



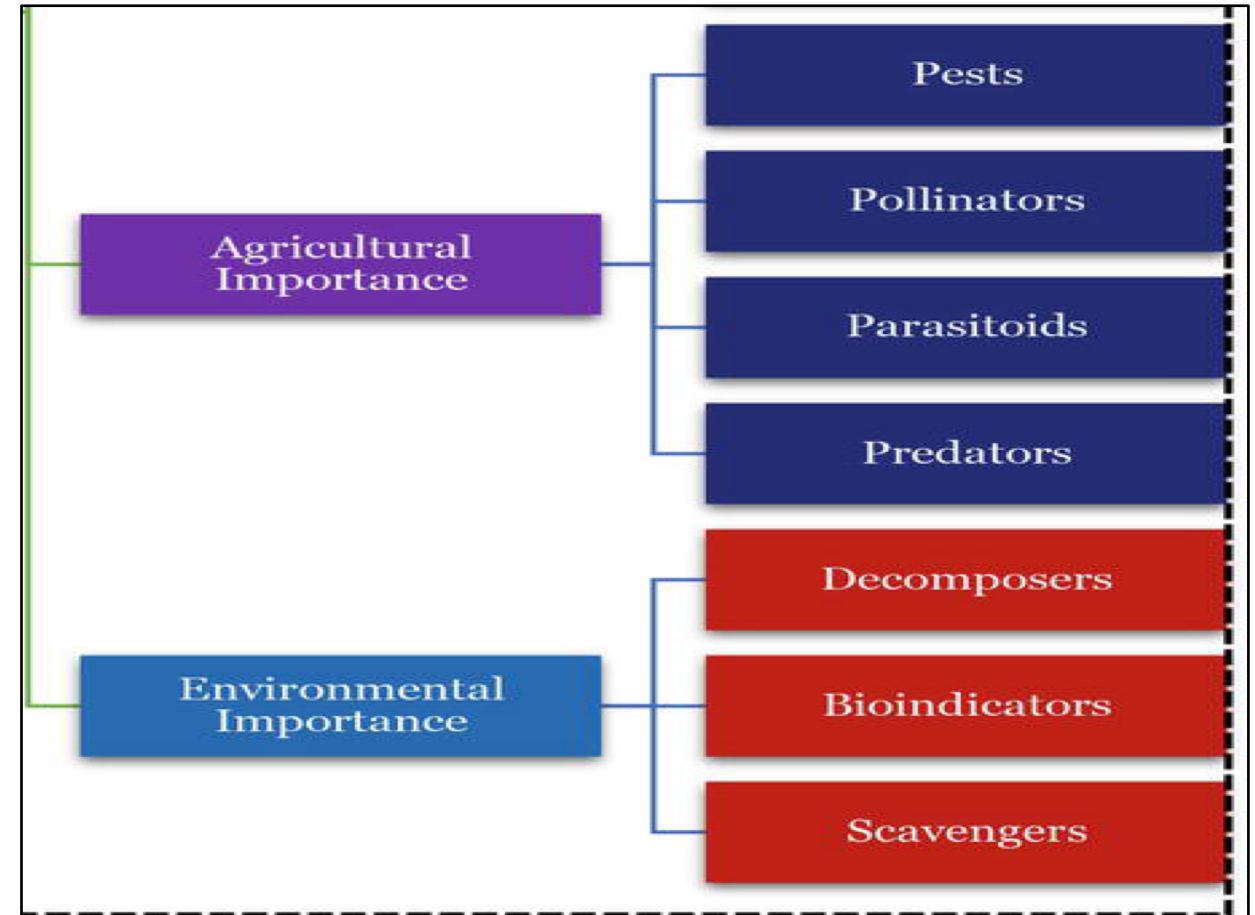
Diversity of insects associated to systemic integration of millet and shrubs (*Faidherbia albida* and *Guiera senegalensis*) in Niakhar area, Senegal

