

Research Application Summary

Invasiveness of *Calliandra calothyrsus* in Ruhande Arboretum in Rwanda

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Abstract

Many plant species are known to be invasive, with power to subdue others plant species within their proximity. The objective of this study was to assess the invasiveness of *Calliandra calothyrsus*, one of the popular agroforestry shrubs at the Ruhande Arboretum in Rwanda. Using Geographical Positioning System (GPS), we marked the plots where *C. calothyrsus* was planted. For each of the *C. calothyrsus* plots, coordinates were recorded once at its centre. Linear transects were established perpendicular to *C. calothyrsus* plots in the four cardinal directions to where the plots extended to the neighboring plots. It was observed that although total area originally planted with *C. calothyrsus* was 2.75ha the area invaded totaled to 1.4ha. The dispersal distance in invading other species was greatest in the square plots, followed by the perpendicular lines, and the least is single line planting. The invasion rate in neighboring plots planted with other tree species varied depending on species, being the highest in Eucalyptus spp. and the least in Araucaria cunninghamii. These results shows that the rate of invasion of *C. calothyrsus* biodiversity of Ruhande Arboretum is threatened by the invasion of *C. calothyrsus* as it increases is exponentially, thus threatening biodiversity at Ruhande Arboretum. The species should be managed cautiously and future, if necessary, should be far from more susceptible species like Eucalyptus.

Key words: *Araucaria cunninghamii*, *Calliandra calothyrsus*, Rwanda

Résumé

De nombreuses espèces végétales sont connues pour être envahissantes, avec le pouvoir de maîtriser d'autres espèces végétales à proximité. L'objectif de cette étude était d'évaluer le caractère envahissant de *Calliandra calothyrsus*, l'un des arbustes agroforestiers populaires à l'arboretum de Ruhande au Rwanda. À l'aide du système de positionnement géographique (GPS), nous avons marqué les parcelles où *C. calothyrsus* a été planté. Pour chacune des parcelles de *C. calothyrsus*, les coordonnées ont été enregistrées une fois en son centre. Des transects linéaires ont été établis perpendiculairement aux parcelles de *C. calothyrsus* dans les quatre directions cardinales jusqu'à l'endroit où les parcelles s'étendaient aux parcelles voisines. Il a été observé que bien que la superficie totale plantée à l'origine avec *C. calothyrsus* était de 2,75 ha, la superficie envahie totalisait 1,4 ha. La distance de dispersion dans l'invasion d'autres espèces était la plus grande dans les parcelles carrées, suivies des lignes perpendiculaires, et la plus petite est la plantation en ligne unique. Le taux d'invasion dans les parcelles voisines plantées d'autres espèces d'arbres

variait selon les espèces, étant le plus élevé chez *Eucalyptus* spp. et le moins chez *Araucaria cunninghamii*. Ces résultats montrent que le taux d'invasion de la biodiversité de *C. calothyrsus* de l'Arboretum de Ruhande est menacé par l'invasion de *C. calothyrsus* à mesure qu'il augmente de manière exponentielle, menaçant ainsi la biodiversité de l'Arboretum de Ruhande. L'espèce doit être gérée avec prudence et à l'avenir, si nécessaire, doit être éloignée des espèces plus sensibles comme l'*Eucalyptus*.

Mots clés : *Araucaria cunninghamii*, *Calliandra calothyrsus*, Rwanda

Introduction

Many plant species are known to be invasive with power to subdue others plant species within their vicinity. Invasive plants are defined as alien plants that recruit reproductive offsprings, often in very large numbers, at considerable distances from parent plants and thus have the potential to spread rapidly (Richardson *et al.*, 2000). Thousands of plant species have been and continue to be dispersed by humans to areas far from their natural habitats. Some are transported accidentally, but more important are the many species that are intentionally introduced and cultivated to serve human needs and contribute to health (Richardson *et al.*, 2003).

The biodiversity of Ruhande Arboretum in Rwanda and its basic value encroached by many aliens invasive species including *Agave sisalana*, *Lantana camara* and *Tithonia diversifolia* covering 2.5, 3 and 36.1% of the total Arboretum area, respectively, in addition to *C. calothyrsus* a popular agroforestry shrub. The objective of this study was to assess the level of invasiveness of *C. calothyrsus* in Ruhande Arboretum in Rwanda.

Materials and Methods

This study was conducted at the Ruhande Arboretum located at (29 44'E and 2 36'S) in Rwanda. Ruhande Arboretum is composed of over 207 native and exotic species, including 143 hardwoods with 69 *Eucalyptus* species, 57 softwood and three bamboo species (Nyiramajyambere, 2011). This plantation covers a surface area of 201 ha; each species is planted in a plot of (2,500 m²) (MINITERE, CGIS-NUR, 2007). Plots in the Arboretum are intercalated with alleys of 6 m wide. *Calliandra calothyrsus* shrubs in Ruhande Arboretum were planted in three arrangements: single line, perpendicular lines and square plots. In all plantings, the line or side length was originally 50 m. Using Global Positioning System (GPS), we walked across the whole Arboretum and using an Arboretum field layout of all plots, we located all plots planted with *C. calothyrsus*. For each of the *C. calothyrsus* plots, coordinates were recorded once at its centre. Coordinates of the ground perimeter were also recorded where the species had spread beyond the original planting location. In addition to the plots planted with *C. calothyrsus*, the species was also planted in lines in an agroforestry setting. These were also considered and the spread of assessed similarly. We then mapped the locations using ArcGIS and land cover of *C. calothyrsus*, to identify more invaded areas by *C. calothyrsus* within Arboretum. A transect method was used to assess the extent of *C. calothyrsus* invasion where linear transects were established by measuring distance from the edge of *C. calothyrsus* plots in the four cardinal directions to where it physically extended in the neighboring plots.

