, 1996), succulent euphorbs and cacti (Martínez del Río *et al.*, 1996; Polhill and Wiens, 1998), grasses and annual herbs

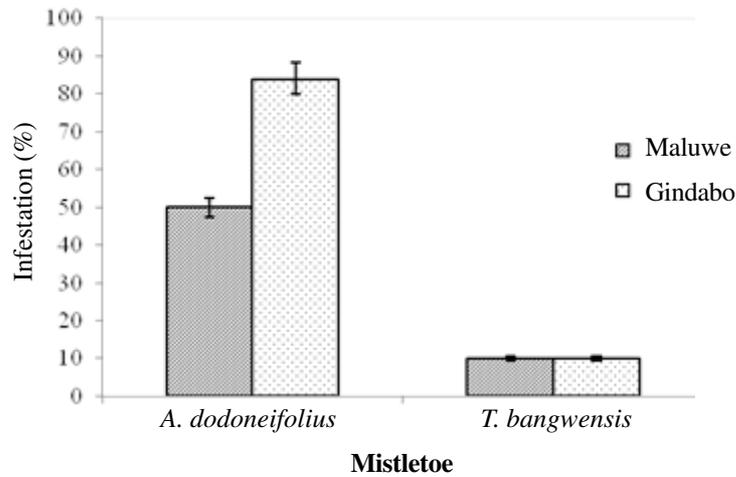


Figure 4. Percentage of *A. dodoneifolius* and *T. bangwensis* infested shea trees at Maluwe and Gindabo.

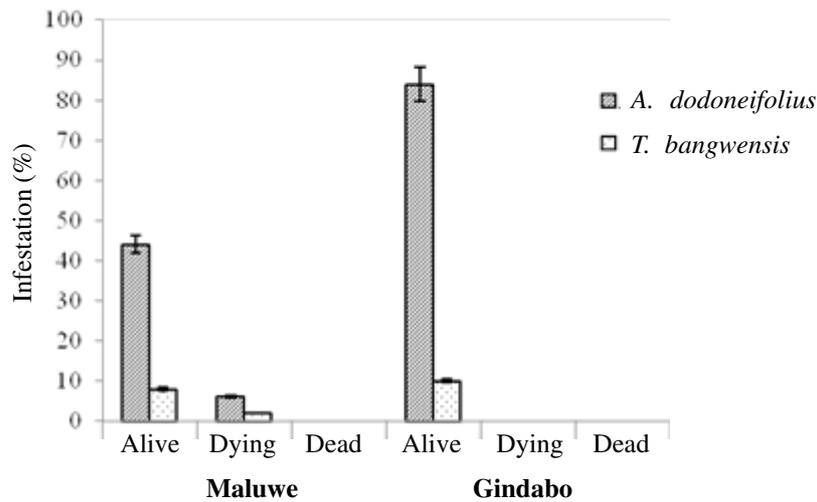


Figure 5. Status of mistletoe infested shea trees at Maluwe and Gindabo.

(Fineran and Hocking, 1983), orchids and ferns (Kuijt and Mulder, 1985). However, trees and shrubs are selectively parasitised by most species of mistletoe and the greatest diversities are associated with forests and woodlands (Kuijt, 1969; Calder, 1983; Hawksworth, 1983).

The two species identified in this study are among 4 species (*A. dodoneifolius*, *T. globiferus*, *T. ophiodes* and *T. bangwensis*) of

mistletoes reported on shea trees in neighbouring Burkina Faso (Boussim, 1991). Of these, *A. dodoneifolius* was the most abundant and widespread (Boussim *et al.*, 1993), which supports findings of this study. The dominance of *A. dodoneifolius* may be due to a number of factors, including response of birds to mistletoe fruit abundance, which results in variation in the transmission of the parasite (Martínez del Río *et al.*, 1996), ability

