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Original article

Determine phosphorus and calcium in soil of the grazing area, El-Khuwei locality, West Kordofan State, Sudan

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ABSTRACT

A two stages flowering and seed setting field experiment was conducted to determine of some macro minerals in soil phosphorus P and calcium Ca in the natural range land, during 2011 in El-khuwei locality, west Kordofan State, Sudan. The data was analyzed used a completely randomized design (CRD) with the effect of stages as the whole plots and effects of sampling as the sub-plots. Sampling was done on two stages at the flowering and seed setting in selected locations (2km2 each), within each stage randomly selected and collected thirty samples of soil. (SPSS) Statistical Package for Social Sciences was used for the statistical analysis. The results indicated that growth stages were effect of macro minerals in the soil phosphorus concentrations and calcium concentrations in the natural range land was significantly difference ($P<0.001$) higher phosphorus P (0.15-0.10ppm) level at the flowering stage and least phosphorus P level at the seed setting stage respectively, also growth stages were effect of calcium Ca (110.22-99.75ppm) level was higher calcium Ca level at the flowering stage and least calcium Ca level at the seed setting stage respectively.

1. Introduction

Calcium is the most abundant mineral in the body, ninety-eight percent of Ca is found in the bones and teeth (Rick, 2007). Ca is normally one of the primary limiting factors in the diets of sheep and goat and hence need to be provided as supplement. To this end responses have been reported to dietary supplementation with Ca and to the application of Ca fertilizer (Rees and Minson, 1976). Some of the important functions of Ca are blood clotting, membrane permeability, muscle contraction, nerve functions, and cardiac regulation and enzyme activations (Rick, 2007). As dietary Ca intake increases, its absorption is reduced (Rick, 2007). There is evidence that deficiencies of elements such as Ca occur under farming conditions. Nutritional calcium deficiency is associated with weakness, poor animal performance that has swollen joints, lameness, weak bones, and a propensity for broken bones (Puls, 1994). Vitamin D is required for active absorption of calcium. In addition, P together with Ca and vitamin D is required for bone metabolism. Friend and Brich (1960) emphasized that about 90 % of the total P in east African soils is present in an organic form. P deficiency results in poor reproductive performance. Cohen (1980) stated that, the tropics P deficiency is common in cattle, but less in sheep. Range pastures are frequently deficient in P. However, sheep in such areas are less deficient than cattle because sheep select more leaves which have higher P than pasture (Carles, 1983). According to Underwood (1981), P is known to be the most deficient element in the soils all over the world. Moreover, in P deficient animals the feed ingested and digested is used less efficiently than in none deficient animals presumably due to a disturbance in energy metabolism. Kabaija and Little (1988) reported that forages and local mineral supplements consumed by livestock have low P in Ethiopia. Phosphorus is the most limiting mineral to grazing animal productivity throughout the world. Calcium deficiency is a problem only in tropical areas with heavily leached soil. In arid and desert areas, range forages often contain high levels of calcium in relation to phosphorus. Forage calcium and phosphorus ratios from 1:1 to 2:1 have been considered optimal, although in many arid areas, this ratio is much higher (Underwood, 1966). Out of different nutritional factors the most important are deficiency or deranged metabolism of Ca, P and Mg. These three minerals play important roles in the development of a number of metabolic and deficiency diseases found in ruminants like cattle, buffalo, sheep and goat. India has vast and rich livestock resources, which play an important part in contributing to the national economy (Khan, 1995). The objective of this paper was to determine soil calcium and phosphors concentrations in the natural rangeland.

2. Materials and methods

2.1. Study area

This study was conducted at El-khuwei locality. It lies between longitudes 28˚:33' to 28˚:30'N and latitudes 12˚:14' to 14˚:12'E, about 105 Km west of El Obeid town. The long term average annual rainfall is about 300-mm, consisting of storms of short duration between July and September with the highest rainfall generally occurring in August. The soil of the site lies within the sand dune area locally known as “Goz” soil. During the rainy season, forage biomass is suitable to provide sufficient feed for animals, but during the dry season forage is scarce and small quantities of grain are also fed to animals. The site is naturally dominated by grasses namely Huskneet (Cenchrus biflorus), Shilini (Zornia glochidiata), Bigail (Blepharis linarifolia) and Aborakhus (Andropogon gayanus). The trees included Humied (Sclerocarya birrea), *Higlig* (*Balanites aegyptiaca)* and Sider (Zizuphus spina- Christi). The Shrubs include Kursan (Boscia senegalensis), Usher (*Calotropis*), *Mereikh* (*Leptadenia pyrotechnica*) and Arad (Leptadenia pyrotechnica) according to MARF (2009).

2.2. Sampling and experimental study

Sampling was done on two stages of plant maturity at flowering and seed setting in selected locations (2km2 each), within each season randomly selected and collected thirty samples of Soil.

