Effect of Seeds Soaking with Molybdenum, Spraying with Selenium and Interaction Between them on Growth and Yield of Green Peas (*Pisum sativum* L.)

Abbas J. Al-Jaberi*, Abdulla A. Abdulla & Haider S. Shano

Department Horticulture and Landscape design, College of Agriculture, University of Basrah, Iraq

*Corresponding author-mail: abbasjawadaljabery@gmail.com

Received 19 September 2019; Accepted 18 November 2019; Available online 22 November 2019

**Abstract**: An experiment was conducted during the winter season 2018-2019 at Abu Al-Khaseeb district, Basrah province, Iraq to study the effect of soaking seed with molybdenum (Ammonium molybdate) at a four concentration (0.5, 10 and 15) mg.L⁻¹ and plant spraying with selenium (Sodium selenite) at a three concentration (0, 10 and 20 mg.L⁻¹) on growth and yield of green peas. Split plot design according to complete Block randomized design was used with three replicates. The results were showed that the soaking and spraying of plants with molybdenum and selenium respectively were significantly superior in the number of branches, root nodules, pods, the yield of plant pods and fresh seeds compared to the control. While the spraying with selenium had a significant effect on the number of leaves. The interaction between molybdenum and selenium had a significant effect on leaves area, the number of leaves, root nodules and pods, the yield of pod and fresh seeds plants treated with molybdenum and selenium at 10 mg.L⁻¹ for each other had to get the highest yield of green pods and fresh seeds 118.6 and 287.0 gm, respectively.

**Keywords**: Pea plants, Molybdenum, Selenium, Vegetative growth, Qualitative yield, Legumes.

**Introduction**

Peas (*Pisum sativum* L.) is considered as one of the important legumes crop. The cultivation of peas in Iraq is in the central and northern regions. The cultivated area for 2015 is estimated at 250 hectares with a total production of 1000 tons and a production rate is4 tons per hectare which is relatively low (Arab Organization for Agricultural Development, 2016). Production can be achieved through fertilization because of its significant effect in regulating the nutritional status of plants, especially molybdenum and selenium. Several studies have pointed to the importance of molybdenum in the plant, which is an essential component in many important enzymes such as nitrogenase enzyme and nitrate reductase enzyme, nitratreductase, xanthin dehydrogenase reduction enzyme and sulphate oxidase enzyme sulphate oxidase. Also besides, it is important in the plant metabolism and in increasing of root nodes, their weight, growth characteristics and yield (Said *et al.*, 1991). Pea plants are considered one of the medium-sensitive plants (Mass & Hoffman, 1976). Increased salinity above 3.4 ds.m⁻¹ has negative effects on the growth of shoot, root,
flowers and yield (Whiting & Wilson, 2003). Therefore, the cultivation of the pea plant in the saline-affected lands, need to treat them with selenium. Selenium is considered a rare element that has an effective role to increase the activity of enzymatic antioxidants which act as a co-factor for these antioxidants, especially Glutathione and Peroxidase enzymes (Hassannzzuman & Fujita, 2010). As well as, it’s an association with amino acids such as methionine and cysteine to formation selenium proteins Selenoproteins which can tolerate cellular membranes for environmental stresses and prevent the Demolition of Denaturation compounds metabolism of protein plants (El-Misry, 2012). Therefore, this study was aimed at response extent of pea plant to both components and their effect in yield parameters and qualitative qualities and the impact of the interaction between the two factors of the study and its impact on growth parameters and yield.

