



Importance of *Faidherbia albida* (Delile) “Gao tree” dieback in agroecosystems of south western Sahelian Niger.

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Abstract

This study carried out in the agrosystems of Dogon Doutchi in Niger showed that 18.87% of *F. albida* trees is attacked by parasites, causing 5.66% of its population mortality. A significant decrease of 33.03-55.47% in yields of the main crops is perceived by the respondents.

Introduction

The production of tree is an old practice in the agricultural production system of West African countries. *F. albida* is known for its importance for improving soil fertility and carbon. This species increases the activity of symbiotic microorganisms, improving crop yields and nutritional values of crop products (Kho et al. 2001; Gnankambary et al. 2008; Faye et al. 2009; Takimoto et al. 2009; Mokgolodi et al. 2011; Moussa and Larwanou, 2018). Since 1980s, the South-central part of Niger, the Dogon Doutchi zone, have planted trees which increase the density of *F. albida*'s population in agro-ecosystems and this ecosystem served the local communities (Thomson, 1994). However, recently, this specie is facing a pest attack in addition to abusive human exploitation. This unidentified pest caused a high mortality of *F. albida* in the region. The objective of this study is to: (i) evaluate the current state of forest density, as well as the level of pest attack and the mortality rate of *F. albida* trees; and (ii) understand local perceptions about the causes of *F. albida* trees decay and its effect on yields of the main crops in the zone.

Material and methods

Steps



Samples' collection



Meeting with authority



Vegetation inventory



Survey

The data collection was carried out in two phases:

- Individual and group surveys with local communities to assess: the importance and benefit of *F. albida*; the constraints on the species; the causes of its mortality; the infestation and mortality rates; and the effect *F. Albida* on the main crops yields
- The second phase concerned the tree inventory in the fields through 48 plots of 2500 m² at three sites to characterize the tree population and the importance of dieback. The soil and branch samples were collected and transported to laboratory for further analysis. The data were processed with the Excel and the Minitib 16 software for the descriptive statistics and comparison test. One-way ANOVA is applied at 5% of significance level to compare some of parameters between the sites.

Results and discussion

Characterization of the woody vegetation

Thirty species were inventoried and belong to 11 genera and 8 families. The families of *Fabaceae* (83.82%) and *Arecaceae* (9.54%) were the most inventoried. The diversity in the agrosystems is low (H').

F. albida trees imposed on the dendrometric parameters of the vegetation (Table 1). This result was reflected in the low value of the Pielou equitability index (E) and the distribution of trees according to diameter classes (Table 1; Fig. 2).

