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Pedo-Landscape and Development of *Lippia multiflora* in the Southern Côte D'Ivoire

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Abstract: A study on geological, geomorpholigical, pedological, hydrological and botanical prospection was undertaken. The main focus was to identify the types of rocks, relief, soils, river and flora which characterize a suitable landscape for the growth of *Lippia multiflora*. The results obtained from this first investigation indicate that *Lippia multiflora* needs a savannah type environmental ecosystem with sandy soils derived from silico-aluminous rocks preferably developed in medium or base of hill topographical positions.

Key words: Domestication, pedo-landscape, savannah ecosystems, silico-aluminous

INTRODUCTION

Lippia multiflora (Savannah tea) is found in the Baoule V in the preforestry Ivory Cost and dwells on all the North savannah areas. The well known virtues and the multiples uses of *Lippia multiflora* (Savannah tea) strongly recommend turning it into a cultivated variety. However, cultivating this gathering plant requires a good knowledge of its natural environment, particularly a good understanding of the relationship between the areas of natural growth of *Lippia multiflora* and geological substratum, relief, vegetation and soil. Therefore, the present study has been undertaken to identify the litho-geomorpho-pedological formations or pedo-landscapes which characterize the natural environment of *Lippia multiflora*.

The pedo-landscape, also known as cartographic soil unit or typological soil unit is a volume of the pedological cover showing the same succession of horizons (Baize and Chretien, 1994). In fact, it has to do with a group of pedological horizons and parts of landscapes (vegetation, effects of humane activities, geomorphology, hydrology, native rocks or substrate), which space organization allow to define the whole or part of the pedological cover (Baize and Girard, 1995).

MATERIALS AND METHODS

Present study was conducted in the period of April to July 2008, in savannah regions on the middle and southern zones of Ivory Coast. The study was done on sites with both natural (Fig. 1) and experimentally grown populations of *Lippia multiflora* (Fig. 2) through pedological pits opened in different zones. Observations also targeted potential rock outcrops, microrelief and vegetation leveling. Pedological pits of 1.5 m deep and 0.80 m wide were opened every 100 m on toposequences

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Fig. 1: Natural populations of *Lippia multiflora*, (a) Zénoufla, (b) Toumodi and (c) Yamoussoukro

Fig. 2: Behavioral trial on *Lippia multiflora* at Yamoussoukro

established on the basis of azimuthal directions as described by Boulet *et al*. (1982). For better understanding of the experimental zone, the vegetation and the geological formations along the toposequences were identified and characterized. Azimuthal driectons were determined using a compass and the coordinates of the experimental pedological pits were obtaind by General Positioning System (GPS) (Garmin V*)*. The GPS was also used previously for the topographical levee.

RESULTS

Geological Substratum

Some *Lippia multiflora* species were found in Anikro's conglomerative type zones or in the volcano-sedimentary zones of the Blafo-Gueto birrimian. However, most of the plant populations were found on lands derived from a granitic substratum, mostly leucogranites with mica and quartz (Fig. 3).

Topography

The natural populations of *Lippia multifora* were mostly observed in base of hill topographic environment, on a strip of land comprised between 75-100 to 350-400 m from the bank of the river (Fig. 4). Some populations were found in mi-slope position, rarely at the summit.

Fig. 3: Geological formations observed on the different sites of natural populations of *Lippia multiflora*. (a) Granitic outcrops at Yamoussoukro; (b) Granitic outcrops crossed by a quartz silla at Zuénoula and (c) Cuirassed quartzite blocks at Yamoussoukro (Toléyaokro)

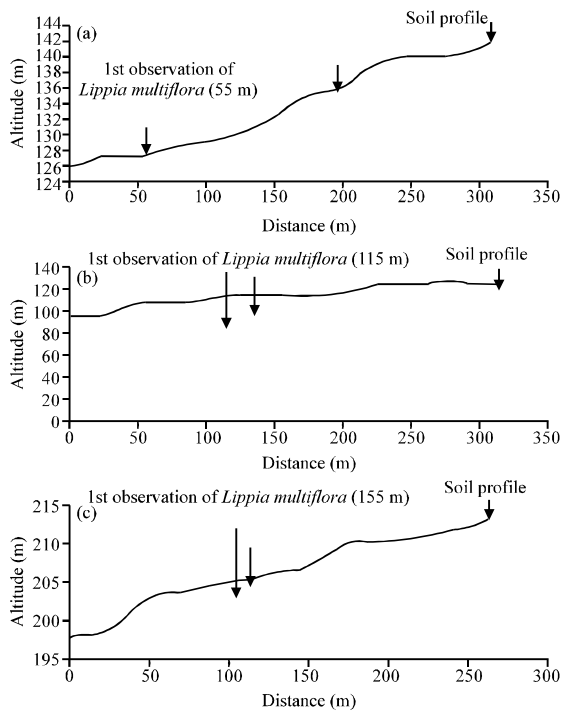


Fig. 4: Topographical positions of *Lippia multiflora* plants(Verbenaceae); (a) Road of Toumodi to Dimbokro (I2T); (b) Road of Abidjan to Toumodi (Assounvouè) and (c) Yamoussoukro (INP-HB)

