Research Article

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2022.45.007208

Assessment of Variation of Soil Seed Bank in Different Soil in Rangeland on North Kordofan State – Sudan

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ARTICLE INFO

Received: July 08, 2022

Published: August 02, 2022

Citation: Alsammani AM, Abdelaziz Karamalla Gaiballa, Abdelrahim Omer Abdelrahim, Tutu SO and Mulik Abbaker Ibrahim. Assessment of Variation of Soil Seed Bank in Different Soil in Rangeland on North Kordofan State – Sudan. Biomed J Sci & Tech Res 45(3)-2022. BJSTR. MS.ID.007208.

ABSTRACT

This study was conducted in Elobied North Kordofan at Am Kass rainy season grazing area (Makhraf), located about 25Km from Elobied town. The study aimed to assess variation of soil seed bank in different soil of rangeland. The sampling assessing rangeland health (soil seed bank) for the study was based on identifying the main rangeland sites based on soil type (sandy and gardud soil). Data collected using transects sample methods. Soil samples were taken to assess soil seed bank for rangeland health assessment. According to main findings at Sandy and Gardud soil has there were variations between the two sites in soil seed bank which was higher in gardud site compared with sand, the live seeds and dead densities were (2067 seed/m2, 1728 seed/m2/5 respectively) whereas found low at sandy site, the live seed and dead densities were 610seed/m2, 676seed/m2 respectively. The dead seeds included (Abutilon figrianum, Echinocloa colonum, Abutilon anagolensis, Abutilon anagolensis, Ocimum basilicum) and dominant live seeds in gardud (Abutilon anaigolensis, Echinocloa colonum, Zaleya pentandra, Abutilon figrianum, Sesamum alatum) and dead seeds included (Echinocloa colonum, Cenchrus biflorus, Ocimum basilicum, Zaleya pentandra and Sida cordofolia). According to the results the study recommended that to concern the variation of soil seed bank and different soil types in rangelands management strategies.

Keywords: Understory; Soil Seed Bank; Sandy; Gardud

Introduction

Soil seed bank is very important for recovery after disturbance (Saatkamp, et al. [1]) Also, the impact of grazing abandonment on grassland vegetation has been studied (Peco, et al. [2]). The soil seed bank is the natural storage of seeds within the soil and refers to the reserve of persistent seeds in the soil and is usually assessed as the number of seed in a given volume of soil for a given ground area. (Clements, et al. [3]) studied the influence of land preparation types on the seed bank. Studies on seed bank composition have revealed considerable differences between soil seed bank under grassland communities (Bekker, et al. [4]). Other study confirmed that heavy grazing reduced the number of emerging species and changed the species composition in the soil seed bank species (Tessma, et al. [5]).

Materials and Methods

a. Study Area

This study was carried out in Elobied, North Kordofan (longitude29-34, 30-30 East) and the latitudes 12-25, 13-30

North) with samples being collected from 2018 natural vegetation in Kordofan and brought to the University of Kordofan. North Kordofan State lies within are arid, semi-arid and low rainfall savanna on sand. The long-term average rain is between 250-400 mm. The maximum temperature is 40-42 C° and the minimum is 13 C°. In the semi-arid region, rainfall is between 300-600 mm and the maximum temperature is 390 Celsius. The humidity reaches 11.75 during the dry season. In the autumn, the air humidity reaches 65-67% (Elobied Meteorology Department office, 1999). Rainfall as sporadic showers in May and becomes regular from June to October. It usually heavier in July and reaches peak in August before declining in September to reach its lower pattern in October. Temperatures are modified by rain at this time though it is hot and humid in general. Temperature and precipitation drops from the amount of evaporation in July and August and the highest rainfall recorded in 2010 was 620 mm (Sheikan locality, 2011).

