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Original Research Article

Effect of Selenium Fertilization on Dry Weight, Concentration, and Selenium uptake in Shoot of Maize (*Zea mays* L.) Growing in Iraqi Calcareous Soils

Hayfaa J.H. Al-Tameemi*, Najla J. AL – Amiri and Mohammed J. Hassan

Dept. of Soil Science and Water Resources, College of Agriculture-Univ. of Basrah- Iraq

***Corresponding Author's E-mail: altamimi.hayfaa1@gmail.com**

Abstract

A cultivation experiment was conducted maize crop (Zea mays L.) in plastic pots on two calcareous soils (Qurna soil, which is poor organic matter and the other soil from Maysan marshes, which is rich in organic matter). To study the effect of selenium, on dry weight, concentration and the amount of selenium absorbed in the shoot of maize crop. Application Selenium was at four levels (0, 10, 20 and 40) gm Se ha^{-1}. Results indicated that the dry weight, concentration and the amount of selenium absorbed in the shoot of maize crop values, increased significantly with increasing the amount of application selenium in both soils. The highest values of dry weight (15.79 and 18.01 gm dry matter pot^{-1}), Selenium concentration (67.45 and 92.30 µg S gm^{-1} dry matter) and the amount of selenium absorbed (1062.00 and 1669.00 mg pot^{-1}) were at Se4 (40 gm Se ha^{-1}) treatment for Qurna and Maysan marshes soils respectively. While the lowest values of dry weight (14.79 and 16.91 gm dry matter pot^{-1}), Selenium concentration (18.09 and 21.64µg S gm^{-1} dry matter) and the amount of selenium absorbed (264.58 and 364.61 mg pot^{-1}) were at Se1 (0 gm Se ha^{-1}) treatment for Qurna and Maysan marshes soils respectively.

Keywords: Selenium, Maize, Calcareous soils

INTRODUCTION

Selenium is an essential element for humans, animals and some species of microorganisms. In higher plants, however, the role of selenium is still unclear, Influence of selenium on plants largely depends on its chemical form and its concentration in nutrient solution (Nowek, 2008). Dhillon and Dhillon (1997) noted that availability of Se in soil to plants is governed by a number of factors, type of plant species grown and the chemical forms of Se that in turn depend upon pH and the redox potential of soils are the two most important ones.

Sajedi *et al*. (2009) reported that the addition of selenium affected the components of the maize crop, and noted that selenium has a role in reducing oxidation process which cause the accumulation of toxic oxins. In their study on the effect of selenium on the protection of the sorghum crop from the effect of thermal stress, Djanaguiraman *et al*. (2010) found that the weights of the plant components increased with the increase of selenium added ($Na_2SeO_4^{-2}$) by spraying on the plant.

Rani *et al*. (2005) indicated that the concentration of selenium in the maize leaf increased with the increased concentration of selenium added, where it ranged from 1.90 to 161.21 µg g $^{-1}$ dry matter of leaf , when the concentration of selenium application to the soil ranged from 0-25 µg g $^{-1}$ Respectively, and noted that the critical concentration of selenium was 76.9 µg g^{-1} dry matter of leaf of maize crop grown in soils of India .Kovacs *et al*.,(2013) found that the concentration of selenium in dry matter of shoot of maize crop had increase from 0.736 to 32.8 mg kg^{-1}, with an increase the amount of selenium

Table 1. Some chemical and physical properties of soil study.

Soils	pH (1:1)	EC (1:1) dSm^{-1}	CEC Cmol kg^{-1}	Carbonates minerals	Total nitrogen	O.M	Soluble ions mmol L^{-1}							Soil separators gm kg^{-1}			Texture
					gm kg^{-1}		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	SO_4^{2-}	HCO_3^{-}	Sand	Silt	Clay	
Basra- Qurna	7.38	2.57	19.23	354.38	1.02	10.20	11.72	7.20	33.32	34.12	78.13	10.30	3.68	26.30	879.30	94.40	Silty
Maysan marshes (Adel)	7.30	2.70	31.10	399.50	3.70	43.10	45.00	53.00	55.70	0.72	70.20	57.50	3.00	211.00	230.00	559.00	Clayey