Hydrography

Areas where the savannah tea naturally grows are run by waterways which are generally affluent of more or less important rivers drying up during severe droughts.

Vegetation

Natural populations of the *Lippia multiflora* are always associated with the presence of some typical plants as shown in Table 1 and Fig. 5. This has been observed anywhere in the present study.

Human Activities

The presence of some plants species like *Imperata cylindrica* along with the natural populations of *Lippia multiflora* is generally an indication of a loss of fertility. As a result, land with *Lippia multiflora* are often let lie fallow. They may be also leave for livestock grazing, particularly when species of the genus *panicum* are present.

Soil

Lippia multiflora tends to growth on a wide range of lands, particularly on sandy and rejuvenated lands, even on lands changing to hardened or deeply cuirassed (Fig. 6). Most of the soils investigated in the present study exhibited the following descriptive characteristics: medium to low humidity; brown dark to brown red color (2.5 to 7.5 YR YR), mostly spotted; a sandy-clayish to clayish-sandy texture, with medium to coarse particles and a clay content of 10-15% in surface horizons and 60-90% in depth; a medium to good porosity; presence of number of millimetric roots preferentially oriented sub-horizontally; a sub-angular polyhedral structure with a granular appearance at the root levels; a medium to strong coherence due to the presence of several coarse particles (70-80%), particularly nodules, concretions and quartz grains which tend to agglomerate and indurate. Theses soils are approximately 1 m deep.

Table 1: Typical plants species associated with natural populations of *Lippia multiflora*

Genus and species	Family
Aframomum latifolium	Zimgiberaceae
Annona senegalensis	Annonaceae
Bridelia ferruginea	Euphorbiaceae
Cochlospermum planchoni	Cochlospermaceae
Crosssopterix febrifuga	Rubiaceae
Erisosema glomeratum	Fabaceae
Ficus caperisis	Moraceae
Fimbristylis exilis	Cyperaceae
Fluggea virosa	Euphorbiaceae
Hyparrhenia dissoluta	Poaceae
Imperata cylindrica	Poaceae
Loudetia arundinaceae	Poaceae
Nauclea latifolia	Rubiaceae
Panicum maximum	Poaceae
Parkia biglobasa	Mimosaceae
Penisetum polystachion	Poaceae
Pericopsis laxiflora	Fiabaceae
Piliostigrua thonningii	Caesalpiniaceae
Pseudarthia hookeri	Fabaceae
Psidium guajava	Myrtaceae
Pterocarpus erinaceus	Fiabaceae
Tephrosia bracteolata	Fabaceae
Terminalia glaucesceus	Cambietaceae
Uraia picta	Fabaceae
Vernonia guineensis	Asteraceae
Waltheria indica	Sterculiaceae

Hyparrhenia dissoluta (Poaceae)

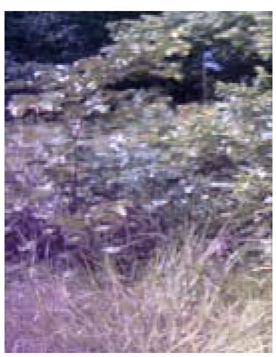
Fimbristylis exilis (Cyperaceae)

Cochlospermum planchoni (Cochlosperniaceae)

Waltheria indica (Sterculiaceae)

Lippia multiflora (verbenaceae)

Nauclea latifolia (Rubiaceae)



Piliostigma thonningii (Caesalpiniaceae)

Eriosema glomeratum (Fabaceae)

Annona senegalensis (Annonaceae)

Fig. 5: Some typical plants found on the sites of natural populations of *Lippia multiflora* (Verbenaceae)

Fig. 6: Soil profiles

DISCUSSION

The sandy structure and the high content in coarse particles observed in the soils under study are the result of the alteration of the silico-aluminous rocks of the geological substratum. This has led to the development of a siliceous environment where *Lippia multiflora* could growth easily, confirming its psammophilic nature. A strong ability of *Lippia mutiflora* to growth on this type of soil, known as highly permeable and filtering was clearly shown in present study.

