EFFECT OF SOIL SEEDBANK IN THE REGENERATION OF WOODY SPECIES IN UKPOM BENDE FOREST RESERVE, ABIA STATE, SOUTHEASTERN NIGERIA.

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ABSTRACT
The study was conducted to determine the effect of soil seedbank in the regeneration of woody species in Ukpom Bende Forest Reserve. Seedling emergence was method used to estimate the density and composition of buried seeds in the soil. The study was carried out in a 2 x 2 factorial experiment in Randomized Complete Block Design (RCBD).Forty replicate soil samples were collected from each of two soil depths (0-5cm and 5-10cm) and two seasons (dry and rainy seasons) using soil auger. The soil samples were monitored for three months for seedling emergence. Data were subjected to analysis of variance; significant means were separated using least significant difference at 5% probability level. The result showed that the total number of individuals per plant species (182 seedlings m^{-2}) that emergedin 0-5cm soil depth was significantly higher than that obtained in 5-10cm soil depth (86.38 seedling m^{-2}). Emerged seedlings in dry season soil collections were also significantly higher (175.92 seedling m^{-2}) than the rainy season (92.75 seedling m^{-2}) soil collections. The soil seed bank was characterized by high proportion of herbaceous species (82.4%) and low proportion of woody species (17. 6%). The result indicates that soil seedbank can contribute to the regeneration of woody species in the forest reserve although to a limited extent. However, the species composition of emerged seedlings suggests that the seed bank is not critical for the regeneration of economic timber tree species in the Forest Reserve. Therefore, re-planting of the heavily exploited areas and portions lost to arable farming within the Forest Reserve with both indigenous timber and exotic species should be carried out.

Keywords: Seedbank, Seedling emergence, Woody species, Ukpom Bende, Forest Reserve

INTRODUCTION

Oke*et al*. (2007), described seedbank as an indicator of past and present seed populations buried by percolation, action of animals, soil litter and physical methods that have persisted in the soil for several years. Roberts (1981) defined soil seedbank as the viable seed reservoir present in a soil. Hyatt (1999) described soil seedbank as all the buildup of viable but domant seeds in or on the soil or mixed with soil debris. The knowledge of the soil seedbank is important in understanding forest regeneration because forest cleared for shifting agriculture has three potential sources of regeneration: seeds present in the soil at the time of disturbance, post-disturbance seed input, and re-sprouting trunks and roots (Young *et al.*, (1987).

Soil seedbank plays an important role in the regeneration of natural ecosystem. For example, the rapid re-vegetation of sites disturbed by wildfire, catastrophic weather, agricultural operations, and timber harvesting is largely due to the soil seedbank. Forest ecosystem contains a number of specialized plant species forming persistent soil seedbanks. The absence of a soil seed bank impedes the establishment of vegetation during primary succession, while presence of a well-stocked soil seedbank permits rapid development of species-rich ecosystems during secondary succession.

Soil seedbanks have historic and future connections with the above ground plant community. The seedbank of a plant community represents the memory of the vegetation previously on the site. It is therefore, possible to look back in time and see picture of previous vegetation (Thompson,1983**).** Coffin and Lauenroth, (1989) noted that seedbank is also an important component of the potential of a community to respond to conditions in the present and future. Harper, (1977) explained that the reappearance of a plant species after disturbance may be the result of its persistence in the soil seedbank. Skogland, (1992), revealed that seeds present in the soil are potentially useful for restoration projects, where establishment of plant cover is desired. He further noted that buried seeds have important implication for conservation management, which preferred species of the original vegetation that have survived in the soil seedbank.

The natural processes which influence forest dynamics have shown that soil seedbank is one of the principal sources of recruitment for new individuals in the initial stages of forest succession (Young et al., 1987). Lunt (1997) also noted that soil seedbank is partially responsible for dynamic changed that may occur during the development of vegetation. William-Linera (1993), observed that the species richness and abundance in seedbanks may provide information on the potential of community for regeneration. However, Warr*et al*., (1993) observed that. Soil seed bank cannot be used to restore all plant communities in an ecosystem. It is against this background that this survey was conducted to determine the density and composition of emerged seedlings of soil seedbank in Ukpom Bende Forest Reserve with the view to ascertaining the role soil seedbank can play in the regeneration of woody

species in the Forest Reserve.

MATERIALS AND METHODS

The Study Area

The study was carried out at Ukpom Bende Forest Reserve about 20Km Southeast of Umuahia, along Umuahia –Bende highway. The Reserve is about 14.750 km^2.and lies on latitude 5° 34' N and longitude 7° 32' E. The soil is loamy clay and is derived from the crystalline acid rocks of undifferentiated basement complex (Ogbonnaya, 2002). The vegetation is of tropical lowland rainforest ecological zone (Nwobosi,1982). The mean annual rainfall of the area is between 1800-2238cm. The mean annual temperature of the area ranges between 32°C and 23°C while the relative humidity is between 65-85% (ADP,2010.The Forest Reserve was acquired in 1929, gazetted in 1953 while plantation establishment began in 1958.The species planted included *Gmelinaaborea, Tectonagrandis, Naucleadiderrichi, Terminalia ivorensis, Mitragyna,* and*Khayagrandifolia*. Others were *Lovea, Entradrophragma, Cederelaodorata, Treculiaafricana, Irvingia*sp, *Triplochytonscleroxylon and Eucalyptus* species. The objectives of management of the reserve include production of timber, poles, pulpwood, fuelwood and non-timber forest products. It also aimed to conserve biodiversity and provide ecological services.