D. Sall, A. Ahamada, H. Maiguizo, M. Diédhiou, A.B. Ndiaye, P. Martin

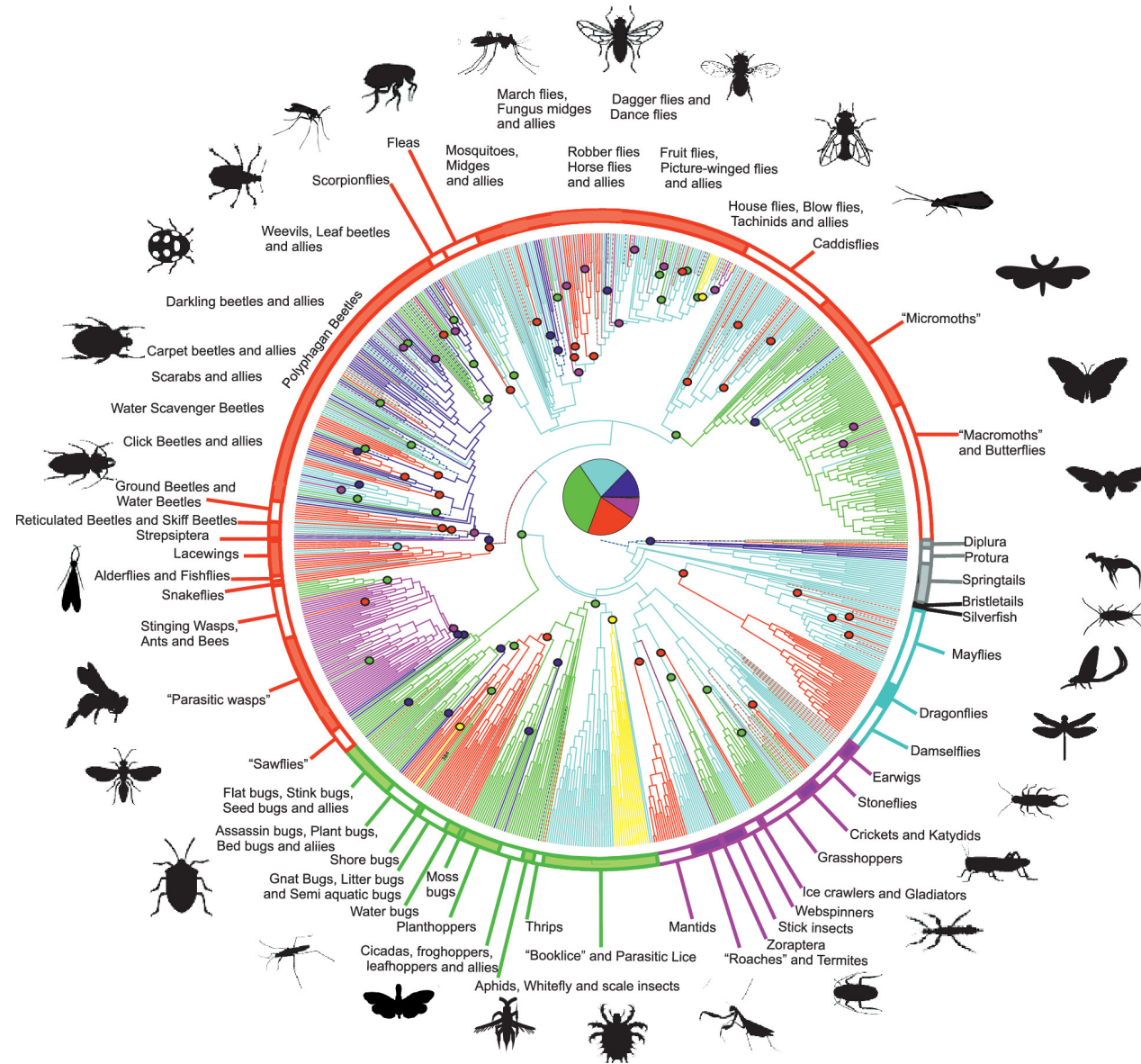


The insects

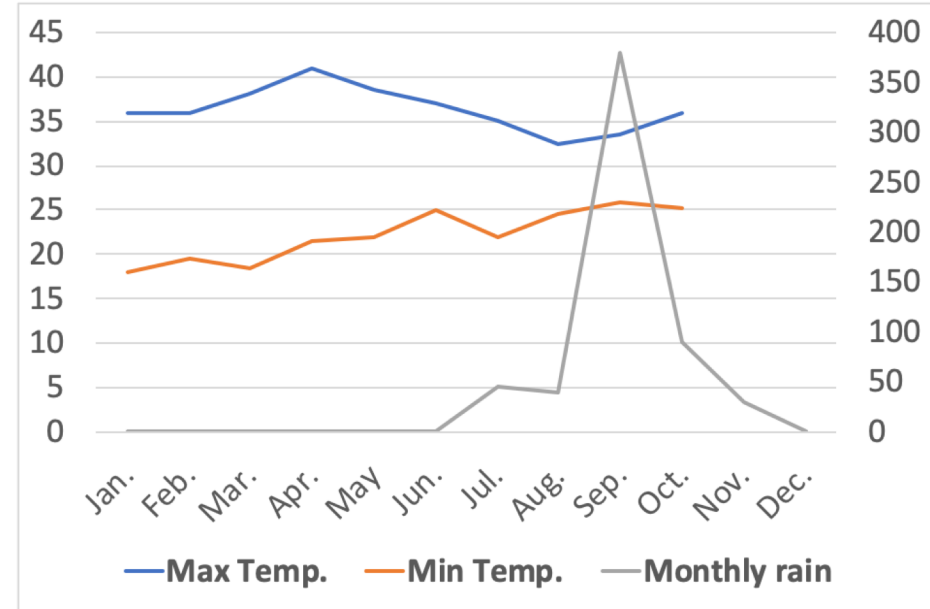
- ❑ an important part of the ecosystems
- ❑ production of ecosystem services
- ❑ contribution to the dispersal and exploitation of the organic matter



A diversity of insects



The Senegal peanut basin (Niakhar)



Two types of soil:

- Slightly leached tropical ferruginous soils (Dior soil), i.e. sandy and permeable with low organic matter content
- Calcimorphic brown soils (Deck soil) with 3 to 8% clay. They are better structured than Dior soils, but not very widespread.

Two main crops: Millet and Peanut

=> Managing soil fertility is crucial to enable agriculture

Improving soil fertility using woody plants



Faidherbia albida

- Until 30 m height
- Inverse phenology, i.e. loses its leaves at the beginning of the rainy season and remains leafy in the dry season
- Promotes soil fixation thanks to a highly developed mixed root system
=> Widely used to restore degraded arid environments



Guiera senegalensis

- Shrub that can reach 1,5 m height (but obs. 3 m)
- Fertility under the shrub due to the cumulative effect of root activity, soil fauna, leaf deposition, and the interception of particles transported by wind and water.