2.3. Samples collection

Soil sampling: Soil samples were taken from different surfaces up to 15-20 cm depth at two different seasons from each pasture using a stainless steel sampling auger. The samples were air-dried and ground using a Wiley mill with a 2 mm sieve and mixed. A total number of 30 soil samples within each season from the study were taken and stored in plastic bags.

Soil preparation: Minerals were extracted from soil using the Mehlich-1 extracting solution method (0.05N HCl + 0.025 N H2SO4) following Rhue and Kidder (1983). Ten grams of air-dried soil were taken in 125 ml conical flask and 40 ml Mehlich-1extracting solution was added to it and shaken for 15 minutes on a reciprocating shaker, filtered through a medium porosity filter paper (Whatman filter paper No. 2). Clear supernatant was obtained by centrifugation for 5 minutes at 180 rpm. The supernatant was stored in plastic bottles for macro determination.

2.4. Laboratory analysis

Macro elements in soil phosphorus and calcium were analyzed using atomic absorption spectrophotometer (Singh et al, 2005).

2.5. Statistical analysis

The data were analyzed using a completely randomized design (CRD) with the effect of seasons as the whole plots and effects of sampling as the sub-plots (Steel and Torrie, 1980). SPSS (Statistical Package for Social Sciences) was used for the statistical analysis. Statistical significance was tested at 0.05, 0.001 and 0.0001 level of probability using the software.

3. Results and discussion

3.1. Soil phosphorus and calcium

The macro minerals concentrations in soil P and Ca for deferent stages are presented in Table 1. Soil concentrations significantly difference (P<0.001) higher Ca (110.22-99.75ppm) and P (0.15-0.10ppm) at the flowering stage and least at the seed setting stage respectively.

Table 1
Soil phosphorus and calcium during the flowering and seed setting stages.

	Stage			
Parameters	**Flowering**	**Seed setting**	**Means**	**SE±**
Calcium (ppm)	110.22a	99.75b	104.98	2.74*
Phosphorus P (ppm)	0.15a	0.10b	0.13	0.01**

a,b Values with the same raw bearing different superscript vary significantly at P <0.05, * = significant (P < 0.05), ** = high significant (P < 0.001).

3.2. Soil phosphorus

During the flowering stage were higher P (0.15ppm) concentration and least P (0.10ppm) level at the seed setting stage. Tiffany et al (2000) reported that low P level of soil during the dry season. The maximum soil P was found in Nainital (29.42±1.21 ppm) and the minimum was in Bareilly (14.51±1.68ppm). It has been observed that highest prevalence of soil Ca deficiency at dry season. Pasha et al (2009) concluded that the seasonal variation in these elements could be related to the fluctuations in climatic condition and P showed the lowest concentration for the dry season. Baruah et al (2000) reported that in wet seasons 80% and in dry season 54% of the soil samples were deficient in P levels, in contrast; phosphorous (P) was marginally deficient in soil. Gueorgui Anguelov et al (2012) reported land-use impact on soil solution constituents from an Ultisol of North Florida; the land- use management had an effect on soil-solution P concentration reflecting managerial and climatic conditions. The means ranged for P 0.45mgL level at wet season and least 0.03 mgL at dry season, these reported is agreement which result. Yerokun (2008) who reported during the wet season soil P increased 1.87 mg/kg concentration and

decreased P 0.30 mg/kg level at dry season; these findings were agreement with result. Phosphorus deficiency is the most widespread and economically important mineral deficiency of grazing livestock. This is attributed to the fact that most Zambian soils are reported to be deficient in Phosphorus (Yerokun, 2008). The presence of high amounts of oxides and the rate of soil weathering due to high temperatures and moisture in part explain the low availability of P in Zambian soils (Yerokun, 2008). P is also affected by soil pH, the situation changes at pH value greater than 8.0. In the presence of calcium, phosphate tends to be converted to calcium phosphate, and availability of P to plants is reduced. Gueorgui Anguelov et al (2012) who suggested that the information on interrelationships of the minerals among soil, plants and animals could give the exact profile of the blood plasma minerals in the developing world, these findings were agreement with study.

3.3. Soil calcium

At flowering stage was increased Ca (110.22ppm) concentration and decreased Ca (99.75 ppm) concentration at seed the setting stage. (McDowell et al, 2000) reported that low Ca content of soils during the dry season; this may be due to concentration of minerals as a result of low soil moisture; Ca and Mg may be deficient in acidic soils becoming more available with reducing soil acidity. However at very high pH the minerals become less available in soil. At pH ranges of 6.34-7.01 for soils in Simamba and 5.67 to 6.29 for soils in Lusitu, Ca and Mg become more available in the soil for uptake by plants. Baruah et al (2000) reported that in dry season soil was deficient in Ca level. This finding is agreement with results study. Khan et al (2008) indicated that the mineral level of ruminants has changed by changing place and season.

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