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Original Research Article

Soil-Plant-Animal Relationship of Micro Minerals in Cattle from Northern Tehsils of Parbhani District, India

P. B. Singare*, V. D. Patil and S. R. Pillewad

Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India
**Corresponding author*

A B S T R A C T

Samples of soil, sorghum straw and blood serum of cow from three tehsils (Jintur, Selu and Pathri) were collected and analyzed for different micro mineral contents in order to find out mineral inter relationship among soil, plant and animal. Among the micro minerals except zinc (98 %) all other minerals were found sufficient in soils of northern tehsils of Parbhani district. Zinc deficiency of soil was very well reflected in straw. Ninety eight per cent straw samples were found deficient in their zinc content followed by deficiency of manganese (58 %). The mineral profile of blood serum of cattle from northern tehsils of Parbhani district showed adequacy of Fe (33.25 mg kg^{-1}), Zn (3.99) and Co (0.81 mg kg^{-1}) in serum of animals. The serum Cu which ranged from 0.20 to 1.30 mg kg^{-1} with an average of 0.62 mg kg^{-1} found deficient in 62 per cent animals from northern tehsil. In case of manganese though mean value (1.03 mg kg^{-1}) indicated its sufficiency in serum of animals, still 23 per cent serum samples were found deficient with respect to Mn content. The result of correlation between soil and plant, plant and animal and soil and animal for manganese and cobalt was observed positive which indicated existence of soil-plant-animal relationship. Correlation between plant and animal for copper, iron and zinc was found significant and positive. Based on the results of present study it is concluded that the cattle of northern tehsils of Parbhani district need to be supplemented with copper and zinc in their daily diet for better health and productivity.

Keywords

Micro minerals, Soil, Straw, Serum, Parbhani

Introduction

Minerals occupy an important place in animal nutrition for production as well as health (McDonald *et al.,* 2009). Mineral deficiencies, imbalances and toxicity severely inhibit livestock production and are often more significance compared to infectious diseases. Deficiencies of certain mineral elements may cause reproductive disorders as minerals play an important role in health and reproduction of the livestock (Sharma *et al.,* 2007). Malnourishment and mineral deficiency is responsible for low milk production, in spite of a large cattle population (Sharma *et al.,* 2003a). The role of soil and nutritional quality of plants with respect to health and production of livestock is very important and varies from place to place (Abdel Rehman *et al.,* 1998). In India, livestock are mainly maintained on grazing. As locally available fees and fodder are varying in mineral content, it is important to know the mineral status of soil, plant and animals of a particular area. Hence, a study was conducted to find out the relationship

among soil, straw and animal for their mineral content.

Materials and Methods

The study was conducted in of northern tehsils of Parbhani district which include three tehsils namely Jintur, Selu and Pathri tehsils. Total seventy two samples of soil, sorghum straw and blood serum of cow were collected. Soil samples at 0-15 cm depth were collected from selected farmer's field from where sorghum fodder was harvested for feeding cattle and labeled properly. Soil samples (72) were processed for estimation of DTPA (diethylene tri amine penta acetic acid) extractable micronutrients (Lindsay and Norvell, 1978). The straw samples (sorghum fodder) were drawn at the time of soil and blood collection. Blood samples were collected from cattle to which sorghum fodder grown on same soil was fed. Approximately 10 ml blood was collected from each cow in clean, sterilized test tube without anticoagulant for harvesting the serum. The sorghum straw samples and serum samples were digested using improved HNO_3/H_2O_2 (5:4) method given by Pequerul *et al.,* 1993. Digested samples were analyzed for their mineral (Cu, Fe, Mn, Zn and Co) concentrations by the atomic absorption spectrophotometry. The correlation between soil, fodder and serum was worked out as per the method given by Panse and Sukhatme (1985).