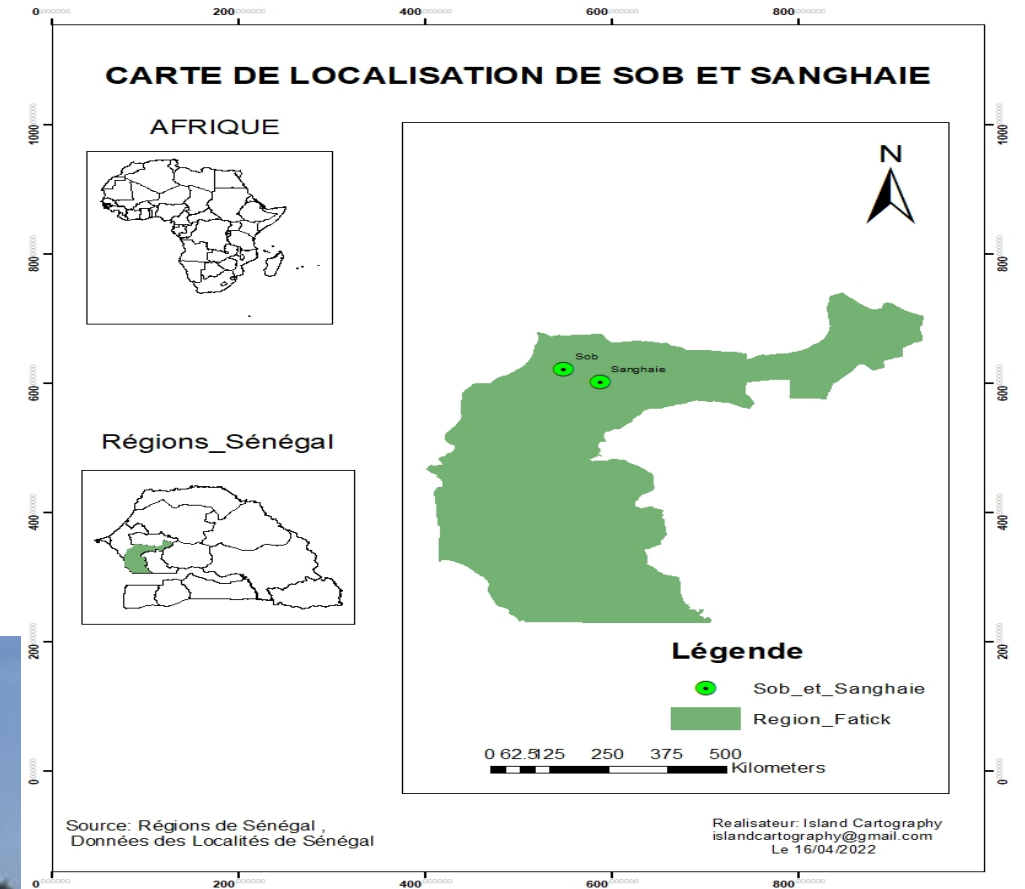
Objective of the work : Analyze the diversity of soil dew insect communities and their functional role to develop an agroecosystem sustainable management strategy

Study sites

Sampling carried out
in September 2021 (rainy) and January 2022 (dry season)
in two locations closed to Niakhar, i.e. Sanghaie and Sob

3 study sites

- **FA_l** : *Faidherbia albida* low density park in Sanghaie
- **GS** : *Guiera senegalensis* in Sanghaie
- **FA_m** : *Faidherbia albida* middle density in Sob



Location of the study sites

Sampling design

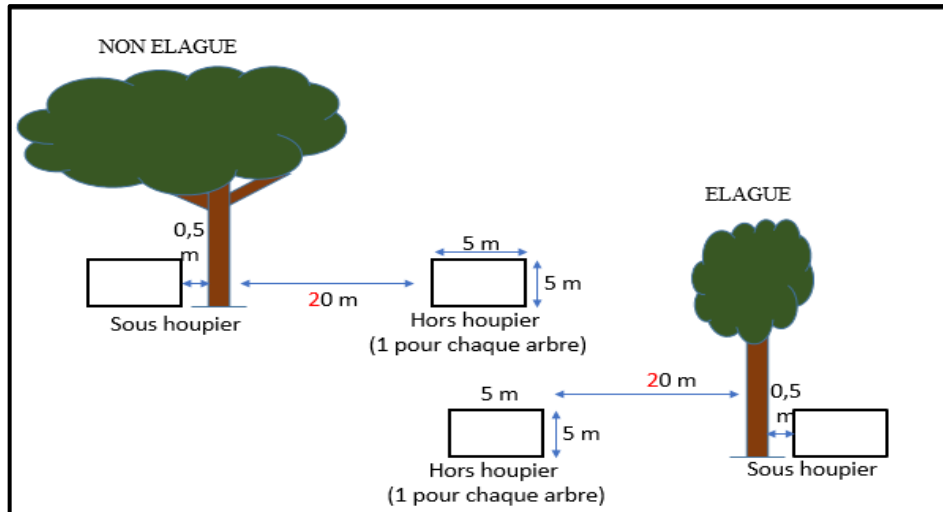
Six pitfall traps placed 0.5m and 20m from *Faidherbia albida* trees (pruned/not pruned) in FA_l and in FA_m