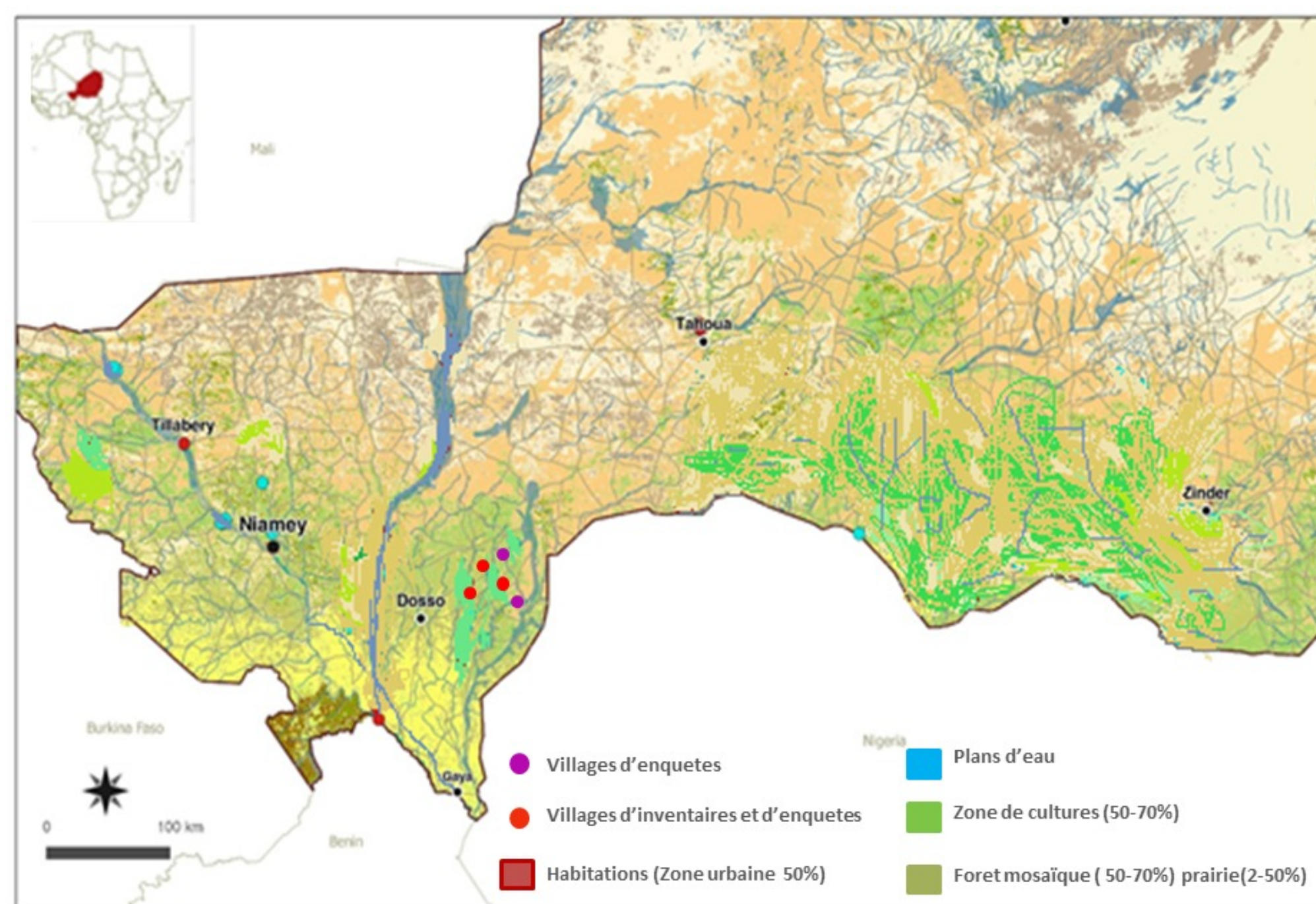


Fig. 1. Location of study

Table 1. Dendrometric parameters and stand diversity and *F. albida* parameters in the area

	Dendrometric parameters			Diversity Indexes		
	Mean Diameter (cm)	Basal area (m ² /ha)	Density (trees)	R (%)	H' (bit)	E
Global	35.19±14.63	2.24±0.005	21.62	11.60	1.33	0.36
<i>F. albida</i>	36.91±14.76	2.10±0.006	17	10.34	-	-