Soils	pH (1:1)	EC (1:1) dSm^{-1}	CEC Cmol kg^{-1}	Carbonates minerals	Total nitrogen	O.M	Soluble ions mmol L^{-1}							Soil separators gm kg^{-1}			Texture
					gm kg^{-1}		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	SO_4^{2-}	HCO_3^{-}	Sand	Silt	Clay	
Basra- Qurna	**7.38**	**2.57**	**19.23**	**354.38**	**1.02**	**10.20**	**11.72**	**7.20**	**33.32**	**34.12**	**78.13**	**10.30**	**3.68**	**26.30**	**879.30**	**94.40**	**Silty**
Maysan marshes (Adel)	**7.30**	**2.70**	**31.10**	**399.50**	**3.70**	**43.10**	**45.00**	**53.00**	**55.70**	**0.72**	**70.20**	**57.50**	**3.00**	**211.00**	**230.00**	**559.00**	**Clayey**

application to the soil from 0 to 10 g ha^{-1}. Chilimba *et al*. (2014) found that the concentration of selenium in the components of maize crop has increased with an increase the amount selenium application to the soil, where the concentration of selenium increased in dry matter of shoot from 0.0234 to 0.0791 mg kg^{-1}, with increasing selenium application from 0 to 10 g ha^{-1}.

Masanza *et al*., (2016) found in their study on the effect of the addition of selenium on selenium absorbed and the concentration of selenium in maize, that the average values of absorbed selenium was 17.1-186.2 mg ha^{-1} when adding Na_2SeO_4 at a concentration of 0-10 g ha^{1} respectively.

The aim of this study was to investigate the effect of selenium on dry weight, selenium concentration and the amount absorbed in shoot of maize crop.

MATERIAL AND METHODS

Soil samples were taken from the experimental soils and from depth (0 – 30 cm), The soils samples were air-dried, ground to pass a 2-mm sieve, and stored for analysis. Physio-chemical characteristics of soils reported in Table 1 were determined by procedures mention by Richards (1954), Jackson (1958), Black (1965) and Page *et al*. (1982).

Experience of growing maize crop

Greenhouse experiment was conducted of the Barcelona maize crop in plastic pots using two different soils (Qurna soil, which is poor organic matter and the other soil from Maysan marshes, which is rich in organic matter).During the 2016 autumn season. Randomized complete block design (R.C.B.D) was used in this study. In order to investigate of effect of selenium, in the growth parameters (dry weight, concentration and the amount of selenium absorbed) in the shoot of maize crop. Treatments of experiment were as follows:-Selenium levels were 4(0, 10, 20, 40) gm ha^{-1}.Soils, rich soil and poor soil in organic matter, with three replicates so the number of treatments were 24 experimental units.

Plastic pots, 15 cm high and diameter of 18 cm, 3 kg soil were used after air-drying and sifting with a 4 mm sieve. Soils were treated with potassium sulfate fertilizer (K_2SO_4) mixed with soils before planting, fertilizer of concentrated super phosphate (CSP) mixed with soils before planting and nitrogen fertilizer (urea) mixed with soil before planting first time and the second time with water irrigation after one month of planting. Selenium fertilizer was application as (Na_2SO_4) with water irrigation after one week of planting, and at levels (0, 10, 20 and 40)gm ha^{-1}.

Planted seeds of maize (Zea mays, L), 10 seeds in each pot, after seedling emergence has been a diminish process to keep 5 plant only. The plants were harvested after 60 days of planting and at a height of 1.5 cm from the surface of the soil to avoid contamination of the shoot and then cleaned with distilled water to remove the soil stuck to it. Then dried in the oven at a temperature of 65 °C, until proven dry weight of the plant. The dry weight was recorded and then cut and grinded with an electric machine and kept in clean plastic containers until the required analysis.

Concentration of selenium in the plant: Dry plant samples (shoot) were digested by concentrated nitric acid (HNO_3) and $HClO_4$ (70%)