Materials & Methods

An experiment was conducted during the winter season 2018-2019 in one of the orchards of Abu Al-Khaseeb district, Hamdan region, 8 km southern Basrah province. Analysis was carried out in the laboratories of the department of soil science and water resources, college of Agriculture, University of Basrah as shown in Table (1). In the current study, seed soaking treatment with Molybdenum was considered as the main factor. Molybdenum used in the form of ammonium molybdate \((\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}\) at four concentrations (0, 5, 10 and 15) mg.L\(^{-1}\) for 6 hours. Whereas leaves spray with selenium was considered as a secondary factor which was in Sodium Selenate form \((\text{Na}_2\text{SeO}_3)\) that used in three concentrations (0,10 and20) mg.L\(^{-1}\) at the rate of three sprays. The first one was in the stage of shoots growth after 30 days of planting, and the second and third sprays were separated by two weeks between each spray. The total of experimental units was \(3 \times 3 \times 4 = 36\) units. The land has been prepared by plowing, smoothing, levelling and design into 12 lines, the length of each one was 10 m and the distance between each one was 1.5 m that divided into three experimental units. The length of the experimental unit is 3 m, the number of hollows in each experimental units was 12 hollow and the distance between the hollows was 25 cm. The number of plants in each line was 24 plants. The lines were drilled at a depth of 25 cm and fertilized with decomposing animal manure (cow’s residues) and triple super phosphate fertilizer (44% \(\text{P}_2\text{O}_5\)) at the rate of 6 tons.dm\(^{-1}\) and 40 kg.dm\(^{-1}\) respectively. A drip irrigation system with RO water was established for irrigation. Syrian type of pea seeds was depended on this study. Three seeds were laid in one hole and covered with a thin layer of Dutch-made Potgrono. After germination, plants were reduced to two plants per hole to reach to a plant density of 11,733 per plants. All agricultural service operations were carried out to produce the crop including hoeing, weeding, irrigation, fertilization, consolidation and maintenance of the drip system. Planting lines in all experiment units were sterilized similarly prior to planting with fungicide (proton) and insecticides (Matlub et al., 1989). The plants were fertilized by the Fertigation method with irrigation water continuously and in three stages: The first one by adding 1 kg.ton\(^{-1}\) of urea fertilizer (46%N) in water during the vegetative growth stage. The second one by utilizing 1 kg.ton\(^{-1}\) of NPK (10.15.25) during the flowering growth stage and the third one by use 1 kg.ton\(^{-1}\)of NPK (20.20.20) during the set flowering stage. A
preventive program was adopted to control insects and fungal diseases by use the insecticide Diazinon to control ants at a rate of 3 g.m\(^{-2}\). The soil was sterilized with fungicide Proton at a rate of 2.5 g. L\(^{-1}\)for three times; the interval between one and the other was 21 days.

Table (1): Physical and chemical characteristics of experimental soil and irrigation water.

| Soil properties          | Units   | Values  |
|--------------------------|---------|---------|
| pH                       | -       | 7.55    |
| EC                       | ds.m\(^{-1}\) | 13.83 |
| Total Nitrogen           | mg. kg\(^{-1}\) | 84     |
| Total phosphorus         | mg. kg\(^{-1}\) | 42     |
| Total potassium          | mg. kg\(^{-1}\) | 101.30 |
| Soil structure           |         |         |
| Sand                     | %       | 2.8     |
| Silt                     | %       | 76.2    |
| Clay                     | %       | 21      |

Soil Texture - Silt loam

| water properties | Units | Values |
|------------------|-------|--------|
| pH               | -     | 7.78   |
| EC               | ds.m\(^{-1}\) | 0.055  |

The studied characteristics

Indications of vegetative growth

Samples from four plants were taken randomly for each experimental unit at the end of the season to measure below:

1- Number of branches. Plant\(^{-1}\)
2- The total number of leaves. Plant\(^{-1}\)
3 - Leaf area: The Leaf area was calculated using the gravimetric method, according to Morsi et al. (1968).
4- Number of root nodules

Indications of qualitative yield

1- Number of pods. plant\(^{-1}\)
2- Weight of the pod (g)
3 - Yield of one plant from the green pods
4 - Yield of one plant from the Fresh seeds

