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AVAILABILITY OF NUTRITIONAL MINERALS (COBALT, COPPER, IRON, MANGANESE AND ZINC) IN PASTURES OF CENTRAL PUNJAB FOR FARM LIVESTOCK

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Abstract

Effects of sampling frequencies on mineral status of *Trifollium* pastures in central Punjab, Sargodha at the livestock station Khizarabad were studied in relation to cattle requirement. Forages were analysed for copper (Cu), iron (Fe), manganese (Mn), and znic (Zn), and cobalt (Co). Forage Co and Cu concentrations were low and deficient in relation to cattle requirements grazing therein for most of the sampling periods. In relation to cattle requirement, the majority of forages were deficient in Co, Cu and Zn. Based on the results of this study it can be concluded that the mineral supplementation on this ranch is strongly encouraged.

Introduction

Mineral deficiencies or excesses in grazing livestock can be predicated by use of systematic mapping survey techniques or regional reconnaissance of a particular region. These techniques mostly based on forage analyses and have been undertaken for most of the known minerals in different regions of the world (McKenzie, 1975; McDowell & Arthigton, 2005). It is now evident that Mo induces deficiency in sheep and cattle, Mn in cattle only, and Co in sheep (Grace *et al.,* 1996). However, a strong correlation between low concentrations of Cu, Co and Zn in the soil samples and known trace element deficiencies in grazing livestock and wildlife is demonstrated in many regions of the world (Grace *et al.,* 1996; McDowell & Arthigton, 2005). Cobalt and/or Cu deficiencies in grazing ruminants have been established in specific regions as a result of low level concentrations of these elements in different tissues/ fluids were reported (Lindsay & Norvell, 1978). In adequate supply of minerals to ruminants is often seasonal resulting from increased demands in case of pregnancy, lactation or rapid growth coinciding with reduced mineral contents or availability in pastures. Seasonal variations in mineral concentrations in livestock have been recorded in different countries (McDowell, 2003). However, if this information is not available, then addition of the deficient element will be almost ineffective. Under sparse grazing conditions, trace element fertilization is usually is considered uneconomical and unreliable because of low forage productivity per unit area as well as variable uptake of the element (Espinaza *el al.,* 1991). However, increased mineral content of forage acquired through fertilization has an additional advantage of assuring a more uniform mineral consumption since all animals consume high quantities of minerals available in the forage. With the knowledge of forage mineral status, some favourable considerations can be made like fertilizer treatment of the soil,

which is an effective means of improving both yield and mineral composition of forage. When animals graze in small and well-defined pastures with just a few plants species, the element may be added to the soil if it is readily taken up by the plants.

The purpose of this study was to assess the mineral deficiencies or excesses for grazing livestock by the use of a systematic technique, which analyzes plant tissues. The final goal was to meet the mineral needs of livestock in order to maximizing the production of animal products. A mineral analysis of the forages consumed by the animals is fundamental to mineral status diagnosis. If forage mineral concentrations are below the minimum requirement or above the tolerance level then certainly there is need for an effective mineral supplementation strategy.

Materials and Methods

This work was conducted during the October 2008 to January 2009 at Livestock Station Khizarabad, central Punjab, Sargodha (32°8′0″ N, 73°7′0″ E). This livestock station was established in 1972. The soils in this region are sandy loam to clay loam. About 2000 Kajli breed of sheep and 1300 Sahiwal breed of cattle are reared at this station. This area is characterized by an altitude 187 m, having a semi-arid to sub-tropical to temperate environment. The mean precipitation is 189 mm and temperature varies from 5^{o} C to 23^{o} C during winter and 25^{o} C to 49^{o} C during summer respectively. The main improved forage species during these periods in pastures in which the experimental animals grazed was of *Trifolium*. Forage samples were collected monthly at the experimental station after the careful observation and simulating the grazing behaviours of the animals. Forages samples were from the three postures, each located within a distance of 0.5 km from the other. These pastures were the representatives of the areas grazed on this form. They were fertilized with 25 kg urea and main source of irrigation was canal and tube well waters. Methods for sample collection, preparation for analyses and statistical evaluation are presented elsewhere by Khan *et al.* (2008).