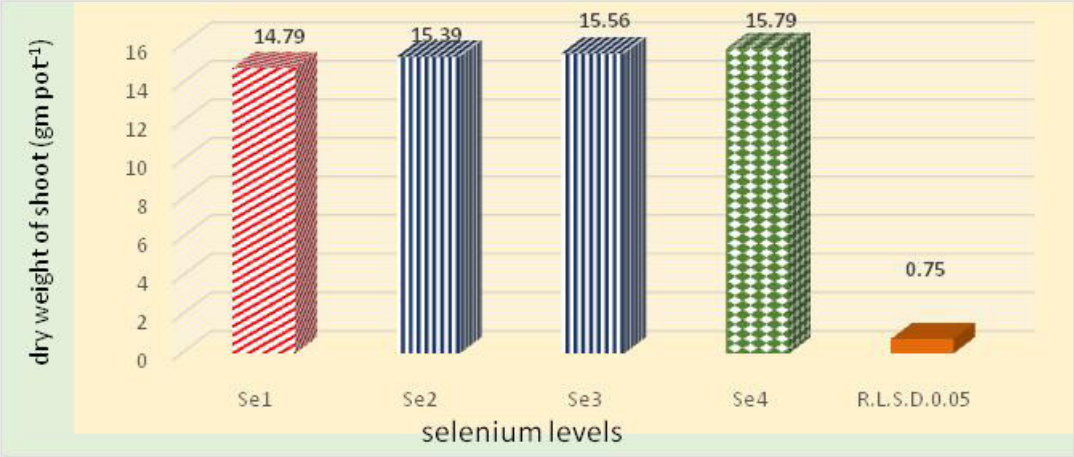

Figure 1. Effect of selenium levels on dry weight of shoot of maize crop (Qurna soil)

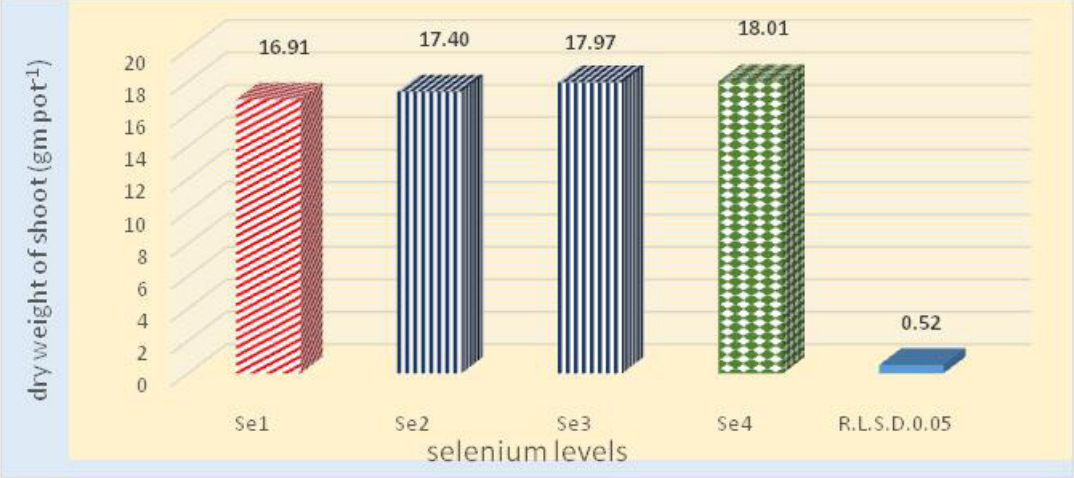

Figure 2. Effect of selenium levels on dry weight of shoot of maize crop(Marshes soil)

with heating at 150°C according to the Gupta method described in Kalra (1998). After adjusting the pH by 25 mL 6*M*HCl, the concentration of selenium was measured using the Atomic Absorption Spectrophotometer type Phoenix-986AA.

Selenium uptake was calculated in the shoot by multiplying dry weight of shoot with selenium concentration in the plant samples.

RESULTS AND DISCUSSION

Results in Figures. 1 and 2 and show that there was a significant effect ($p < 0.01$) for the levels of application selenium (10, 20, 30 and 40 gm Se ha^{-1}) on dry weight of shoot maize crop in Qurna and the Maysan Marshes soils. The dry weight values of the shoot in Qurna (14.79, 15.39, 15.56 and 15.79) gm dry matter pot^{-1}. and marsh soil (16.91, 17.40, 17.97 and 18.01)gm dry matter pot^{-1} for application selenium levels (Se1 and Se2 , Se3 and Se4) respectively, with a percentage increase (4.06%, 5.21%, 6.76%) and (2.90%, 6.27%, 6.51%) on a comparison treatment of the Qurna and marshes soils respectively. The reason for the dry weight increase of the shoot of maize crop with the increase of selenium levels is the role of selenium in the accumulation of starch in green plastids which may be the reason for the increase of plant components (Salwa, 2012).