Results & Discussion

Table (2) shows that soaking of pea seeds with molybdenum significantly affected the number of branches, leaves and root nodules.\(\text{plant}^{-1}\). High concentration (15 mg.L\(^{-1}\)) of molybdenum showed a significant positive effect in the number of branches and leaves with an increase (23.12, 15.16, 12.63) % and (30.70, 15.44 and 22.77) % respectively compared to the control and 5 and 10 mg.L\(^{-1}\). whilst 5 mg.L\(^{-1}\) exceeded significantly in the number of leaves on the comparison treatment with an increase of 13.21%. As well as the molybdenum significantly in the number of root nodules.\(\text{plant}^{-1}\) where the concentration exceeded 5 mg. L\(^{-1}\) significantly compared with control treatment and other concentrations increased by 87.07, 25.15 and 23.23%, respectively, while the concentration was 10 mg.L\(^{-1}\)was significantly higher than the concentration of 15 mg.L\(^{-1}\), an increase of
Al-Jaberi et al. / Basrah J. Agric. Sci., 32(Spec. Issue 2): 220-230, 2019

49.47%. While Soaking with molybdenum did not lead to significant differences in the leaf area. The significant increase in shoot growth parameters may be attributed to the role of molybdenum in increasing the efficiency of nitrogen stabilization which leads to increase the number of root nodules. This result is consistent to the results that obtained by Das et al. (2015) on the pea plant. Malik et al. (2011) found on plant mung bean. Khan et al. (2014) for Chickpea and Hirpara et al. (2017) for peanut plant. The increasing efficiency of the root nodules as a result of its primary action in the nitrogenase enzyme and the reductase Nitrate enzyme that exists between the root nodules (Al-Saidi, 2005), which is contributed to the increase of plant-ready nitrogen and its absorption by the plant, which leads to an increase in the number of branches and leaves. Several people found the same results including Zilanirabbi et al. (2007) and Das et al. (2015) in pea, Elkhatib (2009) and Kandil et al. (2013) in beans, Gad & Abdel-moez (2013) and Eisa & Ali (2014) on cowpea. The spraying with selenium showed significant differences in the number of branches and root nodules and leaf area. Whereas the concentration exceeded 20 mg.L⁻¹ significantly in the number of branches and root nodules compared with the control treatment and concentration 10 mg. L⁻¹ with an increment percentage of 17.59 and 12.95% and 3.35 and 120.45, respectively, while a concentration exceeded 10 mg.L⁻¹ significantly in the number of root nodules compared to the control treatment with an increment percentage of 113.30%. While the selenium spraying treatments increased the leaf area as the concentration of 10 mg.L⁻¹ significantly compared to the control treatment with an increment percentage of 13.61%. While, selenium had no significant effect on the number of leaves. The same table shows that selenium foliar spray has a significant effect in increasing the number of branches, leaf area and the number of root nodules. The increase may be due to the positive role of selenium as an antioxidant, it is work as assistant factor for a large number of antioxidant enzymes, such as the enzyme glutathione peroxide (GPx) and catalase (CAT), these two enzymes have a role in the transformation of the toxic hydrogen peroxide produced by environmental stresses into H₂O water molecules (Ren et al., 2009), which reduces the oxidative stress caused by environmental stresses such drought and salinity (Hasanuzzaman & Fujite, 2011; Hasanuzzaman et al., 2011; Abul-Soud & Abd-Elrahman, 2016; Al-Abdullah, 2018). In addition, selenium acts as a binding factor between amino acids, especially selenomethionine and selenocysteine acid, where they have the ability to bind to other amino acids, which increases the activity of DNA and RNA and this activity increases the amplitude, growth, division and cellular differentiation (Hatfield et al., 2012; Castillo-Godina et al., 2016). In addition to the role of selenium in regulating the metabolism of carbohydrates through oxidation and reduction reactions that may have some catalytic effects in the formation of root nodules (Owusu-Sekyere et al., 2013), these results are consistent with what obtained by some researchers (Kovacs, 2016; Abdel-Aziz & Geeth, 2017; Boghdady et al., 2017; Al-Kazzaz et al., 2017; Al-Kazzaz, 2018; Shedeed et al., 2018) in Pea. For the interaction between two factors, it showed a significant effect on the number of leaves, root nodules and leaf area as the concentration 15 mg. L⁻¹ of molybdenum and the concentration 20 mg. L⁻¹ of selenium. The highest number of leaves have been obtained...
50.00 leaf, from the interaction between 10 mg.L\(^{-1}\) of molybdenum and spray with 20 mg.L\(^{-1}\) of selenium which caused an increase in the number of root nodules for 23.33 nodules. While the plant non-soaked seeds with Molybdenum and sprayed with selenium at 10 mg concentration giving the highest leaf area of the plant which was 36.08 dcm\(^2\).plant. While the control treatment gave