Methods of Data Collection

In order to investigate the density and species composition of viable seeds in the soil, a 2X2 factorial experiment in a Randomized Complete Block Design (RCBD) was used. The first factor was soil depth with two levels 0-5cm and 5-10cmand the second factor was seasonal intervals also with two levels (dry and rainy season). Forty replicates soil samples were taken randomly from each of the two soil layers (0- 5 and 5-10 cm deep) in the same column of soil in February (dry season) and July (rainy season) using soil auger of 8.5cm diameter and were subjected to seedling emergence for three months. The soil samples were put in polythene bags, labeled and then transferred to the Nursery of Michael Okpara University of Agriculture Umudike. The soil samples from the same soil depth were bulked to form composite sample and were air dried for four days after which litters, large stones and roots fragment were removed. The soil sample from each of the two soil depths were sprayed in eight germination boxes of 25cm by 15cm by 15cm sizes. They were maintained under field condition at nursery and watered twice daily. As each plant germinated, the species in each tray were identified; the number of the same species in each tray was also counted and recorded. Once a plant is identified and counted, it was pulled out and the roots rinsed into the plate due to fact that the soil attached into the roots might contain seeds which might be discarded. Once in a while, the soil in each plate was turned over and mixed so as to aid seed germination. In the course of identification, species whose identities were in doubt were taken to the herbarium where proper identification was carried out. The identification followed the flora of West Africa (Hutchinson and Dalziel (1954-1972). The seedling emergence tests were terminated at the end of 3 months for each soil collection. All data collected were subjected to analysis of variance and differences among means were separated by least significant difference (LSD) Steel and Torrie(1980)

RESULTS AND DISCUSSION

Table 1, shows the effect of soil depths (cm) on the number of plant species and total number of individuals of each species that sprouted from each of the soil samples.

Table 1: The effect of soil depths on the number of plant species and the total number of individual per species that sprouted from the soil samples

Parameters	Depth(cm)		
	0-5	5-10	LSD
Total No. of plant species	15.54[a]	9.25[b]	1.22
No. of Herbaceousspecies	11.96[a]	7.13[b]	1.19
No. of Woody species	3.58[a]	2.13[b]	0.60
Total No. of IndividualPlants	182.29[a]	86.38[b]	8.77
Total No. of Herbaceousplant	150.00[a]	73.00[b]	9.05
Total No. of Woody Plants	32.13[a]	13.43[b]	4.76

a,b Means in the same row with different superscripts are significantly different (P<0.05

Number of species that sprouted differed significantly (P<0.05) between the two depths of 0-5cm and 5-10cm. The 0-5cm depth recorded a higher number of sprouts with 15.54 species m^{-2} compared to 5-10cm depth which had 9.25 species m^{-2}. The number of herbaceous species also differed significantly between the two depths with 0-5cm depth recording 11.96 species m^{-2}, while 5-10m recorded 7.13 species m^{-2}.Similarly, 0-5cm depth produced a significantly higher number of sprouted species woody species(P<0.05) (3.58 species m^{-2}) as against 2.13 woody species m^{-2} that sprouted from 5-10cm soil depth.

The total number of individuals per plant species

that sprouted from the soil collection differed significantly P<0.05 between the two depths. The highest total number of individuals (182 seedlings m^{-2}) emerged from 0-5cm soil depth, while, 86.38 seedling m^{-2} sprouted from 5-10cm soil depth. The result shows that the seed bank was dominated by herbaceous species (82.4%), while the woody species (17.6%) on the other hand contributed less to the soil seed bank. The number of herbaceous species also differed significantly (P<0.05) between the two soil depths. A total of 150 seedling m^{-2} of herbs sprouted from soil depth 0-5cm, while 73 seedlings emerged from 5-10cm soil depth. The number of woody species that emerged also differed significantly between the two soil depths, while, 32.13 woody seedling m^{-2} were obtained from soil layer 0-5cm depth, 13.46 seedling m^{-2} sprouted from 5-10cm soil depth.

Periodicity of seedling emergence from seed bank showed that the number of plant species emergence differed significantly (P<0.05) between dry and rainy seasons (Table 2). The number of plant species (15.92 seedlings m^{-2}) that sprouted from dry season soil sample was significantly (P<0.05) higher than that of the rainy season soil collection (8.88 seedlings m^{-2}).