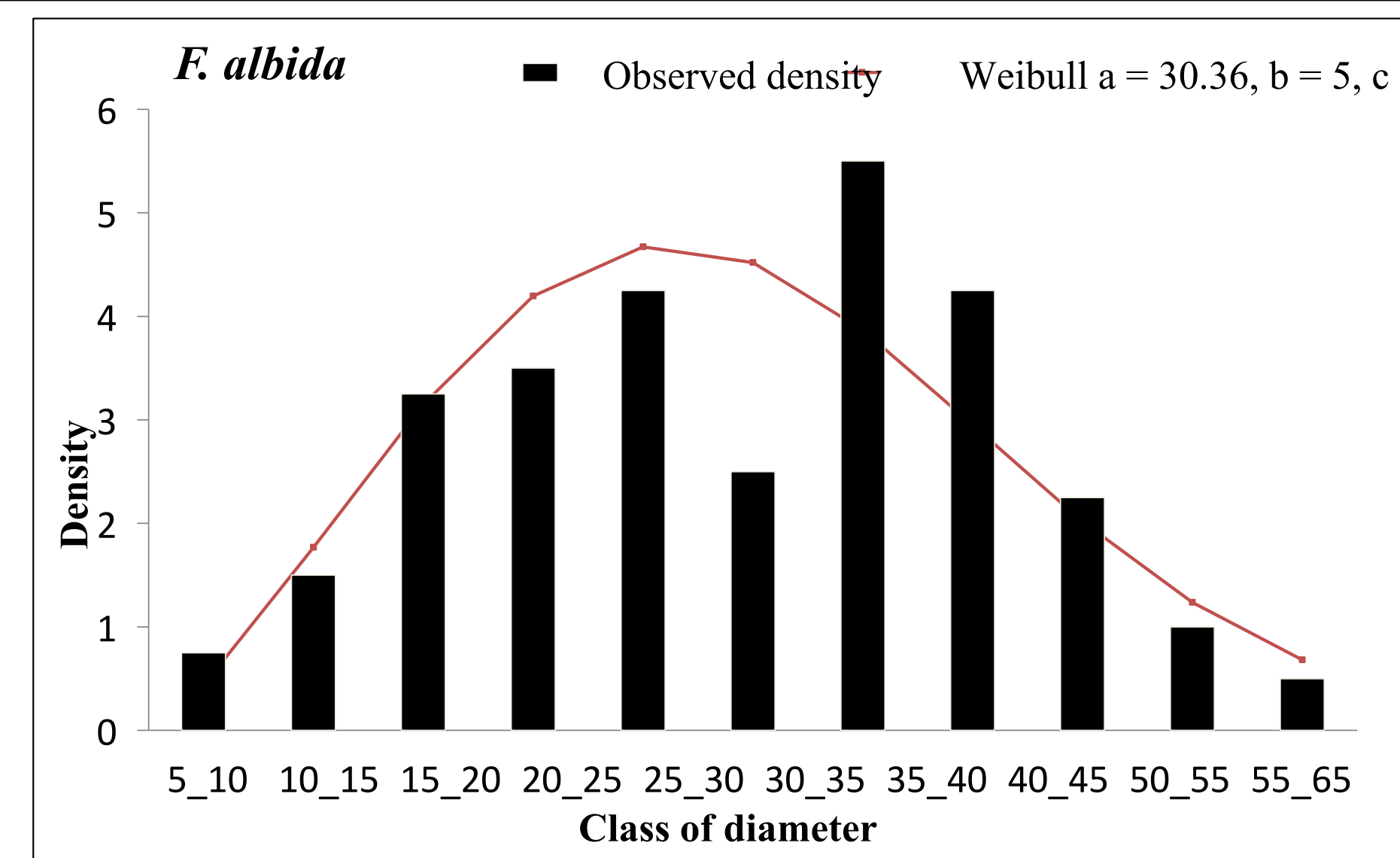


Fig. 2. Distribution of *F. albida* trees by class of diameter

The dieback percentage and its causes

The results revealed that tree dieback is a reality in this area with an infestation rate of 18.8% and mortality rate of 5.66% (Table 2). According to farmers, this mortality would be caused by: (i) defoliating caterpillars; (ii) larvae of beetles; and (iii) the rising of the groundwater. This dieback is most prevalent on relatively large diameter trees (Fig. 3).

Table 2. Distribution of the health status of *F. albida* trees

Health	Specific frequency (%)	Relative density (tree/ha)
Healthy	73.58	19.50
Infested	18.87	5.00
broken	1.42	0.38
Leaning	0.47	0.13
Dead	5.66	1.50
Total	100	26.5