The interaction did not show a significant effect on the number of branches. As shown in table (3), molybdenum soaking significantly affected the number of pods and the yield of one plant of green pods and fresh seeds. Where 10 mg.L\(^{-1}\) concentration caused significantly increase (29.26 and 12.62) and

| Treatment                        | Number of branches | Number of leaves | Leaf area | Number of root nodules |
|----------------------------------|--------------------|------------------|-----------|------------------------|
| Average effect of Mo Mg.L\(^{-1}\) | 0  3.33            | 37.00            | 28.23     | 14.33                  |
|                                  | 5  3.56            | 41.89            | 25.62     | 17.66                  |
|                                  | 10 3.64            | 39.39            | 25.04     | 14.11                  |
|                                  | 15 4.10            | 48.36            | 24.85     | 9.44                   |
| L.S.D.0.05                       | 0.39               | 3.61             | N.S       | 2.32                   |
| Average effect of Se Mg.L\(^{-1}\) | 0  3.41            | 41.77            | 23.95     | 6.99                   |
|                                  | 10 3.55            | 41.04            | 27.21     | 14.91                  |
|                                  | 20 4.01            | 42.17            | 26.64     | 15.41                  |
| L.S.D.0.05                       | 0.45               | N.S              | 2.73      | 1.64                   |
| Interaction between Mo and Se    | 0  0.91            | 17.66            | 17.22     | 5.00                   |
|                                  | 10 3.33            | 20.33            | 36.08     | 17.66                  |
|                                  | 20 3.75            | 7.33             | 31.39     | 20.33                  |
| L.S.D.0.05                       | 0.45               | N.S              | 2.73      | 1.64                   |
| 5                                | 0  3.50            | 21.33            | 32.00     | 7.33                   |
|                                  | 10 3.38            | 7.00             | 18.36     | 21.33                  |
|                                  | 20 3.82            | 6.66             | 26.48     | 7.00                   |
| 10                               | 0  3.27            | 12.33            | 23.85     | 6.66                   |
|                                  | 10 3.66            | 23.33            | 24.62     | 12.33                  |
|                                  | 20 3.99            | 9.00             | 26.65     | 23.33                  |
| 15                               | 0  3.96            | 8.33             | 22.73     | 9.00                   |
|                                  | 10 3.83            | 11.00            | 29.77     | 8.33                   |
|                                  | 20 4.50            | 3.63             | 22.06     | 11.00                  |
| L.S.D.0.05                       | N.S                | 5.09             | 4.89      | 3.63                   |
(14.34 and 35.72) % respectively. While the concentration 15 mg L\(^{-1}\) had significant increasing effect in the number of pods and the yield of each plant compared to the control treatment with an and increase 24.61 and 21.30%, respectively. Whilst, with 10 mg L\(^{-1}\) concentration there was a significant increase in the plant yield of fresh seeds compared to the control treatment and both 5 and 15 mg L\(^{-1}\) concentrations with an increase of (53.75, 23.72, 20.49) respectively. Also, the concentration exceeded (15.5) mg L\(^{-1}\) significantly compared to the control treatment an increase of (27.60 and 24.27), respectively. However, while Molybdenum soaking had no significant affected in the weight of the pod per plant. Table (3) shows that molybdenum soaking has significant effects in the increase in the number of pods and plant yield of green pods and fresh seeds.