Table 2:Number of plant species and total number of individual plants that sprouted from dry and rainy season soil collection from Ukpom Bende Forest Reserve

Parameter	Dry season	Rainy season
Total no. of plant species emerged	$15.92^{a} \pm 1.17$	$8.88^{b} \pm 0.70$
Number of herbaceous species	$12.33^{a} \pm 0.91$	$6.75^{b} \pm 0.61$
Number of woody species	$3.58^{a} \pm 0.32$	$2.13^{b} \pm 0.24$
Total no. of individual plants	$175.92^{a} \pm 17.11$	$92.75^{b} \pm 5.90$
Number of herbaceous plants	$143.67^{a} \pm 13.17$	$79.33^{b} \pm 5.47$
Number of woody plants	$32.13^{a} \pm 4.35$	$13.46^{b} \pm 1.71$

a, b means in the same column with different superscripts are significantly different (P<O.05).

The total number of individuals per species that sprouted from Soil samples from Ukpom Bende Forest Reserve differed significantly in dry and rainy seasons (Table 2**).** The highest total number of individual plants per species (175.92 seedlings m^{-2}) sprouted from dry season soil sample, while 92.75 seedlings m^{-2} sprouted from rainy season soil sample. The total density of sprouted seedlings was greater for herbaceous than woody species in both dry (143.67 and 32.13 seedlings m^{-2}) and rainy season (79.33 and 13.46 seedlings m^{-2}) respectively. This finding corroborates the report of Oke*et al*, (2007).It has been observed that many plants tend to shed their seeds at the early part of the year or dry season(Dike, 1992). Seeds of many species that have not germinated at this period were still available in the seed bank. The sample collected during the dry season included both freshly released and old seeds in the soil.

Table 3 shows the Species composition and number of plant species that sprouted from the soil collected from Ukpom Bende Forest Reserve. The result shows that herbaceous species dominated the species composition. The dominance of herbaceous species in the seedbank of forest soils has been reported by other researchers such as (Oke *et al.,*2007) and (Miller and Kauffma, 1998). Miller and Kauffman (1998) also noted that dicotyledonous herbs were the most common growth form accounting for 53-71% of the identified seedlings in the tropical deciduous forest in Mexico. The absence of regenerating important timber species can be attributed to scarcity of seed sources or ecological requirement for seed germination and seedling growth of the species (Hundera, 2010). Also the presence of few woody species in the seedbank of the forest reserve may be due to low seed production or lack of definite dormancy mechanism in mostwoody species especially primary forest species (Dike, 1992). The presence of few woody species in the seedbank in this study corroborates Dike (1992) who observed that forest species often complete their germination processes within 84 days after dispersal at Omo and Sapoba forest reserves in Southern Nigeria, therefore few seeds remain in the soil seed stores. The result of this study also showed that, the majority of seedlings sprouted from the soil sample of 0-5cm depth and this corroborate other researchers such as (Baider *et al.,*2001) and (Oke*et al.,*2007)

Table 3: **Species composition and number of plant species that sprouted from the soil collected from Ukpom Bende Forest Reserve**

Species	Dry season		Rainy season	
	No. of seedling m^2	% R.A	No. of seedling m^2	% R.A
Acanthusmontanus	07	3.98	NA	NA
Acroceruszinanoides	NA	NA	4	4.30
Amaranthussp	06	3.41	12	12.90
Andropogon tectorum	NA	NA	15	16.13
Aspiliaafricana	15	8.52	NA	NA
Axonopuscompressus	02	1.14	NA	NA
Centrosema pubescence	13	7.38	NA	NA
Commelinabenghalensis	07	3.98	02	2.15
Fern sp	12	6.82	NA	NA
Resisantiaindica	02	1.14	06	6.45
Panicum maximum	15	8.52	07	7.53
Phyllanthusamarus	05	2.84	12	12.90
Physalisangulate	02	1.14	09	9.68
Piper umbellate	03	1.70	NA	NA
Solanumsp	04	2.27	NA	NA
Talinum triangular	03	1.70	11	11.82
Tridaxprocunbens	09	3.83	NA	NA
Vernoniaverbusifolia	07	3.98	NA	NA
Imperata cylindrical	05	2.84	NA	NA
Musangacereropoides	04	2,27	03	3.23
Woody plants				
Desomoduimsp	04	2.27	NA	NA
Tremaorientalis	02	1.14	NA	NA
Triumfeltarhombifolia	13	7.10	NA	NA
Ficusmucoso	04	2.27	NA	NA
Senna hirusta	NA	NA	02	2.15
Chromolaenaodorata	16	9.09	04	4.30
Icacinatrichantha	06	3.41	03	3.23
Urenalobate	02	1.14	NA	NA
Sidarhombifolia	03	1.70	NA	NA
Gmelinaarborea	05	2.84	NA	NA
Mallotusoppositifolia	NA	NA	04	NA
Total	**176**	**100**	**93**	**100**

CONCLUSION

The soil seedbank can contribute to the regeneration of woody species in the forest reserve although to a limited extent. The topsoil should be adequately protected against environmental degradation as most of the seeds are buried at that depth.There was absence of important timber species regenerating in the soil seedbank.It is important to note from this study that the species composition of emerged seedlings suggests that the soil seed bank is not critical for the regeneration ofimportanttimber trees species in the Forest Reserve. Therefore,re-planting of the heavily logged areas and portions lost to arable farming within the Forest Reserve with both indigenous timber and exotic species is imperative considering that natural regeneration through soil seedbank is unsatisfactory.

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