Results and Discussion

Forage Co status: There was no effect of sampling periods on Co forage concentration (Fig. 1). Forage Co concentration varied from 0.023-0.030 mg/kg across all sampling periods. There were definite but slow trends of increase in forage Co with time. These concentrations are considerably deficient for cattle, which require 0.01 mg/kg of Co in their diet (Anon., 1996). Similar findings were reported by Khan (2003); Khan *et al.,* (2006 and 2008) in Pakistan, McDowell *et al.* (1997) in Florida and Espinoza *et al.,* (1991) throughout Florida while evaluating different pastures. Forage Co concentrations were found to be higher during January and lower in October in this investigation. Dietary Co requirements have been established at 0.1-0.1 mg/kg. Under grazing conditions lambs are the most sensitive to Co deficiency, followed by mature sheep, calves, and mature cattle (Anderson *et al.,* 1990; McDowell, 2003; McDowell & Arthington, 2005). In our investigation the forages were deficient in Co, which may result into a gradual loss of appetite and failure of growth or weight loss. If no supplementation is adopted then sever anaemia and death may occur. Keeping in view this deficiency of Co in forages and intern in animals, it can best be prevented by direct oral intake of Co through mineral supplements containing at least 0.002 % Co.

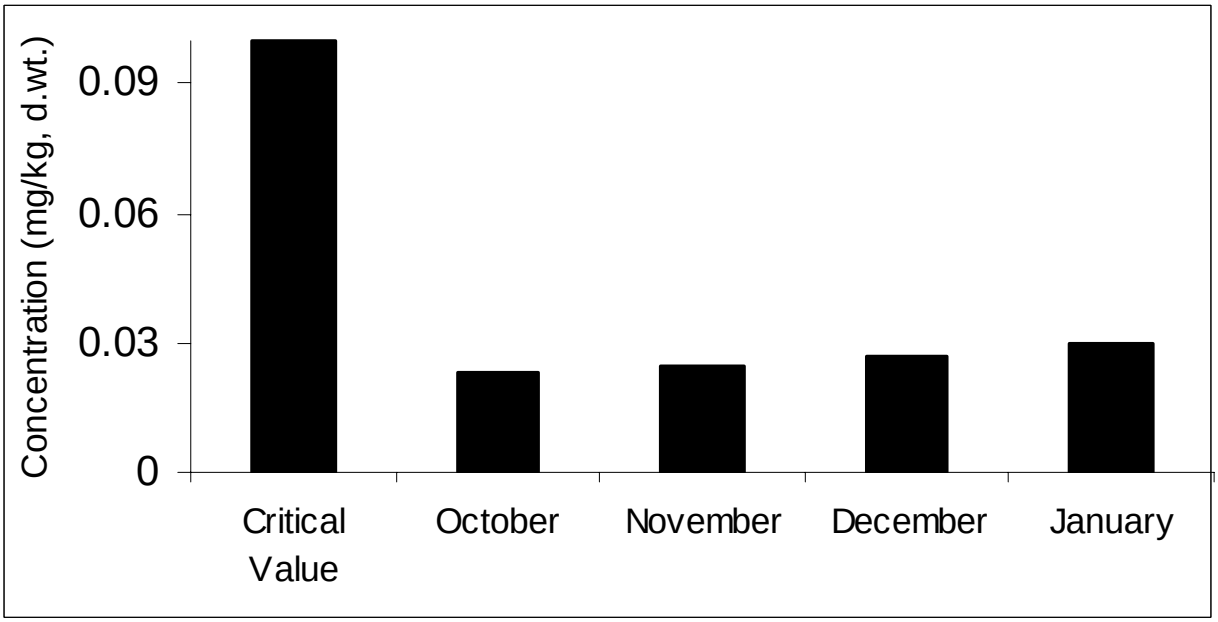

Fig. 1. Co concentrations in forage during different months.