Table (3): Effect of molybdenum soaking (Mo), selenium leaf spraying (Se) and interactions between them in some indications on the qualitative yield of pea plant.

| Treatment                        | Number of pods | Weight of the pod (g) | Yield plant of pods (g) | Yield plant of seeds (g) |
|----------------------------------|----------------|-----------------------|-------------------------|--------------------------|
| Average effect Mo (Mg.L\(^{-1}\)) | 0              | 32.70                 | 5.99                    | 196.2                    | 69.2                     |
|                                  | 5              | 37.53                 | 6.26                    | 232.9                    | 86.0                     |
|                                  | 10             | 42.27                 | 6.33                    | 266.3                    | 106.4                    |
|                                  | 15             | 40.50                 | 5.89                    | 238.0                    | 88.3                     |
| L.S.D.0.05                       |                | 3.30                  | N.S                     | 30.81                    | 11.99                    |
| Average effect of Se (Mg.L\(^{-1}\)) | 0              | 34.72                 | 6.00                    | 207.1                    | 80.7                     |
|                                  | 10             | 40.85                 | 5.96                    | 243.2                    | 88.8                     |
|                                  | 20             | 39.37                 | 6.39                    | 249.7                    | 92.9                     |
| L.S.D.0.05                       |                | 2.33                  | N.S                     | 18.09                    | 8.23                     |
| Interaction between Mo and Se    | 0, 0           | 29.57                 | 5.76                    | 170.2                    | 57.6                     |
|                                  | 10             | 33.36                 | 5.62                    | 187.3                    | 60.0                     |
|                                  | 20             | 35.17                 | 6.58                    | 231.0                    | 90.1                     |
| L.S.D.0.05                       | 4.67           | N.S                   | 39.31                   | 16.66                    |
This can be attributed to the important role of molybdenum in number of enzymes that have a critical role in the growth of the plant, including nitrogen enzyme that is responsible in the reducing of molecular nitrogen and convert it into a form absorbable by the plant as a result to increase the number of root nodules and thus increase the consumption and representation of nitrogen in many components and vital activities within the plant. Also besides, molybdenum has role in increase of chlorophyll production which cause increase the activity of photosynthesis (Abu Dahi & Al-Younis, 1988). This is reflected in the improvement of plant growth and leads to an increase in the number of pods as a result of the increment in the number of branches carrying the pods in the plant and the increase of the yield per plant and this is confirmed by Al-Jubouri (2015). There is a significant positive correlation relationship between the yield plant of peas and the number of pods and thus increase the overall productivity. Consequently, the total productivity of green pods, fresh seeds, dry matter and protein content in seeds were increased, which is in line with what confirmed by El-Hersh et al. (2011). That it exists a significant positive correlation relationship between seed yield and number of root nodules and a positive correlation relationship between the number of root nodules and nitrogen fixation in lentil plant. These results are consistent with what researchers have Tahir et al. (2014), Hidayatullah et al. (2016) in chickpea, and Al-Rikabi & Al-Jabouri (2017a,b) in bean plant. Also, we found that selenium spray with 10 and 20 mg.L\(^{-1}\) caused significantly increasing in the number of pods and the yield of one plant of pods, compared to the control treatment with an increase of (13.39 and 17.65) and (20.56 and 17.43) % respectively. While, there was no significant difference in the number of pods and the seeds yield of the plant between two concentrations. As well as the effect of 20 mg.L\(^{-1}\)of selenium spray concentration induced the increase of plants yield of fresh seeds compared to the control with an increase of 15.11%. However, this selenium concentration had not significantly affected in the weight of the pod per plant. Table (3) indicates that there was a significant increase in leaf spraying with selenium in the number of pods and the yield plant of green pods and fresh seeds. The increase was attributed to the role of selenium in increasing some of the vegetative growth indicators represented by the number of branches and leaf area and the increase in the number of root nodules formed due to its role in increasing the efficiency of photosynthesis process to involved in chloroplast enzymes and carbohydrate metabolism (Mazzafera, 1998), and its role in delaying the aging of leaves. Xue et al. (2001) and an increase in the activity of antioxidant enzymes (Timothy, 2001) thus, improving the resistance of plants grown under saline stress conditions, which is positively reflected in the increase in yield. These results are consistent with the results obtained by Kovacs (2016) and Shedeed et al. (2018) in pea plant. The interaction between the two factors significantly affected the number of pods, the yield of pods and fresh seeds per one plant. The interaction between 15 mg.L\(^{-1}\)of molybdenum and 20 mg.L\(^{-1}\)of selenium showed the highest number of pods which was 49.04 pods. Plant\(^{-1}\). While molybdenum-soaked plants with 5 mg.L\(^{-1}\)and 0 of selenium gave the lowest number of pods that was 28.71 pods. However, 10 mg of molybdenum and 10 mg of selenium per litter was a good interaction to obtain the highest yields of green pods and fresh seeds that were
Al-Jaberi et al. / Basrah J. Agric. Sci., 32(Spec. Issue 2): 220-230, 2019

