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Selenium uptake in tall fescue affected by application of different amounts of cow manure

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Abstract: The present study was carried out to study the effect of different levels of cow manure on the uptake of selenium in tall fescue pasture plant. For this purpose, a pot experiment with complete randomized block design in the form of a factorial experiment was carried out on a single soil sample with *Festuca arundinacea* (Tall Fescue), two levels of cow manure (zero and 100 tons per hectare), and with eight replications during the farming year 2012-2013. Plant was harvested at the height of 20 cm in three turns and after preparation the plant samples, their selenium uptake was measured. The result of means comparison showed that the uptake of selenium in plant at during three harvests, was affected of different levels of cow manure. With increasing cow manure application, selenium uptake in tall fescue in all three harvests revealed a significant decrease ($p<0.05$) which is due to dilution effect and the organic material role in selenium absorption. Selenium uptake for the animales in all treatments in all three harvests was in the optimal selenium uptake range. Due to the impact of cow manure in decreasing of selenium uptake, use of selenium fertilizers is recommended in the soil treated with organic fertilizers to supply selenium for animals and humans.

Key words: *Festuca arundinacea* (Tall Fescue); Selenium uptake; Cow manure

1. Introduction

Because of the role of selenium in human and animal nutrition and health, attention to status of selenium in soil and its uptake by the plant, particularly pasture plants, seem quite vital. Some studies carried out broad surveys in central part of Iran and confirmed this element was deficient in Iran central parts farms soils. This element has a variety of applications in agriculture such as controlling pests and as a supplementary for the cattle browsing in selenium-deficient regions. The organic material enjoys a high capacity for taking and establishing selenium out of soil solution, but its establishment mechanism is different from clays. Micro organisms absorb selenium and direct it to their tissues. They are also able to convert the surface absorbed selenite to soluble organic selenite and selenate compounds (Shrift, 1980). Soils are the major source of selenium for plants and soil selenium exits in various forms including selenides, elemental selenium, selenites, selenates and organic selenium compounds (Surai *et al*., 2008). The bioavailability of selenium is not straightforward because of wide variation in selenium content of foods (determined by a combination of geographical and environmental factors) and chemical forms in which selenium may be absorbed and metabolized (Fairweather *et al*., 2010). Levesque, (1994) reported that adding folic acid to the soils treated with Se^{+4} lead to 12 to 27% reduction in selenium uptake by alfalfa. He concluded that organometallic complexes can be a crucial source for selenium uptake. In his findings Bisbjerg, (1996) found out that selenium intake by red clover, barley, and white mustard (sinapisalba) in a mock soil (with 13% of organic material) was 10 times less than some of mineral soils. Yang *et al*., (1983) showed that soil organic material had a negative correlation with plant selenium adsorption. *Festuca arundinacea* (Tall Fescue) is a pasture crop that is used for the animals. This plant enjoys different potentials for selenium uptake. The aim of present research is studying the effect of different levels of organic fertilizers (cow manure) on the uptake of selenium in tall fescue plant in order to achieve ideal concentration of selenium in this plant

2. Materials and methods

In order to investigate different levels of cow manure on selenium uptake in tall fescue plant, a pot experiment with complete randomized block design in the form of a factorial experiment was carried out on a single soil sample, two levels of cow manure (zero and 100 tons per hectare) and with eight replications during the farming year 2012-2013. The soil sample was taken from four points of the farm in depth of zero to 30 cm, and the compound sample was provided after mixing the samples. Some of the physical and chemical

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characteristics of the taken soil sample were measured according to standard methods (Carter and Gregorich, 2006). Their results are shown in Table 1. Average selenium concentration in this soil was 0.4 mg kg^{-1} that was classified as selenium deficient soils.

After being air-dried the taken soil samples was passed through a 2 mm- sieve. 72 kg of the soil was divided into two equal parts and half of it was loaded with an amount of cow manure equivalent to 100 tons per hectare and it was thoroughly mixed. The prepared soils were moved to 12 pots (6 pots with cow manure and 6 other pots without cow manure) with capacity of 6 kilograms**.** After preparing pots, seeds of tall fescue equivalent to 5 grams per square meter (50 kg per hectare) were planted in depth of 3 cm and were irrigated immediately. The pots were transferred to the green house. Next irrigations were daily up to appearance of sprouts, then and during the growing phase they were irrigated every 4 days. Urea fertilizer was added to the pots during two steps; 22 mili ppm at the time of germination and growing multiple leaves and 33 ppm when the vegetation was complete. Also 55 ppm of ammonium phosphate was added to all samples.

Generally plants were harvested in three turns. The first harvest was when the plant approached the height of approximately 20 cm. Next harvests were done when the plant reached the height of 20 cm. In each harvest, the aerial organs of the plant were taken from 2 cm height from the soil surface. After getting prepared, the plant samples were moved to paper envelopes and they were dried and weighted in a ventilating oven for 72 hours at 65 ºC. The samples were then powdered by Wiley mill and their selenium uptake was measured. Data obtained from each treatment were transferred to excel sheets. The diagrams were plotted using this software. Statistical analysis on data obtained from each treatment was done applying SAS software and Fisher LSD test at level of 5%. The cow manure had a pH and electrical conductivity of 8.6 and 17 dS m^{-1}, respectively. This manure is rich of total nitrogen and organic carbon.