b. Methodology

i. Soil Seed Bank Sampling: To investigate the density of soil seed bank Forty (40) soil samples were taken randomly in each site (20 samples at each site) in 10x10cm at 5cm depth, according to (Boudell, et al. [6]) who reported that the first 2cm accumulate most of the seed bank in arid environment. The samples were mixed probably, and sub- samples of 250g prepared for seeds extraction (Teague WR, et al. [7]). Preliminary washing of the soil samples using sieves of 1.0, 0.5, and 0.25mm pore size. The technique comprised initial washing of the soil, floatation, and then separation of live seeds based on their density using Ca Cl2 solution. Each soil sample (250g) were placed and filtered through three sieves of mesh sizes 1.0, 0.5, and 0.25mm and wash for 20min. The residuals in the three sieves washed by about 250ml of water, then transferred into 500ml beaker and stirred. About 250ml of CaCl2 (1.5g/ml of water) were added to the same sample residues and let each sample residues for 40 min into a beaker. The floated material after stirring included mainly live seeds (Ramadan, et al. [8]) The washing of samples was done at plant sciences laboratory of University of Sudan, College of Forestry and Range Science. Extracted seeds were identified through comparison with reference samples of seeds collected from plants growing in the study area, using a microscope and lenses. The identified seeds in each sample where recorded and counted (Ramadan, 2001). To calculate seed composition by counted the number of dead seed and live seeds of each species in soil samples, then express as number per square meter at designated soil depth

$$\textbf{Percent of live seeds} = \frac{Total\ live\ seeds}{Total\ of\ all\ seeds} \times 100 \quad \text{.....(1)}$$

$$\textbf{Percent of dead seeds} = \frac{Total\ dead\ seeds}{Total\ of\ all\ seeds(live\ \&\ dead)} \times 100 \quad \text{.....(2)}$$

Data Analysis: Data analyzed by using standard equations of soil seeds bank which used for calculation both seeds live and dead. Te species diversity and evenness of seeds recovered from the soil seed banks from the study sites were calculated using the Shannon-Wiener index.

Shannon diversity index, $H = -\sum i_{=1} sPi * \ln pi$

Where: H′=species diversity index; ln=natural logarithm and Pi=n/N is the proportion of individuals found in the i the species (ranges 0 to 1); n=number of individuals of a given species; and N=total number of individuals found in that particular site.

Results and Discussion

Soil Seed Bank

Generally, soil seed bank was higher in Gardud site compared with Sandy site, the live seeds and dead densities were (2067 seed/m2,1728 seed/m2/5 respectively) whereas low at sandy site. The live seed and dead densities were (610seed/ m2),676seed/m2 respectively. This seed density was reported by (Fumanal, et al. [9]) with 536 +/- 194 to 4477 +/- 717seeds/m^2.Tree seeds density ranged from 828.6 to 1052.6 seeds m2 in the top 5 cm soil depth, whereas Karrer,et al. [10]) also stated that the soil seed densities found only in the upper soil layer (0-10 cm) (Roberts HA [11]) with 467.9 and 146.22 seeds / m^2 (Figure 1). (Table 1) indicated that the total dead seeds were higher than the total viable seeds in both sites at study area. The high density of dead seeds may either seed persistency was low and/or the rainy season was not favorable for growth for some species due to poor survival (Hacker, et al. [12]) pre-dispersal seed predation (feeding on flowers, seeds), post-dispersal seed predation (consume seeds when they matured), trampling, un-controlled agricultural practices and it may be due to short term persistent. Abutilonanagolensis, Echinocloaclona, scored high densities in Gardud site viable seeds, while Echinocloa clonumwas high at the sand site.

Table 1: Dominant density of viable seeds /m2.

Species	Soil seed density /m2	
	Sand	Gardud
Abutilon anagolensis	4389	4990
Echinocloa colonum	2048	2661
Abutilon figrianum	1170	1996
Zaleya pentandra	1170	1330
Sesamum alatum	877	998

Table 2: Seed bank densities of dead seed /m2.