Results and Discussion

Data on status of DTPA- extractable micronutrients in soils of northern tehsils of Parbhani district are given in Table 1. The results revealed that soil has adequate DTPA-Cu, DTPA- Fe, DTPA-Mn and DTPA- Co content with average value of 2.80 mg kg^{-1}, 14.09 mg kg^{-1}, 15.31 mg kg^{-1} and 0.89 mg kg^{-1}, respectively. DTPA- Zn which ranged from 0.25 to 0.61 mg kg^{-1} with an average of 0.37 mg kg^{-1} was found deficient (98%) in soils of northern tehsils of Parbhani district. Similar results were reported by Sunewad (2014), Ghodke (2014) and Mandavgade (2014).

Table 2 represents mineral concentration of sorghum straw from Parbhani district. The mean concentration of Cu, Fe, Mn, Zn and Co observerd in sorghum straw samples was 37.65 mg kg^{-1}, 270.27 mg kg^{-1}, 37.06 mg kg^{-1}, 22.83 mg kg^{-1} and 1.83 mg kg^{-1}, respectively. Straw recorded adequate Cu, Fe and Co. Most of straw samples from northern tehsils of Parbhani district were found deficient with respect to their zinc (98%) content followed by manganese (58%). The results indicated that soil zinc deficiency is as such reflected in plant. The results are in agreement with the findings of Bhat *et al.,* (2011). Total Mn content of 58 per cent straw samples was found below the normal level of 40 mg kg^{-1} which may be partially due to soil pH (Das *et al.,* 2003) which was found alkaline in present investigation.

The results on status of serum minerals in cattle from northern tehsils of Parbhani district (Table 3) revealed that mean values of Fe (33.25 mg kg^{-1}), Zn (3.99) and Co (0.81 mg kg^{-1}) in serum of animals fall in category of adequate range. The serum Cu which ranged from 0.20 to 1.30 mg kg^{-1} with an average of 0.62 mg kg^{-1} found deficient in 62 per cent animals from northern tehsils. In case of manganese though mean value (1.03 mg kg^{-1}) indicated its sufficiency in serum of animals, still 23 per cent serum samples were found deficient with respect to Mn content. Similar results were reported by Yatoo *et al.,* (2011). High level of iron in diet of cattle could be responsible for lower levels of serum copper and manganese as reported by Noaman (2013).

Table.1 Status of DTPA- extractable micronutrients in soils of northern tehsils of Parbhani district

Tehsils	Cu	Fe	Mn	Zn	Co
Critical level	mg kg $^{-1}$				
	0.2	4.5	2.0	0.6	0.25
Jintur	2.20-4.24 (2.79)	9.98-14.40 (11.84)	13.50-21.40 (16.20)	0.25-0.60 (0.33)	0.91-1.22 (1.01)
Selu	2.24-2.61 (2.42)	10.26-17.95 (14.44)	14.20-18.32 (15.93)	0.30-0.59 (0.41)	0.62-0.95 (0.79)
Pathri	1.18-5.64 (3.24)	10.18-25.48 (16.24)	8.13-24.33 (13.58)	0.26-0.61 (0.37)	0.62-1.09 (0.85)
Range and average	1.58-5.64 (2.80)	9.98-25.48 (14.09)	8.13-24.3 (15.31)	0.25-0.61 (0.37)	0.62-1.22 (0.89)

* Critical Level (Lindsay and Norvell, 1978)

Table.2 Micro mineral concentration of sorghum straw from northern tehsils of Parbhani district

Tehsils	Cu	Fe	Mn	Zn	Co
Critical level	mg kg $^{-1}$				
	8	50	40	30	0.1
Jintur	19.35-67.58 (39.72)	186.75-445.25 (278.83)	23.0-60.0 (39.73)	17.15-31.05 (22.98)	1.08-3.50 (2.07)
Selu	30.50-46.50 (38.27)	201.75-375.50 (300.96)	25.25-63.50 (41.64)	19.0-25.60 (22.45)	1.03-2.25 (1.78)
Pathri	19.25-49.75 (34.60)	78.50-340.0 (225.66)	8.0-48.0 (28.82)	15.50-35.25 (23.09)	0.75-2.40 (1.61)
Range and average	19.25-67.58 (37.65)	78.50-445.25 (270.27)	8.0-63.50 (37.06)	15.50-35.25 (22.83)	0.75-3.50 (1.83)