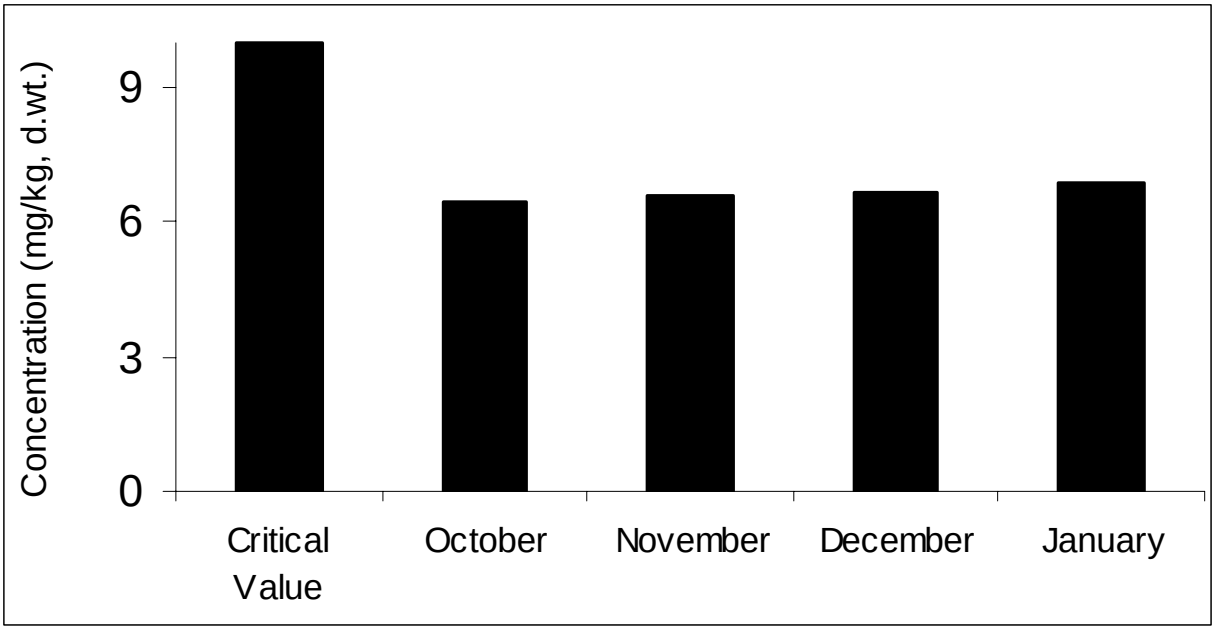

Fig. 2. Cu concentrations in forage during different months.

Forage Cu status: Concentrations of forage Cu were ranged from 6.48-6.90 mg/kg at different sampling periods and majority of forage samples had deficient Cu concentrations (Fig. 2). In relation to cattle requirements of 10 mg/kg established (Anon., 1996, 2006), there Cu concentrations remained unchanged with the increase in time. Thus, this cattle range is deficient in forage Cu. Thus, fertilization practices and other soil amendments will help much to improve the performance of the livestock at the station. Copper requirement of most ruminants is 10 mg/kg, whereas in the present investigation we found forage Cu below this level. This Cu concentration could be adequate provided if there is no Mo, which often antagonistically reduces its concentration. With very low level of Mo, as little as 4 mg/kg Cu is adequate for livestock (Underwood, 1981).

A wide variety of disorders in animals have been found at this ranch including anaemia, diarrhoea, depressed growth, temporally infertility and weak, and fragile bones indicating the deficiency of Cu. Thus, there is a need for Cu supplementation to the livestock at the station.

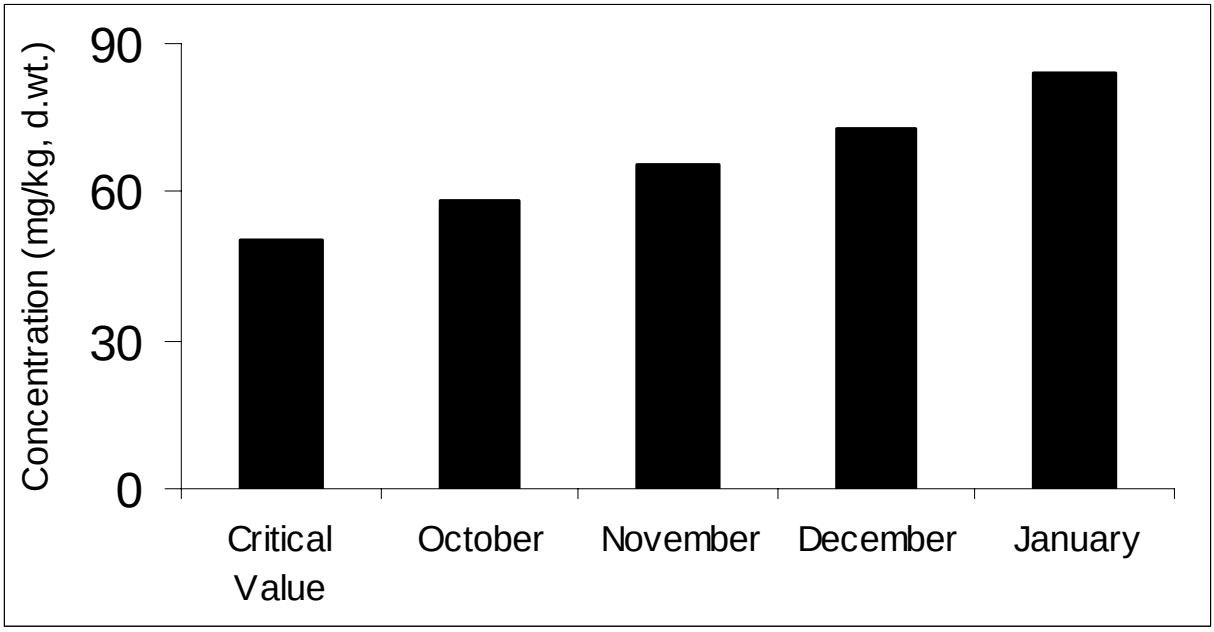

Fig. 3. Fe concentrations in forage during different months.