=> total 12 pitfall traps

Trap exposition : 48h



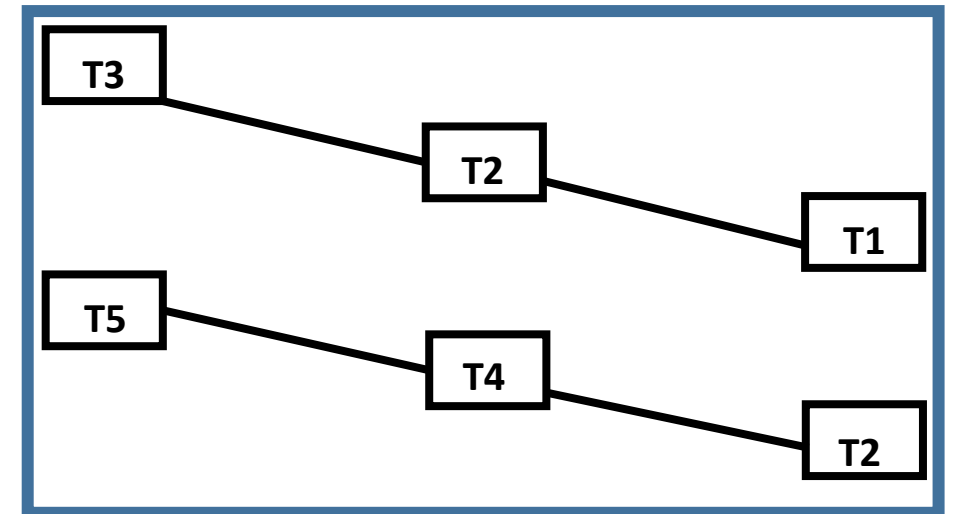
Pitfall trap



For GS, 3 pitfall traps placed in each of 2 36 m transects in plots that had received an organic amendment:

- T1: *Guiera* litter
- T2: *Guiera* residues (stem and leaves)
- T3: local manure
- T4: 100% mineral fertilizer
- T5: 50% mineral fertilizer

Trap exposition : 48h



Identification and Indicators



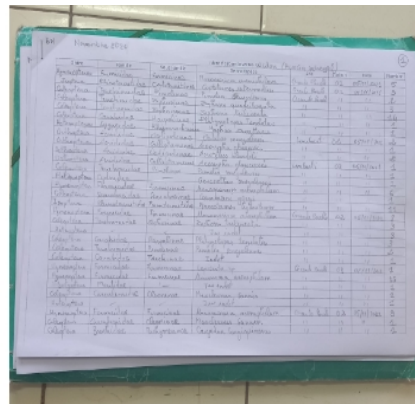
Binocular magnifier



collection box



Books



Spreadsheets

- **Specific richness:** # of species per population
- **Relative abundance:** $AR (\%) = \frac{ni}{N} \times 100$
- **Constance:** $C (\%) = \frac{Ri}{R} \times 100$
- **Shannon index:** $H' = - \sum P_i \log_2 P_i$
- **Equitability index:** $E = \frac{H'}{H_{max}} = \frac{H'}{\log_2 S}$
- **Jaccard Similarity Index:** $J = \frac{C}{(a+b-c)}$

ANOVA test using R studio on insect abundance and comparison of means using Student test

Global specific richness

N = 606 individuals

of Orders: 7

of families: 18

of subfamilies: 29

of species: 49

Coleoptera: 31 species from 7 families

Hymenoptera: 11 species from 4 families

Dictyoptera: 1 species

Orthoptera: 1 species

Dermaptera: 1 species

Diptera: 2 species

Heteroptera: 2 species

List of species and their location (1/3)

Order	Family	Sub-family	Species	FA _I	GS	FA _m
Dictyoptera	Polyphagidae	Polyphaginae	<i>Heterogamodes</i> sp.	X	X	X
			<i>Mylabris</i> sp.	X		
	Meloidae	Lyttnae	<i>Mylabris affinis</i>	X		
			<i>Mylabris argentata</i>	X		
		Masoreinae	<i>Tetragonoderus quadrum</i>	X	X	
		Chlaeniinae	<i>Lissauchenius</i> sp.		X	
			<i>Hyparpalus saponarius</i>	X		
			<i>Hyparpalus holosericeus</i> Dejean			X
Coleoptera	Carabidae	Harpalinae	<i>Hyparpalus</i> sp.		X	
			<i>Bradybaenus moritanicus</i>	X		
			<i>Bradybaenus scalaris</i>	X		X
		Cicindelinae	<i>Lophyra senegalensis</i>	X		
		Scaritinae	<i>Scarites senegalensis</i>	X	X	X

Order	Family	Sub-family	Species	FA _l	GS	FA _m
Coleoptera	Scarabaeidae	Coprinae	<i>Metacatharsius peleus</i>			X
			<i>Metacatharsius</i> sp.		X	
			<i>Metacatharsius auberti</i>		X	
			<i>Ontophagus bidens</i>			X
			<i>Ontophagus bituberculatus</i>		X	
			<i>Ontophagus</i> sp.		X	
			<i>Catharsius phidias</i>		X	
		Cetoniidae	<i>Coenochlus</i> sp.		X	
		Scarabeinae	<i>Allogymnopleurus aneus</i>		X	
			<i>Scarabaeus palemo</i>		X	
	Tenebrionida	Zophosinae	<i>Zophosis quadrilineata</i>		X	X
			<i>Zophosis trilineata</i>	X		X
		Opatrinae	<i>Leichenum mulleri</i>	X		
		Akidinae	<i>Storthocnemis stuneri</i>	X		
		Pimeliinae	<i>Pimelia senegalensis</i>	X	X	X
		Erodinae	<i>Erodus laevigatus</i>		X	
	Nitidulidae	Carpophilinae	<i>Carpophilus hemipterus</i>	X		X
	Bruchidae	Pachymnerinae	<i>Caryodom</i> sp.		X	
	Cucurlionidae	Brachyderinae	<i>Siderodactylus sagittarius</i>		X	