* Critical Level (Prabowo *et al.*, 1990 and Mc Dowell *et al.*, 1984)

Table.3 Status of serum minerals in cattle of northern tehsils of Parbhani district

Tehsils	Cu	Fe	Mn	Zn	Co
Critical level	mg kg $^{-1}$				
	0.65	0.65	0.60	1.0	0.2
Jintur	0.20-1.30 (0.64)	25.80-64.0 (41.79)	0.10-1.40 (0.57)	1.50-7.60 (4.60)	0.50-1.60 (0.94)
Selu	0.30-0.80 (0.57)	25.0-37.0 (30.21)	1.0-2.0 (1.43)	3.0-4.60 (3.59)	0.50-1.20 (0.77)
Pathri	0.40-0.90 (0.65)	20.30-34.0 (26.99)	0.60-2.0 (1.10)	2.50-4.80 (3.76)	0.30-1.20 (0.72)
Range and average	0.20-1.30 (0.62)	20.30-64.0 (33.25)	0.10-2.0 (1.03)	1.50-7.60 (3.99)	0.30-1.60 (0.81)

* Critical Level (Mc Dowell *et al.*, 1984)

Table.4 Correlation coefficients between soil, plant and animal for Cu, Fe, Mn, Zn and Co

Minerals	Soil-Plant	Plant -Animal	Soil-Animal
Cu	-0.068	0.456**	0.261*
Fe	-0.274*	0.332**	-0.433**
Mn	0.348**	0.312**	0.187
Zn	-0.011	0.271*	-0.019
Co	0.236*	0.901**	0.245*

* Significant at 5% level ** Significant at 1% level

McDowell (1985) suggested that decreased gut absorption as well as increased excretion of copper in animals resulted in lower concentration of this mineral. Besides deficiency of zinc in soil and straw none of serum sample showed its lower content. This might be due to minute requirement of zinc by the animals or it might be a result of better utilization from fodder and its incorporation in blood. Similar results where forage Zn was below requirement of grazing ruminant but animal tissue did not indicate deficiency of zinc were reported by Balbuena *et al.,* (1989). As minerals may be mobilized from target tissue, during low dietary intake and complex inter relationships. Hence, regular supplementation of mineral mixture in the ration of animal is necessary.

The mineral interrelationship among soil, plants and animals (Table 4) revealed that there was non-significant negative correlation for copper between soil and plant while significant positive correlation between plant and animal and soil and animal. Iron content of plant and animal was found significantly and positively correlated. Zinc showed non-significant negative correlation between soil and plant and soil and animal while significant positive correlation between plant and animal. For manganese significant positive correlation between soil and plant and plant and animal and non-significant positive correlation between soil and serum was observed. Significant positive correlation between soil and plant, plant and animal and soil and animal was observed for cobalt. This indicated soil-plant-animal relationship for manganese and cobalt. Sharma *et al.,* (2003b) and Sharma and Joshi (2004) also reported similar results. A significant negative correlation between soil and straw for Fe (-0.274*) and between straw and serum for Fe (-0.433**) was observed. This is in agreement with the findings of Yatoo *et al.,* (2011), Bhat *et al.,* (2011), Noaman (2013) and Reddy (2005). This emphasizes involvement of different factors which affect the availability of micro minerals from soil to plants and thence to animals.

From the results it was clear that definite pattern of impact of one nutrient on its availability and further uptake by fodder was not observed indicating inconsistency. Thus, the cattle from northern tehsils of Parbhani district need to be supplemented with copper, manganese and zinc in their daily diet for better health and productivity.

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