Species	Soil seed density /m2	
	Sand	Gardud
Abutilon figrianum	4096	1996

Echinocloacolona	2340	2495
Abutilon anagolensis	1755	-
Zaleyapentandra	-	1996
Sesamumalatum	877	-
Ocimumbasilicum	877	2328
Cenchrusbiflorus	-	2994

Note: Source: field data

This result in (Table 2) indicates that early grazing leads to soil erosion and in the area will be dominated by less preferred plants. Grazing management can improve the species composition by decreasing the pressure on the species that disappeared with heavy grazing such as Cenchrus biflorus. The results in Table 5 shows the main five dominant species density /m2 of the dead seed at gardud site. In Table 5 the high dead seeds were recorded by Echinocloa colonua, followed by this result agree with (Ali and Ahmed [13]) as found that species recorded high score at clay soil. (Fumanal B, et al. [9]).

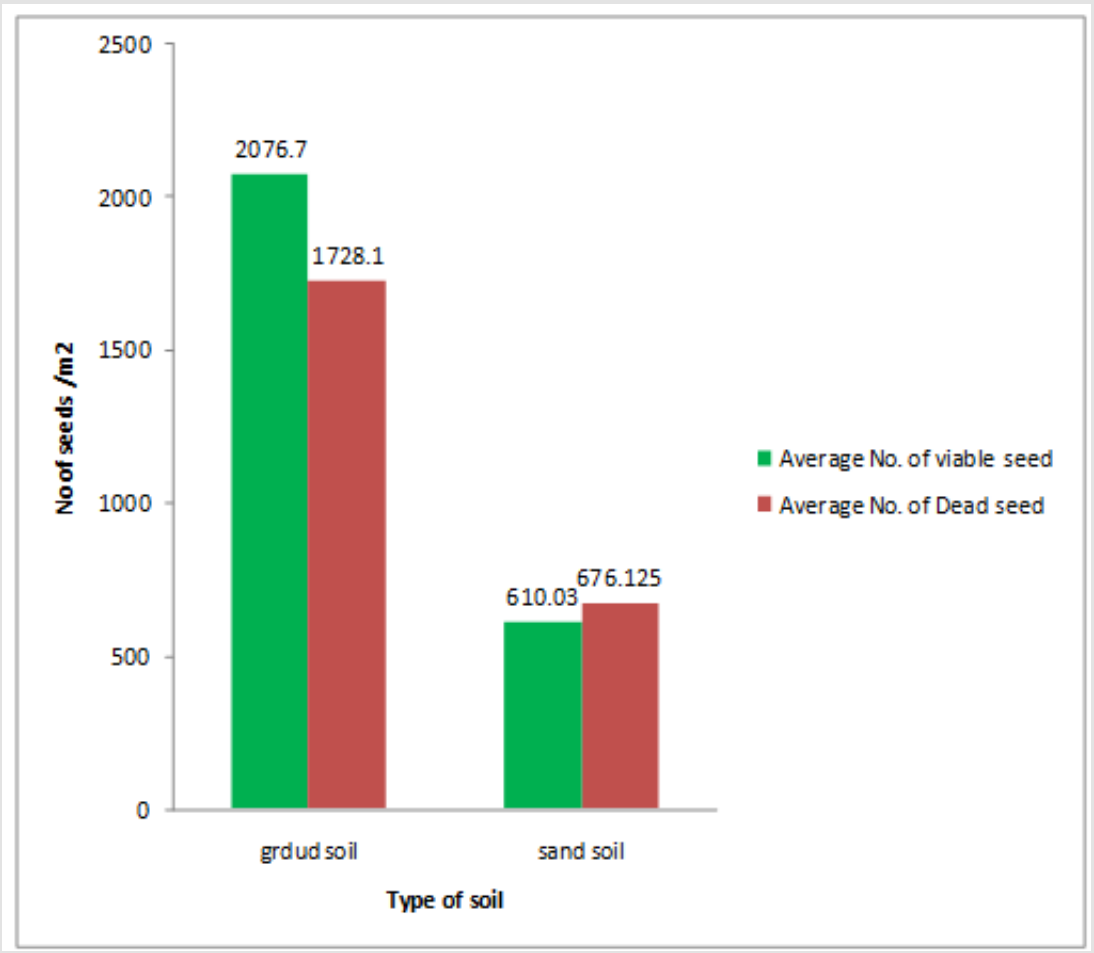

Figure 1: Average indicates live and dead seed/m2.