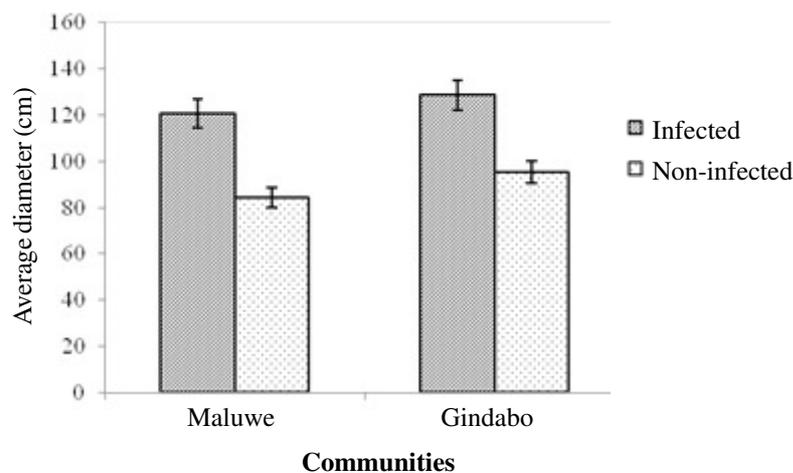


Figure 6. Average diameter (D_{50}) of mistletoe infested shea trees at Maluwe and Gindabo.

of the mistletoe seeds to germinate and establish successfully (Reid *et al.*, 1995) and mistletoe-host compatibility which is a function of host susceptibility to infection and of mistletoe infectivity (Yan, 1993).

There was positive relationship between mistletoe infestation and tree diameter. Large trees hosted mistletoes and this could be due to the fact that large trees serve as better perches for birds (Overton, 1994) that disseminate seeds of mistletoes (Reid, 1991).

Reid and Yan (2000) observed that mistletoes have greater impact on trees following water stress or drought. Also, Rigling *et al.* (2010) suggested that, mistletoe infestation makes trees more vulnerable to drought stress when growing in a xeric site. This is because, when trees reduce their rate of transpiration in response to drought, mistletoes continue to transpire, thus increasing water loss and drought stress experienced by host trees (Fischer, 1983; Zweifel *et al.*, 2012).

Severe mistletoe damage was observed on shea trees under drought stress conditions which resulted in deaths (Boussim *et al.*, 2004). Though 6% of the mistletoe infested shea trees were dying at Maluwe in this study, none of them was found dead at both study sites. The survey was conducted in the rainy season and this might have limited our

knowledge on the impact of mistletoe infestation on shea under water stress. Nevertheless, mistletoe infested trees at Maluwe were also infested with stem borers. This observation may be due to the fact that mistletoe infection increases the susceptibility of trees to fungal diseases and bark beetles (Hawksworth and Weins, 1996).

To the best of our knowledge, this study is the first report of the presence of *Ficus* on shea in Ghana. *Ficus* (Moraceae), the world's most diverse woody plant genus, has approximately 750 species worldwide and it is mostly distributed in the tropics and subtropics, exhibiting a variety of growth forms that include shrubs, trees, climbers, epiphytes and hemi-epiphytic stranglers (Corner, 1988; Berg, 1989; Frank *et al.*, 1992).

The growth characteristic of the identified *Ficus* on the shea tree at Gindabo is yet to be studied. If identified as a strangler, it may have dire effects on the survival of shea trees since stranglers produce anastomosing aerial roots that enclose and kill the host, leaving the *Ficus* to freely stand (Dobzhansky and Murca-Pires, 1967). Birds, bats and arboreal mammals might have contributed to the presence of *Ficus* on the shea tree, since they eat the fleshy fruits and the drupes are voided in their faeces (Shanahan *et al.*, 2001).

CONCLUSION

This study has identified two types of mistletoe, namely, *Tapinanthus bangwensis* and *Agelanthus dodoneifolius*, in the family Loranthaceae thrive on shea trees in two communities, Maluwe and Gindabo, in Northern Ghana. *Agelanthus dodoneifolius* is the dominant species and large shea trees hosted most of the parasites. Further studies need to be conducted to determine the distribution, severity and impact of mistletoes on the productivity of the shea trees. The association of *F. popenoei* with shea tree also needs to be investigated.

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