Forage Fe status: The Fe concentrations were variable among sampling periods and ranged from 58.15-84.30 mg/kg (Fig. 3). Lower and higher forage Fe levels were found in October and January respectively. All mean forage Fe values observed were above the critical level of 50 mg/kg (Jones, 1972; Anon., 2006). Forage Fe levels were similar to those observed previously, with the noticeable absence of the higher concentrations seen in the month of October by Khan *et al.,* (2008, 2007, 2006). It was found that pastures in this cattle range provide adequate Fe levels. Iron requirements of livestock are not well established, however, it is known that young animals have higher requirements than adults (Judson & McFarlane, 1998). For adult animals, the Fe requirement is estimated to range from 30-60 mg/kg, while the requirement of calves and lambs is thought to be 100 mg/kg. In our investigation, the forage contained less Fe but animals did not exhibiting any symptoms of this deficiency, perhaps due to availability of Fe to animals from reserves, which are considered sufficient to prevent serious anaemia (McDowell and Arthington, 2005).

Forage Mn status: Mn concentrations were strongly affected by sampling months. Very high concentrations of Mn (115.50 mg/kg) were found in forage during the month of November and very low (76.65 mg/kg) during January (Fig. 4). With very prominent inconsistent decrease or increase at different sampling periods. However, forage Mn concentrations at all sampling periods were well above the critical level (20 mg/kg) and there is no evidence that dietary Mn at this concentration is detrimental to ruminants (Anon., 2006, 1996). Similarly, higher concentration of forage Mn level was reported by McDowell *et al.,* (1982) and Merkel *et al.,* (1990) in Florida and Khan *et al.,* (2005) in Pakistan. Mn requirements are substantially lower for growth than for optimal reproductive performance (Mcdowell & Arthington, 2005). In our study Mn levels were found to be sufficient for all requirements of different categories of livestock, which precludes a need for supplementation.

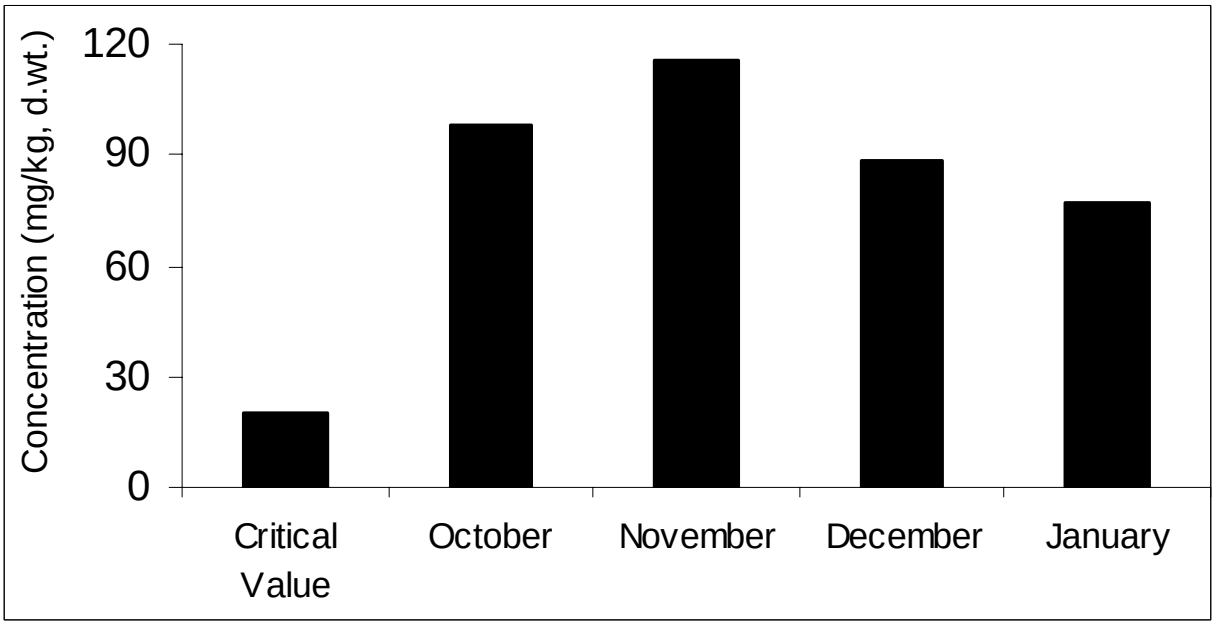

Fig. 4. Mn concentrations in forage during different months.

