Effect of Fire and seasonality on Some Soil Properties in ElNour Forest at Blue Nile State

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Abstract- Fire in one of the factors that affect the vegetation cover in low rainfall savannah, so this study was carried out to examine the effect of fire on *Acaica seyal* forests soil and also to test its accumulative effects. The results showed that the Nitrogen, Organic carbon, Phosphorus and pH were not affected with fire .But Phosphorus and pH were decreased through seasons while Nitrogen, Organic carbon were not affected with seasons.

Index Terms- Acacia seyal. Fire. Season. Phosphorus. pH.

I. Introduction

Fire effects are variable from area to area and results on the forest and soil beneath can vary accordingly (Trabaud, 1987).There are many factors controlling the effects of fire on soil like frequency of fire, heat intensity and duration of fire, forest floor and soil type(Davis, 1959). The physical effects of fire on soil are severe erosion and accelerated surface water runoff by destruction of the vegetation cover, infiltration is reduced, colloidal structure is changed, increased soil temperature through blacking of the surface(Bot and Benites, 2005). The chemical effect of the soil comes from tow sources; minerals release in the process of combustion and left in ash and changed micro-climatic condition following burning (Ahlgren and Ahlgren, 1960). Available Nitrogen in the soil is usually increased following burning because of low volatilization temperature of Nitrogen and subsequent temperature accelerated mineralization and nitrification rates after soil exposure to fire(Neary et al, 1999). Phosphorus and soil pH also increased after burning. (Blank et al, 1994). *An Acacia seyal tree is* a multipurpose tree which spread widely in the clay plain of Sudan. Seasonal fires were common in those areas (Hassan, 2004) .So this work aimed to study the effect of fire on soil properties, which may influence the vegetation cover.

II. Material & Methods

This study was carried out in Elnour forest, east of Eldamazeen in the Blue Nile State. (11^{o} $50^{/}$ North and 34^{o} $29^{/}$ East) during 2001-2002-2003. Clearance of all kinds of trees was done in an area of 100 m x 80 m (area of study). The number and species of trees cleared were 56 *A.seyal*, 27 *A.senegal*, 5 *Zizphus.spina –Christi*, 11 *Balanites aegyptiaca*. The experimental area was divided into four blocks; each block was further divided into four plots with an area of 7 m X 12.5 m each. Fire lines 3 m wide within the plots and 10 m wide around the whole area were established. Plots in each block received one of the following treatments:

Control: grass cover kept intact. (Grass was 120 cm tall), Light fire: fire with low intensity, this was done by cutting 75% of the grass tallness and burning the rest, Moderate fire: fire with moderate intensity, this was done by cutting 50% of the grass tallness and burning the rest, Severe fire: fire with high intensity, this was done by burning all the grass (100%).

The first burning was in November 2001, second in November 2002 and the third in November 2003.

The macro kjeldahl method was used to determine of nitrogen content in each soil sample (Chapman and Pratt, 1961). The soil samples were digested with sulphuric acid on an electric heater for 2-3 hrs, and then the clear solution was distilled and titrated against hydrochloric acid.

Available phosphorus was determined by Olsen's method as described by Jackson (1958).

Organic Carbon percentage was estimated by oxidation with potassium dichromate in sulphuric acid using Walkely Black method as described by Page and Willard, 1946.

The soil pH was measured in a saturated soil paste Kincked digital pH meter model(type 644/ 1).

III. Results and Discussion

The site before clearance was dense with Acacia trees, which are characterized by nitrogen fixation; in spite of this, the percentage of nitrogen was low in the site (table, 2). The level of nitrogen in the soil was not significantly different throughout the period of the study (3 seasons)(Table 1). Thus it may be assumed that it had no effect on plant growth in the site since it was not taken from the soil.

Fire had no effect on nitrogen levels in the soil (Table 1). This may be explainable by that the quantity available to plants was not decreased because most of the nitrogen lost from burning material would be lost without burning through slow decomposing. (Davis, 1959).

Phosphorus is an essential nutrient because it is a vital component of DNA (memory unit) and RNA and ATP (energy unit) of plants (AlKhateeb, 1998). The levels of phosphorus in the site deceased with time(Table 2), while it was high in the first year (Although it was under the critical level, it was a bout 7ppm and the critical level for the grasses is 15ppm(Little and Mccutcheon, 2004) it decreased significantly in the second year and third year. Phosphorus level in the soil is affected by many

factors like degree of weathering, climate condition, erosion and crop removal (Alkhateeb, 1998).In this case study this decrease may be due to the grass consuming which have a higher requirement of phosphorus (Spikes, 2004; little and Mccutcheon, 2004). Because of the high density of grass growth in the first and second year, this probably absorbed phosphorus from the soil.

Organic Carbon was added to the soil by plant residues or ash remains after burning. The level of Organic Carbon was found not affected with fire (three intensities) (Table 1). The quantity of Organic Carbon added to the soil with burning is equal to that was added by plant residues in unburned (control) area. Seasons seem to have no significant effect on the level of Organic Carbon in the soil (table 2).

Soil pH is defined as the logarithm of the hydrogen ion concentration; it is an indication of the soil acidity or alkalinity (Elkhateeb, 1998). The soil pH in the site was 7.8 – 7.9 in the first season (Table 2), this means that the site soil was slightly to moderate alkaline, pH decreased in the second season to 6.2 – 6.3, thus the soil became slightly acidic. These pH changes seem not affected with fire treatment, because light, moderate and severe fire were not significantly different from untreated area in pH level. (Table 1).The changes in pH level may explain the loss of phosphorus, because most of the minerals are more soluble or available in acid soils than the neutral or slightly alkaline soils (Bichelhaupt, 2004),this mean that the pH made phosphorus available to be absorbed by plants, and this cause phosphorus decreasing in the soil.pH changes is a result of rain water leaching away basic ions(Ca, Mg, K, Na), carbon dioxide from decomposing organic matter and root respiration dissolves in soil water forming a weak organic acid and formation of strong organic and inorganic acids.

Table (1) effect of fire on Soil Nitrogen, Phosphorus, Organic carbon and soil pH overall seasons

Treatments	*Mean / %Nitrogen content*	*Mean Phosphorus content (ppm)*	*Mean / Organic Carbon content*	*% Mean /Soil pH*
Control	0.06 a	3.42 a	0.78 a	6.7 a
Light Fire	0.06 a	3.33 a	0.64 a	6.8 a
Moderate Fire	0.011 a	2.99 a	0.79 a	6.8 a
Severe Fire	0.011 a	3.49 a	0.75 a	6.8 a
P≤	0.1481	0.046	0.09	0.65
SE±	0.02	0.2	0.05	0.07
CV=	137	85	31	12

Table (2) Effect of Seasonality on Soil Nitrogen, Phosphorus, Organic carbon and soil pH overall treatments

Seasons	*Mean / %Nitrogen content*	*Mean Phosphorus content (ppm)*	*Mean / Organic Carbon content*	*% Mean /Soil pH*
May 2001	0.12 a	7.13 a	0.78 a	7.9 a
Nov 2001	0.06 a	6.63 a	o.74 a	7.8 a
May 2002	0.08 a	0.5 c	0.66 a	6.3 b
Nov 2002	0.06a	1.8 b	0.70 a	6.2 b
May 2003	0.07 a	2.32 b	0.80 a	6.3 b
Nov 2003	0.12 a	1.48 bc	0.75 a	6.2 b
P≤	0.376	0.0001	0.55	0.0001
SE±	0.02	0.2	0.06	0.09
CV=	137	85	31	12

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