The presence of high number of natural populations of *Lippia multiflora* on medium and base of hill could be attributed to the disintegration of rocky formations in siliceous particles followed by their transportation at lower topographic levels, where they contribute to the formation of the sandy and porous soils.

From the present study, it seems that one should consider taking into account the existence of this geomorphological substratum as suggested by Wright *et al*. (2004) and focus on the continuum variation rather than cutting into distinguish layers and the establishment of a link between the variability of the functional diversity of plant populations and the ecosystem properties. Despite their high content in siliceous sandy, soils derived from the transformation of the geological substratum of the natural environment of *Lippia multiflora* seem to contain essential nutrients for the growth of this plant. This is supported by several scientific reports showing the importance of adequate mineral nutrition on the biomass production and the overall productivity of *Lippia multiflora* (Langer, 1959; Duru *et al*., 2000). Adequate mineral nutrition generally favors more development of talks in *Lippia multiflora* due to an increase of the number of thallus reaching the double-ripple step (Duru *et al*., 2000; Duru, 2003). It is well known that soil is a particular ecosystem consisting of different plants, animals and microorganisms functioning together with all the non-living physical factors of the environment. As a result, soil would be considered as the most important factor having an impact on the differences observed between *Lippia multflora* natural populations. Soils is were begin all the first steps of the food chain including protein production by microorganisms from mineral nitrogen, water and mineral nutrition of plants, which in turn synthesize carbohydrates from atmospheric CO_2. As stated by Baize *et al*. (1990, 1992), soil makes live, live makes soil and soil diversity makes the overall diversity of biotopes and landscapes.

The vast majority, if not almost all plants observed in the natural environment of *Lippia multiflora* is made up of specific plant species savannah ecosystem, which disappear as soon as settled a forest climax and because these plants live with *Lippia multiflora* proves that it is indeed a savannah plant, which eloquently justifies his other name savannah tea.

CONCLUSION

The present study on the pedological landscape of *Lippia multiflora* shows that this plant naturally grows on mainly sandy soils, well organized, with coarse particles derived from the transformation of silico-aluminous geological substratum. These soils were found to be deep and located in medium or base of hill positions. Beside the litho-geomorphological and geological characteristics, the environment of *Lippia multiflora* is often characterized by the presence of some typical plant species of savannah ecosystems.

REFERENCES

Baize, D., M.C. Girard, A. Ruellan and J. Boulaine, 1990. The new French reference base for soils pedological references. Basic concepts and special features. 14th International Congress of Soil Science, August 12-18, Kyoto, Japan, pp: 16-21.

Baize, D., M.C. Girard, J. Boulaine, C.L. Cheverry and A. Ruellan, 1992. Why a Pedological References? Definition of References Horizons. 1st Edn., INRA, Paris (FRA), ISBN: 2-7380-0410-5, pp: 80.

Baize, D. and J. Chrétien, 1994. Pedological area of a sinemurian plateforme in Bourgogne-morphological et pedo-geochemical features. Study Soil Manage., 2: 2-28.

Baize, D. and M.C. Girard, 1995. Pedological References. 1st Edn., INRA, Paris, ISBN: 2-7380-06633-7, pp: 332.

Boulet, R., A. Chauvel, F.X. Humbel and Y. Lucas, 1982. Structural analysis and cartography in pedology. I-Taking into account the bidimensional organization of pedological area: Toposequences studies and their main contribution to soil knowledge. Cah. Orstom Ser. Pedol., XIX: 309-321.

Duru, M., V. Delprat, C. Fabre and E. Feuillerac, 2000. Effect of nitrogen fertilizer supply and winter cutting on morphological composition and herbage digestibility of a *Dactylis glomerata* L. sward in spring. J. Sci. Food Agric., 80: 33-42.

Duru, M., 2003. Effect of nitrogen fertilizer rates and defoliation regime on the vertical structure and composition (crude protein content and digestibility) of a grass sward. J. Sci. Food Agric., 83: 1469-1479.

Langer, R.H.M., 1959. Growth and nutrition of timothy (*Phleum pratense* L.). V. Growth and flowering at different levels of nitrogen. Ann. Applied Biol., 47: 740-751.

Wright, I.J., P.B. Reich, M. Westoby, D.D. Ackerly, Z. Baruch and F. Bongers *et al*., 2004. The worldwide leaf economics spectrum. Nature, 428: 821-827.