287.0 and 118.6 g respectively compared to the interaction between the controls of both treatments which were 170.2 and 57.6 g respectively.

**Conclusions**

The use of soaking of seeds with molybdenum and leaf spraying with selenium and their interaction increased some indicators of vegetative growth. This effect was reflected on the qualitative yield qualities in the pea plant as well as, soaking of seeds with molybdenum led to an increase in the number of leaves of the plant but did not increase the leaf area and the weight of the pod in the plant and leaf spraying with selenium increased the leaf area of the plant but did not increase the number of leaves and the weight of the pod in the plant.

**Acknowledgements**

My thanks and gratitude to everyone who helped me starting and everyone helped me during my studies.

**References**

Abdel-Aziz, M.A. & Geeth, K.H.M. (2017). Effect of spraying by some substances on low temperature stress for growth and productivity in late peas (*Pisum sativum* L.) planting under the middle Egypt region conditions. J. Plant Production, Mansoura Univ., 8(8): 859-867.

Abu Dahi, Y. & Al-Younis, M.A. (1988). Directory of Plant Nutrition. Min. High. Educ. Sci. Res. Univ. Baghdad. 411pp. (In Arabic).

Abul-Soud, M.A & Abd-Elrahman, S.H. (2016). Foliar selenium application to improve the tolerance of eggplant grown under salt stress conditions. Int. J. Plant. Soil. Sci., 9(1): 1-10.

Al-Abdullah, N.N.H. (2018). Effect of selenium in improving on salinity tolerance of two cultivars of okra (*Abelmoschus esculentus* L.) cultivated in greenhouses. Ph. D. Thesis, Coll. Agric., Univ. Basrah. Iraq. 210pp. (In Arabic).

Al-Jubouri, F. (2015). Effect of molybdenum seed soaking and spray plants with boron on growth and yield of broad bean (*Vicia faba* L.). M. Sc. Thesis, Coll. Agric., Univ. Baghdad: 56pp. (In Arabic).

Al-Kazzaz, A.G.M. (2018). Effect of salinity stress and selenium spraying on broad bean plant *Vicia faba* L. Plant Archives, 18(2): 2335-2339.

Al-Kazzaz, A.G.M.; Al-Attar, B.R.W.M.; Hayani, I.H.H. & Yahya, S.S. (2017). The role of selenium in tolerance of broad bean plant *Vicia faba* L. to salinity stress. Int. J. Sci. Tech., 12(2): 53-58.

Al-Rawi, K.M. & Khalaf-Allah, A.M. (1980) Design and analysis of agricultural experiments. Iraq. Dar Al Kutub for Printing and Publishing. Univ. Mosul: 487pp. (In Arabic).

Al-Rikabi, M.N.M. & Al-Jubouri, K.D.H. (2017a). Effect of biofertilizers and molybdenum on growth and yield of green beans. J. Iraqi Agri. Sci., 48(3): 681-689.

Al-Rikabi, M.N.M. & Al-Jubouri, K.D.H. (2017b). Response of green beans to nitrogen-molybdenum-fixing bacterial vaccine. J. Iraqi Agri. Sci., 48(2): 413-421.

Al-Saidi, S.H. (2005). Plant breeding under different stress conditions and scarce resources (low input and
physiological bases her). Dar Alnshr for Univ.: 331pp.

Arab Organization for Agricultural Development (2016). Year book of Agricultural Statistics, Vol. 36, Khartoum: 430pp. (In Arabic).

