

Effect of growth stage on the macro mineral concentrations of forbs and grasses in a semi-arid region of Sudan

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Introduction

Ruminants grazing forages in severely mineral-deficient areas may be more restricted by this condition than by inadequacy of energy or protein. Mineral imbalances in soils and forages are responsible for low production and reproduction in grazing livestock. As grazing livestock are not usually offered mineral supplements apart from common salt, they depend upon forages for their requirements. However forages rarely fully satisfy all mineral requirements. Mineral intakes of livestock are influenced by the factors that determine the mineral content of plants and their seeds. The concentrations of minerals in plants depend largely on plant genotype, soil environment, climate and stage of maturity. Leguminous species are generally much richer in macro-elements than grasses growing in similar conditions, whether temperate or tropical. The objective of this study is to assess the status of the macro-mineral elements Na, K, P, Ca, and Mg in the dominant native species during the flowering and seed set stages of plant growth at Sheikan Locality, North Kordofan State, Sudan.

Materials and Methods

Sampling periods corresponded to two different stages of growth namely flowering (rainy season) and seed set (early dry season) of 2010 and 2011. A total of 29 plant species (21 forbs and 8 grasses) were collected from the rangelands. Plants' shoots (leaves and stems) were picked randomly by hand according to diet selected by sheep. ICP was used to determine mineral content. T-test was used to compare differences between stages of growth. Missing data was accounted for by GLM.

Results and Discussion

Mineral concentrations in plants generally reflect the adequacy with which the soil can supply absorbable minerals to the roots. However, plants react to insufficient supplies of available minerals in the soil by limiting their growth, reducing the concentration of the deficient elements in their tissues or, more commonly, by reducing growth and concentration simultaneously. The extent of a particular response varies with type of minerals, plant species as well as with the soil and climatic conditions. The primary reason for mineral deficiencies in grazing animals is that the soils are inherently low in plant-available minerals.

Tables 1 and 2 illustrate the levels of the macro-minerals Na, K, P, Ca and Mg of some plant species of rangeland over the two stages of growth for forbs and grasses respectively. Flowering stage showed a higher concentration of macro-minerals compared with the seed set stage ($P < 0.05$). A similar result was obtained by Coates *et al.*, 1990 who reported that, phosphorus concentrations of forage plants decline markedly with advancing maturity, although the decline is less in legumes than in grasses. Changes in mineral concentration with maturity often reflect increases in the proportion of stem to leaf with stems showing lower mineral concentrations than young leaves. Our data also indicated a higher content of macro-minerals in forbs compared with grasses. These results suggest adequate macro-mineral levels for sheep as reported by Grusak (2001) for phosphorus, calcium, magnesium and potassium (0.2 %, 0.5%, 0.2% and 1.0 %) respectively. The present results are in variance with those of Cook and Fadlalla (1987) who reported a deficiency of phosphorus in the diets of grazing animals in South Kordofan, Sudan, which ranged from 0.18% in the rainy season (flowering stage) to 0.09% in the dry season (seed set stage). The difference may be explained by variance in soils and rainfall. Soils of South Kordofan are predominantly clay while those of North Kordofan are mainly sandy, locally known as Qoz soils. Rainfall is also higher in South Kordofan. Berman and de Wit (1983) reported that northern sandy soils rangelands are superior in protein and minerals compared with those of ecological areas with heavier soils and higher rainfall. Abundant rainfall seems to have an adverse, probably leaching effect, on phosphorus. During long periods of P deficiency this mineral may become deficient in the rumen, leading to reduced microbial growth efficiency and at times

digestibility and intake of forage (Leng, 1990). This author also reported that calcium deficiency is also most likely to occur in areas of high rainfall and humidity.

Table 1. Concentrations of Macro-elements Na, K, P, Ca and Mg (mg/kg) for some forbs at flowering and seed set Stages