Order	Family	Sub-family	Species	FA _I	GS	FA _m	
Orthoptera	Pyrgomorphidae	Pyrgomorphinae	<i>Chrotogonus senegalensis</i>	X		X	
Dermatoptera	Forficulidae	Forficulinae	<i>Forficula senegalensis</i>			X	
Diptera	Drosophilidae	Drosophilinae	<i>Zaprionus vituger</i>			X	
	Muscidae	Muscinae	<i>Musca domestica</i>	X	X	X	
Heteroptera	Lygaeidae	Rhyparochrominae	<i>Dieuches</i> sp.	X			
	Cydnidae	Cydninae	<i>Aethus macrophatanus</i>	X			
	Halicticidae	Nomiinae	<i>Nomia</i> sp.	X			
	Apidea	Apinae	<i>Apis mellifica</i>	X			
	Hymenoptera			<i>Camponotus sericeus</i>		X	X
			Formicinae	<i>Camponotus maculatus</i>	X		X
				<i>Cataglyphis bicolor</i>			X
Formicidae			<i>Monomorium</i> sp.			X	
			<i>Monomorium areniphilum</i>	X	X	X	
		Myrmicinae	<i>Monomorium bicolor</i>	X		X	
			<i>Pheidole neutralis</i>	X			
			<i>Crematogaster</i> sp.	X	X	X	
Scoliidae	Scoliinae	<i>Camposmeris</i> sp.		X			

9 omnipresent species

Beneficials



Heterogamodes
sp.



Scarites
senegalensis



Camponotus
maculatus

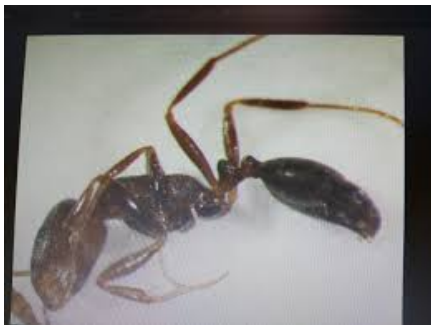


Pimelia
senegalensis



Crematogaster
sp.

Polyphagous



Monomorium
areniphylum



Zophosis
trilineata

Phytophagous



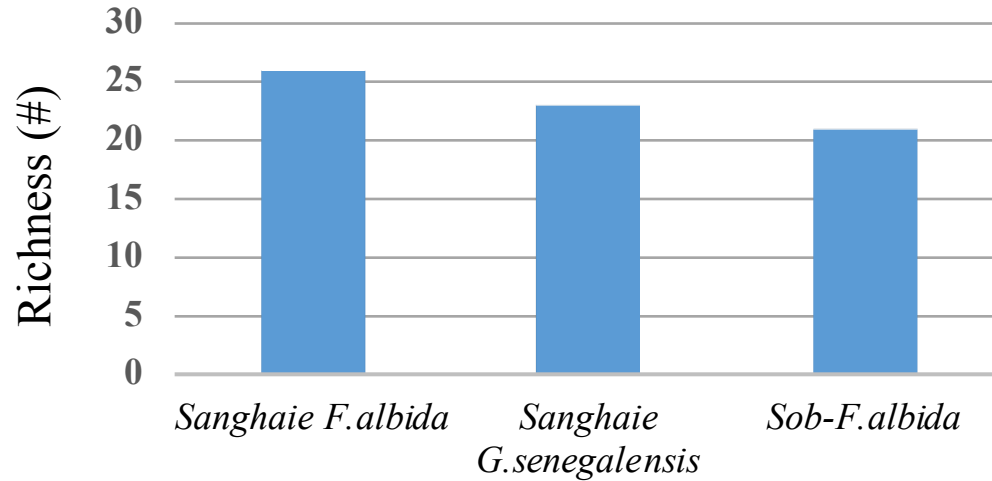
Carpophilus
hemipterus

Decomposer



Musca domestica

Richness per site



Indices per site

Site	FA _m	FA _l	SG
H'	2.5	1.5	2.6
H'max	3	3.2	3
E	0.8	0.5	0.8

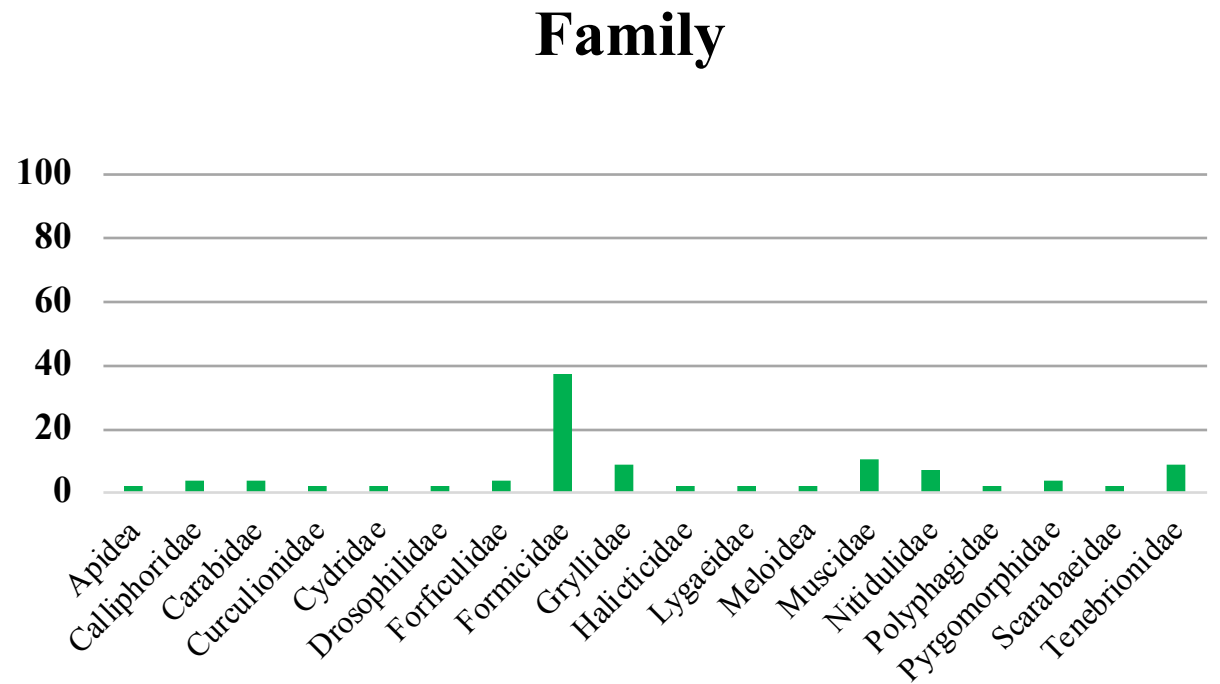
The Shannon H' diversity and Pielou evenness indices:
=> the catches in FA_m and SG sites are quite close but more diversified than that of FA_l