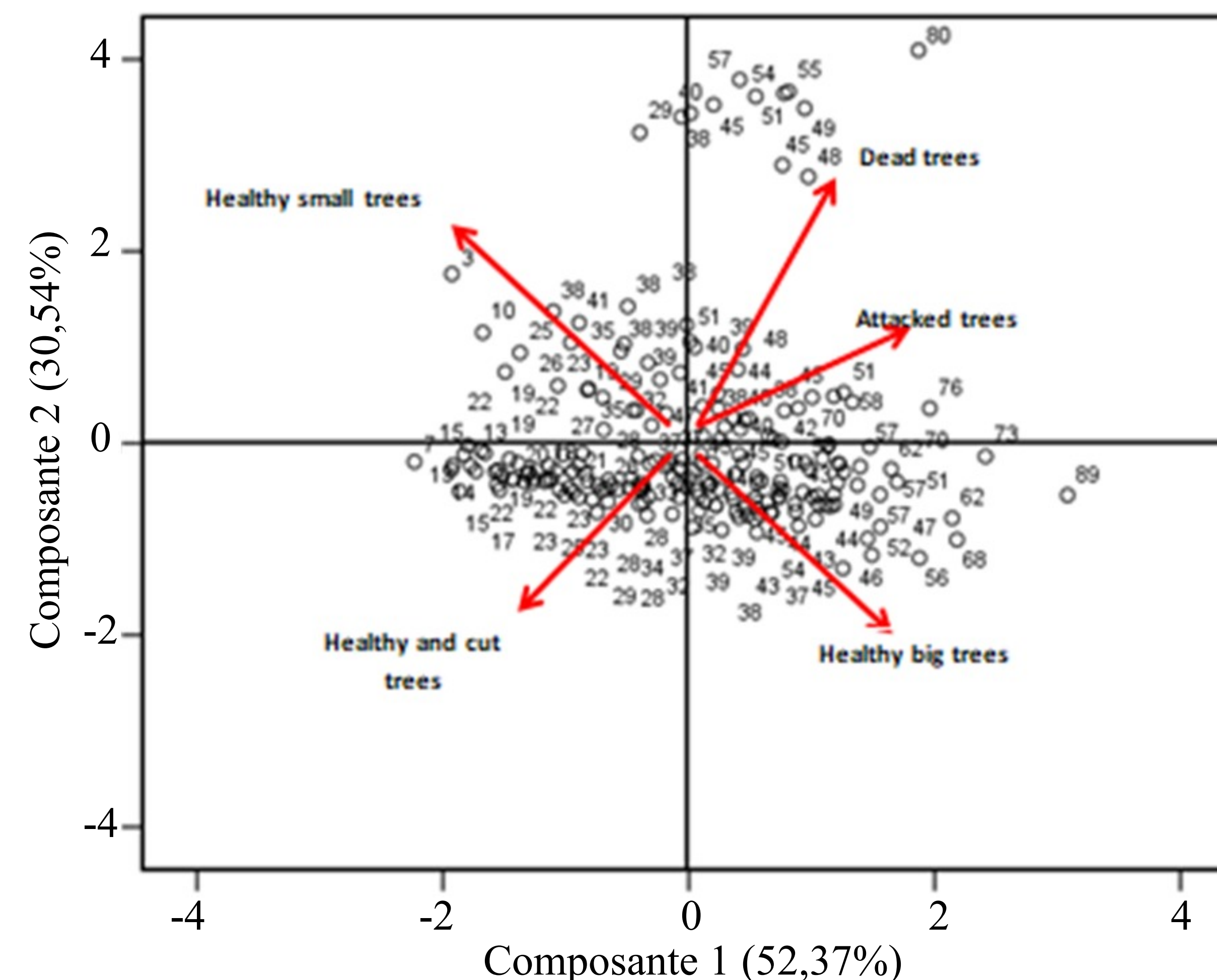


Fig. 3. : Principal Component Analysis (PCA) of the Health Status X DBH Matrix of *F. albida* Trees

Table 3. Crops yield and its reduction due to the pest by farmers perceived

Crops	n	Field area	Yield before the pest (kg/ha)	Yield with the pest attack (kg/ha)	Yield reduction (%)	Probability
Peanut	68	6.51±8.32	386.21±8.92a	241.81±6.38b	33.03±3.32	0.000
Millet	150	5.17±6.58	386.21±8.92a	241.81±6.38b	33.03±3.32	0.000
Cowpea	148	5.16±6.62	634.65±34.90a	334.55±19.75b	47.84±1.05	0.000
Hibiscus	54	6.80±8.25	161.11±11.64a	75.37±7.02b	52.09±2.028	0.000
Sorghum	99	5.32±6.30	90.91±20.42a	39.36±9.37b	55.47±1.75	0.023

Effects of the *F. albida* attack on crops yield

Overall, tree attacks led to a significant reduction in yields of the main crops in the zone (Table 3; $P \leq 0.05$).

Conclusion

- The diversity is low in the agrosystems of the zone
- The woody vegetation is dominated by *F. albida* trees with a density of 17 versus 21.62 trees / ha;
- The trees are under serious attack with an infestation rate of 18.87% and 5.66% mortality rate;
- According to the local communities, this attack caused yields reduction of main crops, ranged from 33.03 to 55.47%.

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