Temporal and spatial variation of soil seed bank in Elain Natural Forest Reserve North Kordofan, Sudan

Mohammed H. Mohammed[1], Hussien M. Sulieman[2]
[1]TU-Dresden, Institute of Forest Growth and Computer Science, Germany
[2]University of Gadaref, Faculty of Agricultural and Environmental Sciences, Sudan

International Research on Food Security, Natural Resource Management and Rural Development

Competition for Resources in a Changing World: New Drive for Rural Development
University of Hohenheim

Tropentag October 7 - 9, 2008 in Stuttgart-Hohenheim

1. Introduction:

There is an increasing demand for reliable information on seed banks, both for scientific purposes and as decision tool in habitat and landscape management (Hölzel and Otte, 2004). Soil seed bank is an accumulation of seeds in different soil depths over time. Soil seed banks play an important role in restoring former species diversity (Bakker *et al.*, 1996) and have the potential for initiating natural regeneration after disturbance (Balun, 1999). While seed banks are essential to maintain life and growth in forests it can also reflect evolutionary changes in plant communities as a consequence of changes in land use (Greene and Waters, 2001) beside serving as safeguards for genetic variability (Baker, 1989).

The main objective of this study was to investigate the temporal and spatial changes of the soil seed banks in Elain Natural Forest Reserve North Kordofan, Sudan.

2. Material and methods:

Data for the this study were collected from Elain Natural Forest Reserve North Kordofan, Sudan (12º 52′-13º 04′ N and 30º 10′-30º 24′ E). The falls under semi-arid and receives annual rain fall between 200-250 mm. The mean annual temperature is 27º C. Soil is non cracking soil, locally known gardud, of poor infiltration rate and high runoff capacity. Ecologically the forest lies within the *Acacia* Wooded Grassland Savannah and dominated by *Acacia mellifera*. Other woody vegetations namely *Acacia nilotica*, *Terminalia brownii, Balanites aegyptiaca* and *Adansonia digitata* are also found.

Three biodiversity components – species richness, floristic diversity and soil seed bank were studied. Two community patches, of one hectare each, were located in the forest. These patches were determined according to tree density i.e. 88.9 and 150.3 trees/ha later known as site A and B respectively. Nine circular plots, 0.1 hectare, were fixed. Diversity and frequency of woody species were measured. In each plot, soil samples for seed bank estimation were taken at four depths (0-5, 5-10, 10-15 and 15-20 cm) before and after rainy season. Number of visible seeds in each soil sample (≈300 cm^3) was determined and the average seed bank m^{-2} was calculated.

Soil samples were placed in a container for seeds germination under nursery conditions. Emerged seedlings were counted and identified, up to 6 weeks, as trees/shrubs and grasses to dicotyledonous and monocotyledonous and then removed. Number of emerged seedlings was determined in each depth for each community patch and season. Descriptive statistics, mean comparison and regression techniques were applied.

3. Results:

The study showed that only seven woody species were reported five of which naturally regenerated. *Acacia mellifera* is dominated the forest (81.1 and 150.0 stems/ha (97%) having only 3-7% of natural regeneration. Tree seeds ranged from 828.6- 1052.6 seeds m^{-2} where 59.7- 73.9% of the seeds found in the top 5 cm (Table 1).

Maximum germinated seeds were 3540.5 m^{-2} of which only 10% were tree seeds (Table 2). All tree seeds detected in the banks belong to *A. mellifera*. Viable tree seeds vary and available up to 10 cm while herbaceous are found up to 20 cm soil depth (Fig. 1). Seed banks decrease with increasing in depth.

Table 1. Tree seeds density m^{-2} in different soil depths

Soil depth (cm)	Community patch			
	Site A		Site B	
	Before rain	After rain	Before rain	After rain
0-5	614.0	583.8	494.7	777.9
5-10	244.8	337.4	333.9	274.7
10-15	0.0	0.0	0.0	0.0
15-20	0.0	0.0	0.0	0.0
Total	858.8	921.2	828.6	1052.6

The results also revealed that there is a weak relationship, R^2= 0.05 and R^2 = 0.13 for site A and B respectively, between soil seed bank density and above ground vegetation density (tree/shrubs) (Fig. 2).

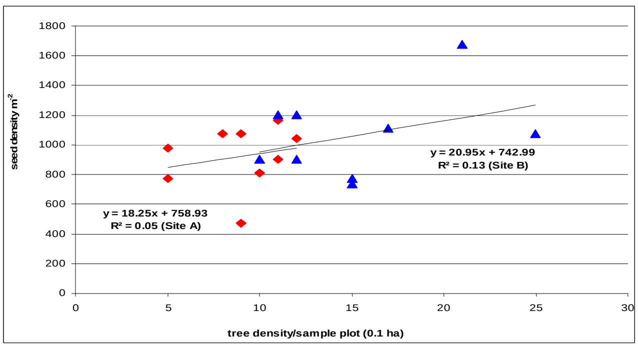

Fig. 2 The relationship between seed density and tree density

Table 2. Viable seed banks Density m^{-2} in different soil depths

Soil depth (cm)	Community patch			
	Before rain		After rain	
	Site A	Site B	Site A	Site B
0-5	188.3(508.5)	301.3(27775.5)	148.4(1525.5)	389.0(847.5)
5-10	37.7(320.2)	52.8(277.1)	33.4(678)	55.0(508.5)
10-15	0.0(56.5)	0.0(113.0)	0.0(339)	0.0(169.5)
15-20	0.0(0.0)	0.0(18.8)	0.0(0.0)	0.0(169.5)
Total	226.0(885.2)	354.1(3186.4)	181.8(2542.2)	444.0(1695)
Tree seeds (%)	20.1	10	6.8	20.8

Note: between brackets are grasses' seeds

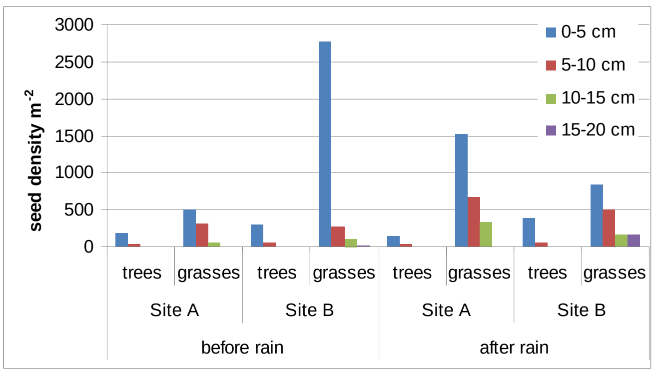

Fig. 1. Temporal and spatial variation of soil seed bank

Non cracking soils and high runoff may prohibit seeds to fall deep into the soil. The results which show only *A. mellifera* seeds were detected and the weak relationship between seed density and above ground vegetation density do not actually depict the above ground vegetation in terms of density and diversity. Tree seeds below 5 cm depth may not contribute to the natural regeneration.

These findings may be of great values for further studies in the context of soil seed banks and their impacts on plant biodiversity.