Site similarity

Site	FA _m /FA _l	FA _m /GS	FA _l /GS
Jaccard Index	0.3	0.2	0.2

=> No similarity between species caught at the three sites

FA₁ and FA_m: relative abundance of the taxons

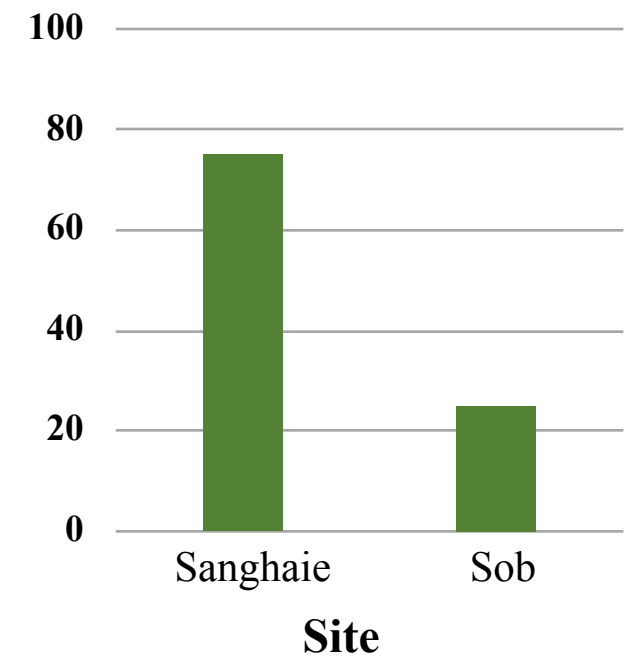
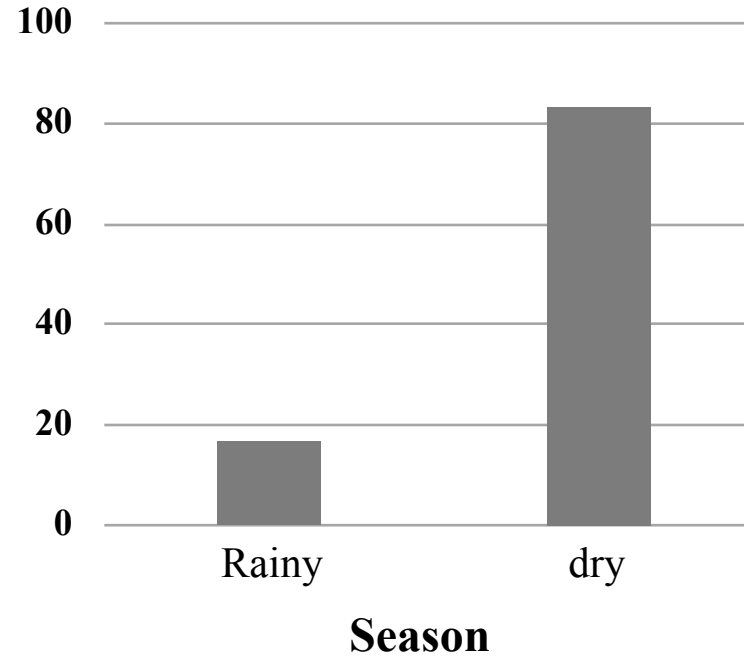
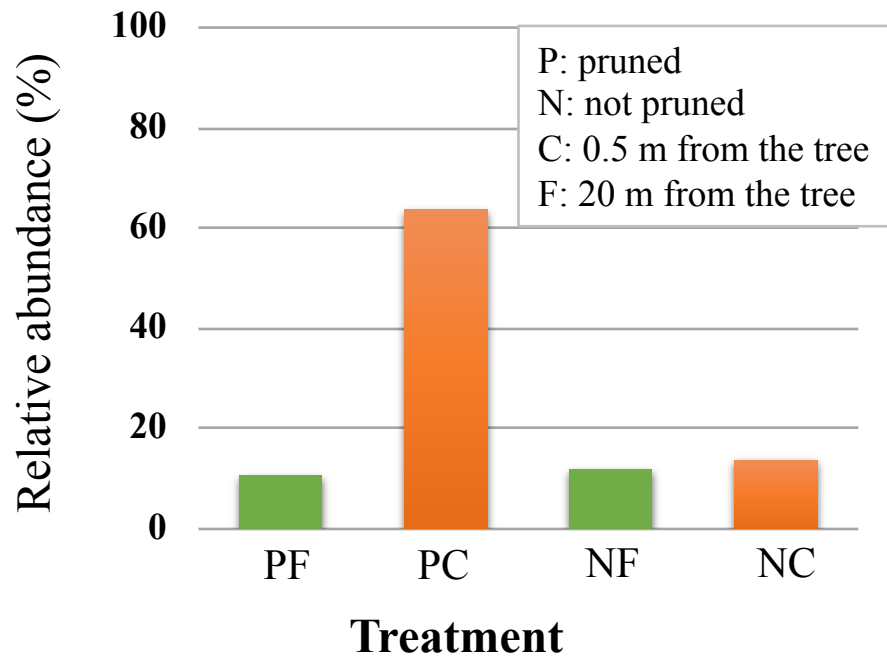