Results and Discussion

Results show that the spread of *C. calothyrsus* beyond its original planting areas varied between spatial arrangements of the mature, originally planted trees and the tree species growing in the plots adjacent to *C. calothyrsus* plots (Fig 1.). Basing on the extent, *C. calothyrsus* individuals originating from square plot plantings were distributed over 0.62 ha compared to those from single line planting which was distributed on 0.41ha. The abundance of *C. calothyrsus* individuals originating from the three-original spatial (planting) arrangements; the perpendicular line showed a higher abundance rate than the other arrangements; followed by square plot and lastly by the single line planting. Plot planting led to the invasion into the other species at distance of 55m. The abundant and dispersal distance in the single line planting which showed a dispersal distance of 34m. These results show that the biodiversity of Ruhande Arboretum is threatened by the invasion of *C. calothyrsus* as it increases exponentially. The species should be managed cautiously and future, if necessary, should be far from more susceptible species like Eucalyptus.

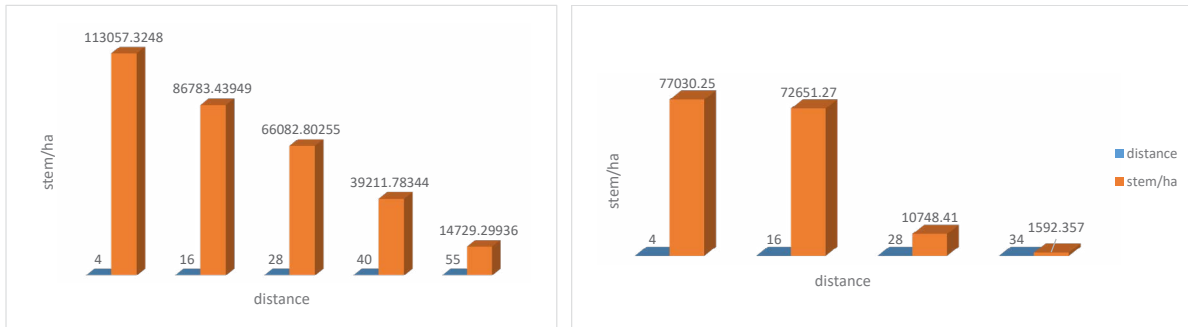


Figure 1 and 2. Distribution of *C. calothyrsus* on the single line planting and square plots at Ruhande Arboretum in Rwanda

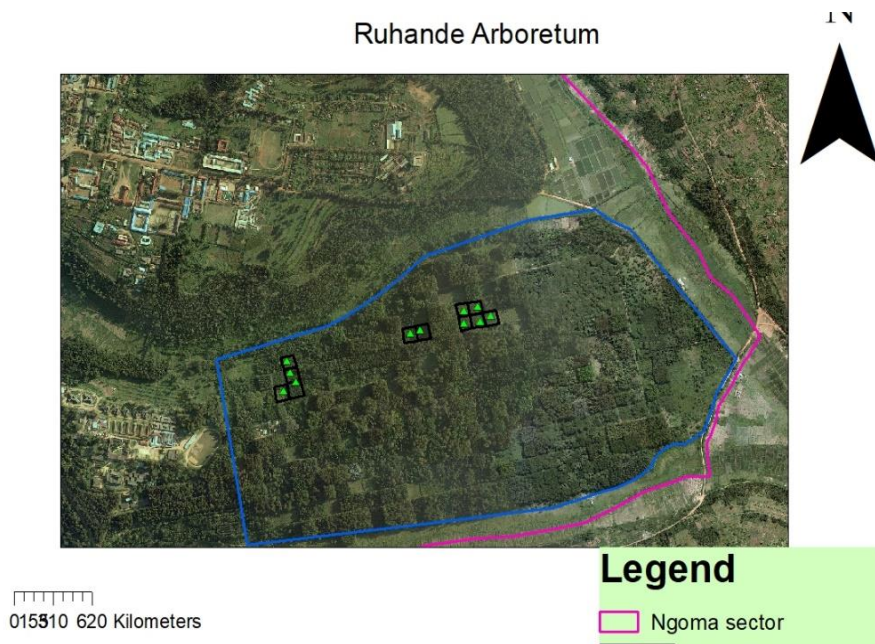


Figure 2. Map showing the distribution of *C. calothyrsus* plots in Ruhande Arboretum in Rwanda

Conclusion

This study has revealed that the total planted area covered by *C. calothyrsus* in Arboretum is three folds greater (0.62 ha) than the originally planted site, which is an unprecedented rate of invasion. We recommend that *C. calothyrsus* be maintained, and should be restricted to the area planted by this species. The species should be managed cautiously and future, if necessary, should be far from more susceptible species like Eucalyptus.

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