From the results in Figures 3 and 4 notes high significant of ($P < 0.01$) for the levels of application selenium (10, 20, 30 and 40 gm se ha^{-1}) in the selenium concentration in the shoot of maize crop in studied soils. Mean values of selenium concentration were (18.09, 29.81, 47.10, 67.45 µg Se gm^{-1} dry matter) (21.64, 34.14, 51.00, 92.30 µg Se gm^{-1} dry matter) for selenium levels(10, 20, 30 and 40 gm se ha^{-1}) of the Qurna and marshes soils respectively, with a percentage increase of 64.77% and 160.40% and 272.90%) and (57.78% and 135.69% and 326.52%) on a comparison treatment of the Qurna and marshes soils respectively. The reason for

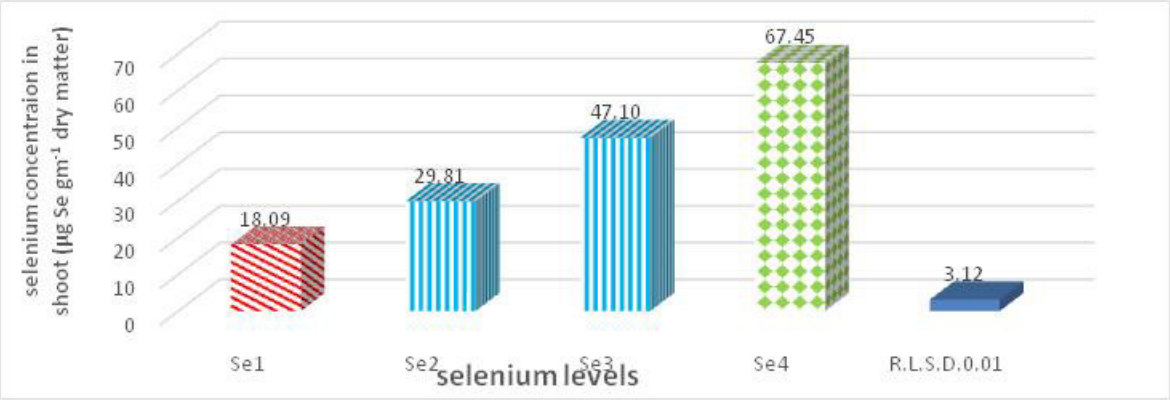

Figure 3. Effect of selenium levels on selenium concentration of shoot of maize crop (Qurna soil)

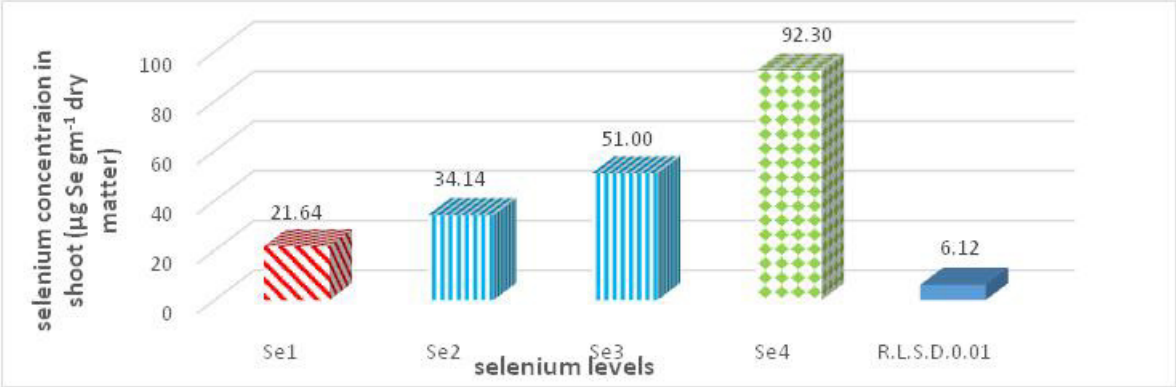

Figure 4. Effect of selenium levels on selenium concentration of shoot of maize crop(marshes soil)