Predominance

Hymenoptera: 45%
Coleoptera and Diptera: 11%

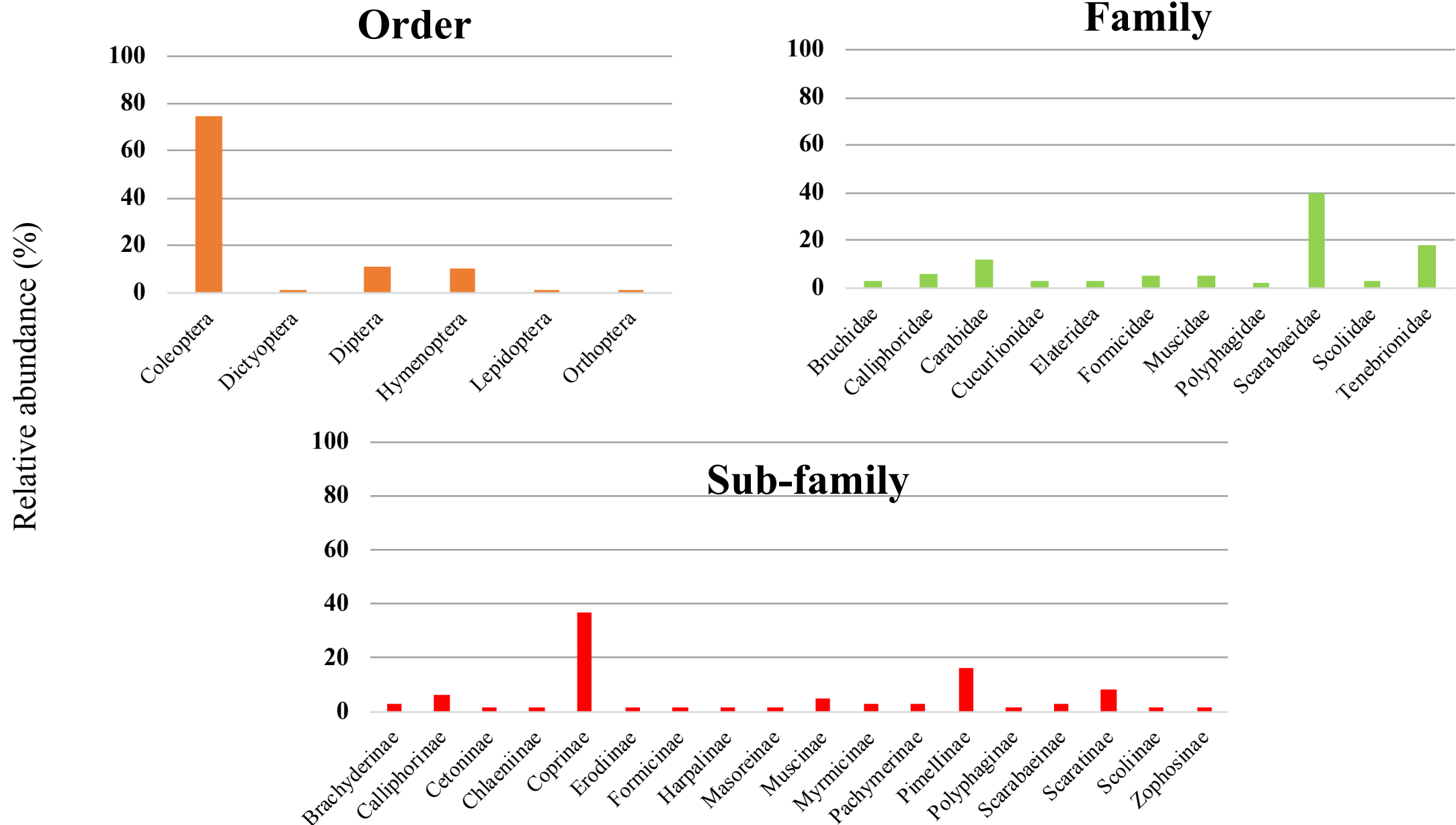
Formicidae: 37%
Muscidae: 10%

FA₁ and FA_m: Variation factors (pruning, season, and sites)