Scientific name	Flowering stage					Seed set stage				
	Na	K	P	Ca	Mg	Na	K	P	Ca	Mg
<i>Colocynthis citrullus</i>	212	13863	1823	9948	2666	275	11854	1167	7907	1733
<i>Seddera spp.</i>	1433	11660	1328	21824	3593	4673	13485	1614	18997	4608
<i>Polygala eriotea</i>	473	22692	1654	18858	3247	625	12596	2049	6461	2486
<i>Crotalaria spp.</i>	280	21462	1854	12640	2426	178	14767	1043	8292	1501
<i>Requenaiaob cordata</i>	235	16049	1517	9656	2631	389	17829	1606	9051	2658
<i>Justicia kotschyi</i>	203	27631	2011	31457	18277	230	28632	2063	18694	10340
<i>Sesbania sesban</i>	540	23236	2332	12260	1154	765	14164	1491	9986	1853
<i>Belpharis linarifolia</i>	127	21445	1581	18578	3978	102	15860	1295	17604	2650
<i>Ipomoea sp.</i>	10142	24012	2509	9194	4437	3084	26609	2581	9172	6197
<i>Tephrosia spp.</i>	669	18548	1504	10002	3173	172	14897	1319	11818	3524
<i>Tribulus terrestris</i>	1507	20173	2049	26132	5606	--	--	--	--	--
<i>Corchorus oiltorius</i>	808	22394	1703	13950	3669	388	15200	2301	20378	3459
<i>Indigofera aspera</i>	671	41579	2369	24604	11755	--	--	--	--	--
<i>Acanthus spp.</i>	665	15139	1696	11038	3813	613	20019	1838	12186	4746
<i>Indigofera spp.</i>	410	20191	1795	26752	5277	260	16176	1240	14524	2592
<i>Solanum dobium</i>	294	29652	2320	15361	6684	158	25396	1451	14516	4538
<i>Dicomato mentosa</i>	181	19597	2272	9748	4081	--	--	--	--	--
<i>Farsetia longisclizua</i>	594	15831	1870	18057	4673	--	--	--	--	--
<i>Ipomoea belpharosepala</i>	12156	19010	2536	7524	3382	8079	21194	1483	9199	3727
<i>Acanthospermum hespidum</i>	--	--	--	--	--	407	29131	1180	11733	4689
<i>Abutilon glaucm</i>	--	--	--	--	--	748	22719	1769	24015	6383

Table 2. Concentrations of macro-elements Na, K, P, Ca and Mg (mg/kg) for some grasses at flowering and seed set stages

Scientific name	Flowering stage					Seed set stage				
	Na	K	P	Ca	Mg	Na	K	P	Ca	Mg
<i>Echinocloa colonum</i>	2718	25962	1415	3863	4345	1319	21958	697	5531	3690
<i>Eragrostis tremula</i>	11606	11926	1689	3905	2244	11397	11894	1221	3552	2535
<i>Schoenefoldia gracilis</i>	3412	16114	1199	3994	2031	1091	15606	705	3658	1994
<i>Cenchrus biflorus</i>	280	23633	1101	6086	2417	1448	20262	706	4080	2608
<i>Chloris virgate</i>	299	22480	1209	3694	3553	--	--	--	--	--
<i>Dactyloctenium aegyptium</i>	3256	10673	1229	5121	2219	--	--	--	--	--
<i>Cyprus spp.</i>	632	17332	867	6175	3250	1282	20535	1017	6914	2708
<i>Aristida mutablis</i>	195	11324	1194	2972	1703	--	--	--	--	--

Conclusion

Our current investigations on minerals evaluation of rangelands revealed that these are good sources of macro-minerals that can meet the requirements of sheep in North Kordofan State, especially during the stage before plants set their seeds. Forbs are richer in macro-elements compared with grasses. They provide a better option compared with grasses in terms of mineral content as well as protein and as such can be used in reseeding of degraded areas to furnish animals with sufficient mineral nutrients.

References

- Berman, H. and C. T. de Wit. 1983. Rangeland productivity and exploitation in the Sahel. *Science* 221: 1341-1347.
- Coates, D. B., P. C. Kerridge, C. P. Miller and W. H. Winter. 1990. Phosphorus and beef production in Australia. 7. The effect of phosphorus on the composition, yield and quality of legume based pasture and their relation to animal production. *Tropical Grasslands* 24: 209-220.
- Cook R. H. and B. Fadlalla. 1987. Seasonal variations in plasma phosphorus levels of transhumant sheep in Kordofan, Sudan. *Trop Anim Health Prod.* 19 (1):57-62.
- Grusak. M. A. 2001. Plant macro- and micronutrient minerals. Encyclopedja of life sciences /and 2001 Nature Publishing Group / www.els.net.

Leng, R. A. 1990. Factors Affecting the Utilization of "Poor-Quality" Forages by Ruminants Particularly Under Tropical Conditions. *Nutrition Research Reviews* (3): 277-303.

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