3. Results and Discussion

3.1. The effect of cow manure on selenium uptake in tall fescue at during three harvested

Mean comparison of selenium uptake in tall fescue under the effect of different levels of cow manure in three harvests is presented in Fig. 1. As can be seen, increasing cow manure usage, selenium uptake in tall fescue showed a significant decrease in each harvest ($p<0.05$). Selenium uptake in first harvest of the control treatment was 1.1 µg and in treatment of 100 mega grams per hectare was 0.6 µg (Fig. 1). In the second and third harvests also selenium uptake in the control treatments revealed a significant decrease in comparison to the treatment where cow manure was not used ($p<0.05$). The effect of the organic material in selenium uptake, increased action of micro-organisms and selenium uptake by them or conversion of selenium mineral forms to evaporating organic forms can be mentioned as factors that cause decreased selenium uptake in treatments where cow manure was used. Results of Davis *et al*., (2006) showed that with increasing the organic material, selenium uptake decreased in plant.

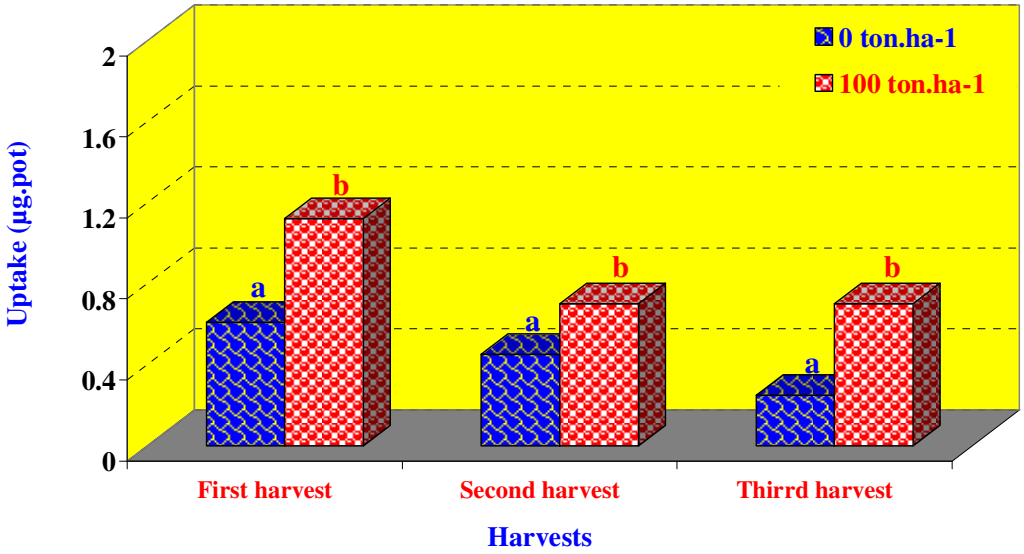

Fig. 1: Mean comparison of the different cow manure rates on selenium uptake in tall fescue at different harvest. (Bars within a manure class having the same letter are not different at P = 0.05).

3.2. The effect of cow manure on the mean uptake of selenium by tall fescue plant

The means comparison of selenium uptake by tall fescue plant under the effect of cow manure is shown in Table 2. As can be observed, with increasing application of cow manure, selenium uptake by the plant among control treatment and cow manure

treated samples showed a significant decrease ($p<0.05$). The highest uptake was related to treatment where cow manure was not applied (0 mega gram cow manure per hectare), and it showed, limiting effect of cow manure on the uptake of selenium. Generally, cow manure-untreated samples had higher uptake than cow manure treated samples, the reason can be related to the effect of the organic material in selenium absorption. Williams *et al*., (1982) found that soil organic material had a negative correlation with selenium uptake by plant. Ajwa *et al*., (1998) showed that adding plant residual or manure to the selenate treated soils, limited selenium uptake by cabbage or festuca in three harvests.

Table 1: Some physical and chemical properties of soil

Index	Soil texture	pH	EC_e dS m^{-1}	O.C g kg^{-1}	N_t g kg^{-1}	$CaCO_3$ %	SO_4 meq l^{-1}
Soil sample	SiCL	6.08	2.4	1.6	0.8	32.75	0.04

Table 2: Effect of cow manure rates on selenium uptake in tall fescue plant (µg per pot)

The amount of cow manure (Mg ha^{-1})	Mean of uptake
0	0.15^{a}
100	0.06^{b}

4. CONCLUSION

1. Applying cow manure led to a significant decrease ($p<0.05$) in selenium uptake in tall fescue in the three harvests. This decrease can be due to dilution effect, and the role of the organic material in selenium uptake which led to reduced fertilizer amount in soil.
2. In next harvests (second and third harvest), uptake in the studied plant showed a significant decrease. The reason for this decrease is seem that decreasing amounts of manure as a result of processes like uptake by the plant, leaching, uptake by microorganisms and their synthetic materials and finally evaporation of the manure to organic forms.
3. Due to the impact of cow manure in decreasing plant selenium uptake, use of selenium fertilizers is recommended in the soil with organic fertilizers to supply selenium for animals and humans.

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