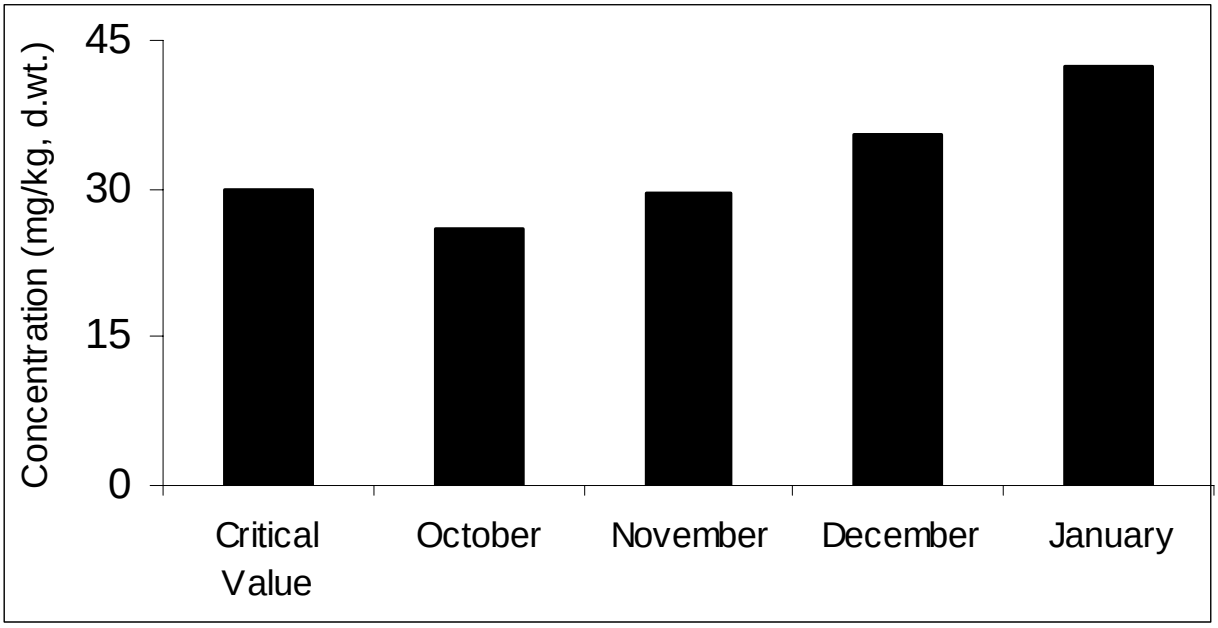

Fig. 5. Zn concentrations in forage during different months.

Forage Zn status: Zn concentrations varied from 25.88-42.24 mg/kg with the lowest values during the month of October and highest during January (Fig. 5). In October forage contained Zn levels below the critical level (30 mg/kg) for cattle (Anon., 1996), however, during November forage Zn was almost equal to the critical level but during December and January it exceeded the critical level. Forage Zn concentrations during all the sampling periods were higher than those observed by Espinoza *et al.,* (1991) and Khan *et al.,* (2008). The minimum Zn requirement of livestock varies with the chemical form or combination of the diet (McDowell, 1985). In our study the forage Zn concentrations seemed to be sufficient for all form of life at different stages of animals as 7 mg/kg dietary Zn is sufficient to maintain growth but 15 mg/kg is needed to maintain

normal Zn blood levels and a Zn intake of 17 mg/kg is apparently adequate for growth in ram lambs but not adequate for normal testicular development and function, which can be improved by a dietary intake of 32 mg/kg of Zn (Underwood & Suttle, 1999). Based on this investigation there is no warranted need of Zn supplementation to livestock grazing therein but there is a need for maintaining the relative proportions of the concentrations of Ca, Cu, Fe, and Cd in soil and forages with which Zn interacts in the process of absorption and utilization (McDowell, 1985, 1992; McDowell and Arthington, 2005).

Conclusions

Based on this investigation it can be concluded that the use of pasture fertilization could be of great importance to livestock producers on this ranch. Pasture amendments with fertilizers containing bio-available trace minerals can create an environment more suitable for plant growth and improve forage mineral nutritive value. The supplementation with adequate mineral mixtures is currently warranted at this area of this investigation as forage contained deficient mineral levels particularly of Co and Cu likely to cause deficiency in grazing ruminants.

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