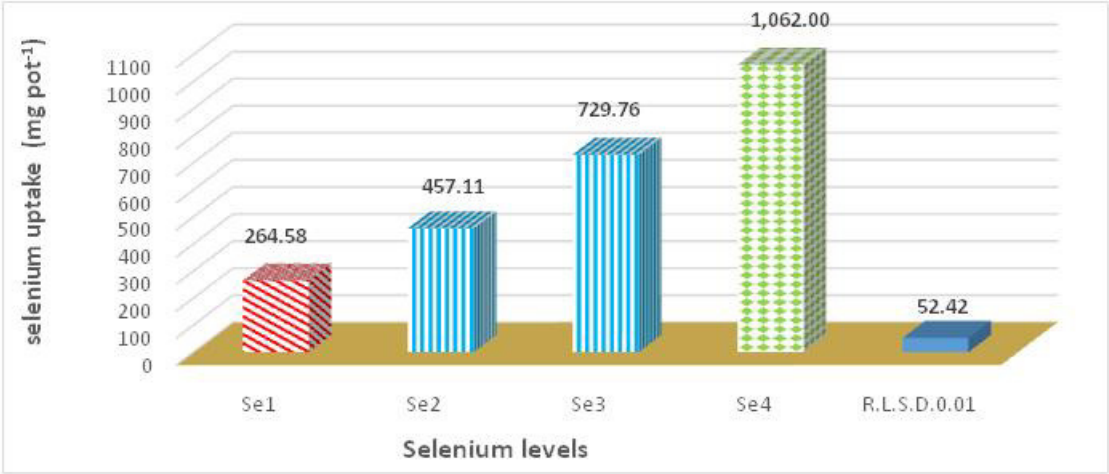

Figure 5. Effect of selenium levels on selenium uptake by shoot of maize crop (Qurna soil)

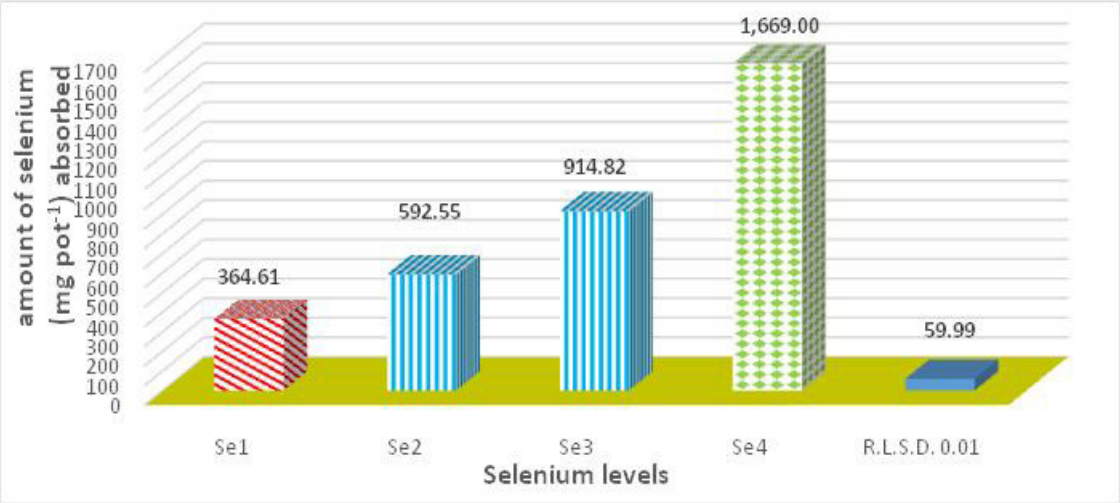

Figure 6. Effect of selenium levels on selenium uptake by shoot of maize crop (marshes soil)

increasing the concentration of selenium in the shoot of the plant can be explained by the increased concentration and availability of selenium in the soil, and hence its increased uptake by the plant and its concentration. Wang et al. (2013) and Mombo et al. (2016) found that the concentration of selenium in all parts of the maize crop increased with increased levels of application selenium to the soil. When comparing the values of selenium concentration in the shoot in the study soil, the superiority of these values in the soil of the maysan marshes compared to the soil of Qurna is due to the characteristics of the primary soil and the content of Maysan marshland soil from organic matter and its role in increasing selenium availability of the plant. Masanza et al., (2016) found an increase in selenium availability through the decomposition of soil organic matter after a period of planting, soil fertilization with organic matter and increased selenium concentration in the plant.