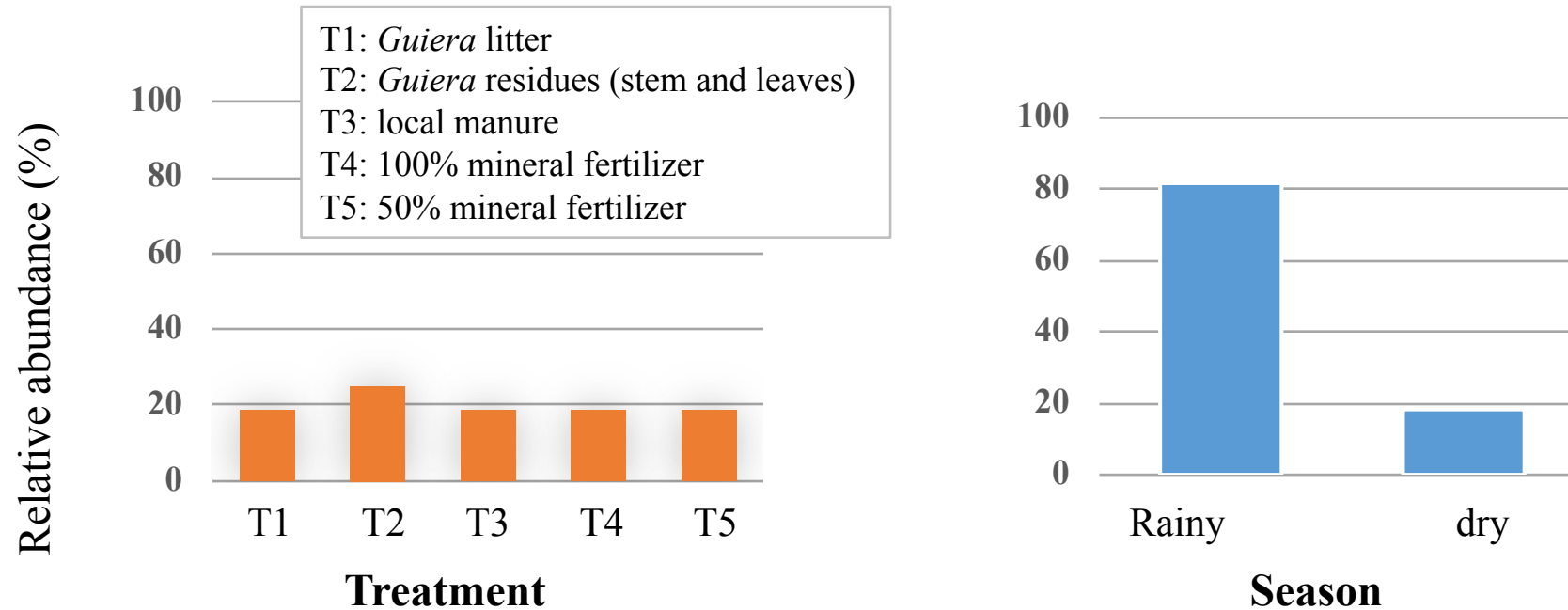


- 64% of insects were catch under pruned *F. albida*
- Dry season more suitable
- Insects more diversified in Sanghaie site (low density of *F. albida*)
- Site, seasons, and site have a significative effect on insect abundance under *F. albida* **p=2*10⁻¹⁶**
- Their combination impacts also abundance of insects : **p-value =0.0036**

GS (*Guiera senegalensis*): Relative abundance of the taxons



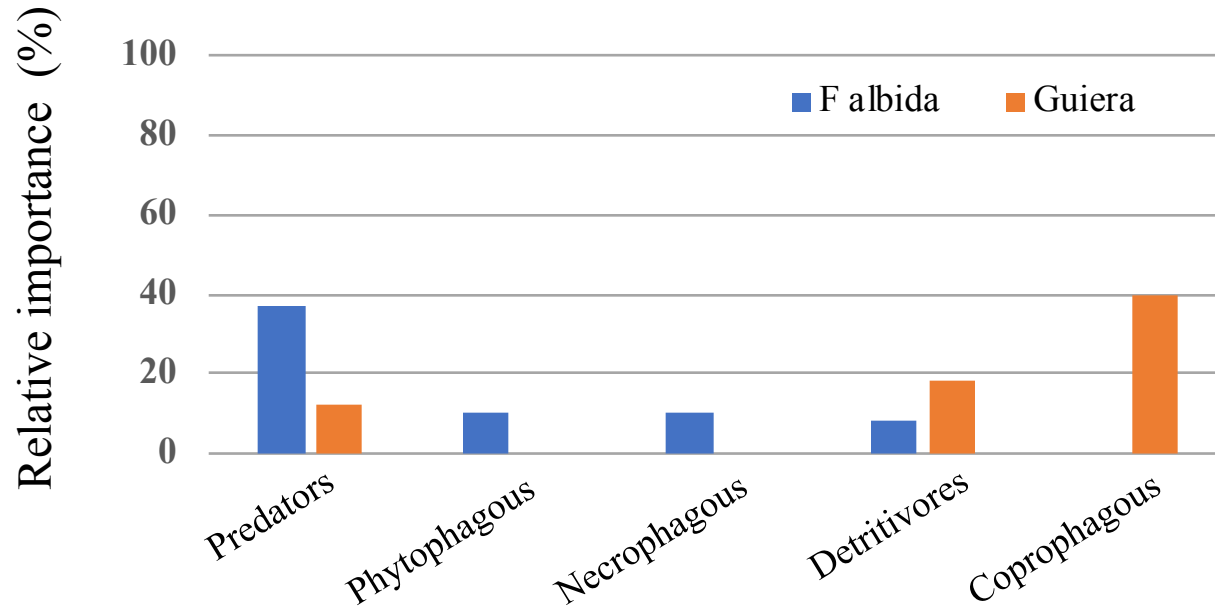
GS: Variation factors (treatment and season)



No significant effect on insect abundance of:

- season (p-value 0.21) and
- treatment (p-value 0.59)

Functional groups



Functional groups more diversified under *Faidherbia*
=> Potential for biological regulation

For GS, potential for recycling organic matter

For GS, the 3 most observed coleopteran families belong to a different functional group:

- Scarabaeidae (Coprinae = 37%) => Coprophagous
- Tenebrionidae (Pimeliinae = 16%) => Detritivores
- Carabidae (Scaritinae = 8%) => Predators

Conclusion

- *Faidherbia albida*: Hymenopteran (Formicidae) were predominant under pruned trees during the dry season
- *Guiera senegalensis* : Coleopteran (Scarabaeidae and Tenebrionidae) were predominant in the rainy season.
- Pruning *Faidherbia albida* and using *Guiera senegalensis* increase insect diversity and could contribute to natural pest regulation and seed dispersal in agroforestry systems.