Live and Dead Seeds Species at Gardud Site

According to (Table 3) 26 species were identified at Sandy site as live seeds whereas 28 species were identified from the dead seeds. The most dominant as live seeds Echinociloa clona, Abutilon figrianum,Zaleya pentandra, Sesamum alatum (Roberts HA, et al. [14]). The most dominant species identified from dead seeds included: Abutilon figrianum, Echinocloa colona, Abutilon anagolensis, Ocimumbasilicum due to different factors affect the viability of seed bank in the soil. Grazing and cutting intensity affect the seed bank, through effects on the seeds return. (O'Connor, et al. [15]) studied the seed bank of Aristida bipartia and other spp. in savanna grassland and reported that the seed bank was dominated by less preferred species in areas subjected to heavy grazing. (Table 4) shows viable seeds in the study area at the two sites. Gardud site recorded highest seed density for both seeds (lives and dead seeds), that is could be due to palatability of species which found in the vegetation cover in this site. Sandy site recoded lowest seed density in both live and dead seeds, that is might be due to heavy density, low vegetation cover and palatability of species in the site. (Okin, et.al. [16]) stated that heavy grazing often results in a remarkable decline of plant seed production and seed number in soil (Coffin, et al. [17]) Management plan should be reseeding

with the dominant specie in the vegetation in the different sites. Echinocloa clonum, Gisekia pharnaceoides. The highest overall Shannon-Wiener diversity index of the soil seed bank was recorded Table 4. It's founded that Abutilon figrianum and Zaleya pentandra has the highest value of Shannon index 0.273 followed by 0.235 of Sesemum alatum while Ociumum basilicum and Echinochloa colonum has the lowest index 0.022 and 0.033 respectively (FayRK, et al. [18]).

Table 3: Average live and dead seeds densities of species in the two sites at the study area.

Scientific name	Habit	Sites			
		Sandy		Gardud	
		Live	Dead	Live	Dead
Zaleya pentandra	Forbs	4	2	6	6
Zornia glochidiata	Forbs	0.0	1	0.0	0.0
Echinochloa colonum	Grass	7	8	8	75
Dactyloctenium aegyptium	Grass	1	1	3	1
Abutilon figrianum	Grass	4	14	4	0.0
Sesemum alatum	Forbs	3	1	3	1
Cenchrus biflorus	Grass	0.0	9	0.0	9
Xanthium brasilicum	Forbs	0.0	1	0.0	1
Acanthospermum hispidum	Forbs	0.0	2	0.0	0.0
Sida cordofolia	Forbs	0.0	0.0	15	6
Ocimum basilicum	Forbs	1	3	2	7
Total		35	42	41	105
Total seeds/m2		610	676	2076	1728

Note: Source: field data

Table 4: Shannon index (H') of all species presents in study area.

Species	N	Pi	In (Pi)	Pi*In (Pi)	H'
Abutilon figrianum	20	0.1379	-1.981	-0.2731	0.273
Echinochloa colonum	30	0.2068	-0.1576	-0.0325	0.033
Zaleya pentandra	20	0.1379	-1.981	-0.2731	0.273
Sesemum alatum	15	0.1034	-2.269	-0.2346	0.235
Sida cordofolia	50	0.3448	-0.0647	-0.1843	0.184
Ocimum basilicum	10	0.0689	-2.675	-.02230	0.022
Total	145	0	0	0	0

Conclusion

The study concluded that the number of seeds were higher at the gardud site where were lower in sandy site. The study concluded that the two sites were dominated by different seeds species for both live and dead seeds. The research recommended that to concern the variation of soil seed bank and different soil types in rangelands management strategies.

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ISSN: 2574-1241

DOI: 10.26717/BJSTR.2022.45.007208

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