The results in Figures 5 and 6 show the high significant (P <0.01) of selenium levels on the amount of selenium uptake in the maize crop grown in the Qurna and Marshes soils. The values of selenium uptake by maize were 264.58, 457.11, 729.76 and 1062.00 mg pot^{-1}) and (364.61, 592.55, 914.82 and 1669.00 mg pot^{-1}) for application selenium levels Se1, Se2, Se3, and Se4 for Qurna and marshes soils respectively, with a percentage increase (72.77 and 175.82 and 301.40%) and (62.52 and 150.91 and 375.75%) on a comparison treatment of the Qurna and marshes soils respectively. This is because increasing the level of application selenium to the soil has increased the concentration of selenium in the plant and its dry weight and thus increase the amount of selenium uptake by the plant. These results are consistent with (Masanza et al., 2016; Wang et al., 2013). When comparing the values in the Qurna soil with the values of selenium uptake by the maize crop grown in marshes soil treated with the same levels of selenium, the marshes soil values are superior to the values in the Qurna soil due to the role of organic matter in improving properties, and its response to added selenium. These findings are consistent with what note Canqui et al. (2005).

REFERENCES

Black CA (1965). Method Of Soil analysis. part 1.physical properties Am.Soc.Agron Inc. Publisher Madison, Wisconsin, U.S.A.

Canqui BH, Lal R, Owens LB, Post WM, Izaurralde RC (2005). Strength properties and organic carbon of soils in the North Appalachian region. Soil Sci. Soc. Am. J. 69, 663–673.

Chilimba ADC, Young SD, Joy EJM (2014). Agronomic bio fortification on maize, soybean and groundnut with selenium in intercropping and sole cropping systems. Afr. J. Agri. Res. 9(50):3620-3626.

Dhillon KS, Dhillon SK (1997). Distribution of splendiferous soils innorthwest India and associated toxicity problems in the soil-plant-animal-human continuum. Land Contamination and Reclamation 5: 313-322.

Djanaguiraman M, Prasad PVV, Seppannen M (2010). Selenium protects sorghum leaves from oxidative damage under high temperature stress by enhancing antioxidant defense system. Plant Physiology and Biochemistry 48:999-1007.

Jackson ML (1958). Soil chemical analysis prentice Hall Inc. Englewood Cliffe N. J. pp 151- 153 and 331- 334.

Kovacs B, Bodi E, Nagy K, Toth B, Fekete I, Andrasi D (2013). Effect of selenium and molybdenum content in rhizoboxes on element uptake of maize and sunflower.Sci. Papers.Series E. Land Rec., Earth observation and Surv.,Envi.Eng.Vol 2:2013.

Masanza B, Maida JHA, Chilimba ADC, Lowole MW, Nalivata PC (2016). Liming And Selenium Application Effects On Selenium Uptake By Maize (Zea Mays)And Selenium Contents In Maize Grain. International J. of Development Res. 6(4): 7280-7289.

Mombo S, Schreck E, Dumat C, Laplanche CH, Pierart A, Longechamp M, Besson PH, Rouelle MC (2016). Bio accessibility of selenium after human ingestion in relation to its chemical species and compartmentalization in maize. Environmental Geochemistry and Health. 38 (3): 869-883.

Nowak BH (2008). Effect of selenium on selected macronutrients in maize plants. J. Elementol. 13(4): 513-519.

Page AL, RH Miller, DR Kenny (1982). Methods of Soil Analysis.Part 2 Chemical and Biological Properties. Amer. Soc. Agron. Inc. Pnblisher , Madison. Wisconsin.

Rani N, Dhillon KS, Dhillon SK (2005). Critical levels of selenium in different crops grown in an alkaline silty loam soil treated with selenite-Se. Plant and Soil. 277:367–374.

Richards LA (1954). Diagnosis and improvement of Saline and Alkaline soils. USDA. Hand book 60. USDA., Washington , DC.

Sajedi NA, Ardakani MR, Naderi A, Madani H, Mashhadi MAB (2009). Response of Maize to Nutrients Foliar Application Under Water Deficit Stress Conditions.AmericanJ.of Agricultural and Biological Sciences 4 (3): 242-248.

Salwa, M. A.(2012). Effects of low temperature and selenium application on growth and the physiological changes in sorghum seedlings. J.of stress Physio.and Biochem.8(1):268-286.

Wang J, Li H, Li Y, Yu J, Yang L, Feng F, Chen Z (2013). Speciation, distribution, and bioavailability of soil selenium in the Tibetan plateau Kashin-Beck disease area—acase study in Songpan County, Sichuan Province. China. Biol. Trace Elem. Res. 156:367–375.