Boghdady, M.S.; Desoky, E.M.; Azoz, S.N. & Nassar, D.M.A. (2017). Effect of selenium on growth, physiological aspects and productivity of Faba Bean (Vicia faba L.). Egypt. J. Agron., 39(1): 83-97.

Castillo-Godina, R.G.; Foroughbakhch-Pournavab, R. & Benavides-Mendoza, A. (2016). Effect of selenium on elemental concentration and antioxidant enzymatic activity of tomato Plants. J. Agric. Sci. Tech., 18: 233-244.

Das, R.; Mandal, R.; Chattopadhayay, S.B. & Thapa, U. (2015). Synergistic influence of macro nutrient, micro nutrient and bio-fertilizer on root nodulation, growth and yield of garden pea (Pisum sativum L.). The Bioscan., 10(1): 291-297.

Eisa, G.S.A. & Ali, T.B. (2014). Impact spraying of some microelements on growth, yield, nitrogenase activity and anatomical features of cowpea plants. World J. Agric. Sci., 10(2): 57-67.

El-Hersh, M.S.; Abdel-Hai, K.M. & Ghanem, K.M. (2011). Efficiency of molybdenum and cobalt elements on the lentil pathogens and nitrogen fixation. Asian J. Plant Path., 5: 102-114.

Elkhatib, H.A. (2009). Growth and yield of common bean (Phaseolus vulgaris L.) in response to rhizobium inoculation, nitrogen and molybdenum fertilization. Alexandria Sci. Exchange J., 30(2): 319-332.

El-Missry, M.A. (2012). Antioxidant enzymes. Intech,. Univ. Mansoura, 410pp.

Gad, N. & Abdel-moez, M.R. (2013). Influenced of molybdenum on nodulation, nitrogen fixation and yield of cowpea. J. Appl. Sci. Res., 9(3): 1498-1504.

Hassannzzuman, M.A. & Fujita, M. (2010). Selenium in higher plants physiological role antioxidant metabolism and tolerance. J. Plant Sci., Acad. J., 5(4): 354-375.

Hassannzzuman, M. & Fujita, M. (2011). Selenium pretreatment up regulates the antioxidant defense and methyl glyoxal detoxification system and confers enhanced tolerance to drought stress in rapeseed seedlings. Biol. Trace Elem. Res., 143(3): 1758-1776.

Hassannzzuman, M.; Hossain, M.A. & Fujita, M. (2011). Selenium-induced up-regulation of the antioxidant defense and methyl glyoxal detoxification system reduces salinity-induced damage in rapeseed seedlings. Biol. Trace Elem. Res., 143(3): 1704-1721.

Hatfield, D.L.; Berry, M.J. & Gladyshev, V.N. (2012). Selenium its Molecular Biology and Role in Human Health. 3rd ed. Springer, London: 591pp.

Hidayatullah; K.; Tahir, M.; Kakar, A.S.; Shah, S.G. & Usman, M. (2016). Response of peas to molybdenum application with and without rhizobium inoculum under alkaline calcareous soils. Sci. Int. (Lahore), 28(5): 4753-4758.

Hirpara, D.V.; Sakarvadia, H.L.; Savaliya, C.M.; Ranpariya, V.S. & Modhavadiya, V.L. (2017). Effect of different levels of
boron and molybdenum on growth and yield of summer groundnut (Arachis hypogaea L.) under medium black calcareous soils of south Saurashtra region of Gujarat. Int. J. Chem. Stud., 5(5): 1290-1293.

Kandil, H.; Gad, N. & Abdel-Hamid, M.T. (2013). Effects of different rates of phosphorus and molybdenum application on two varieties common bean of (Phaseolus vulgaris L.). J. Agric. Food. Tech., 3(3): 8-16.

Khan, N.; Tariq, M.; Khitab-Ullah; Muhammad, D.; Khan, I.; Rahat-Ullah, K.; Ahmed, N. & Ahmed, S. (2014). The effect of molybdenum and iron on nodulation, nitrogen fixation and yield of chickpea genotypes (Cicer arietinum L.). J. Agric. Vet. Sci., 7(1): 63-79.

Kovacs, R.B. (2016). Accumulation of selenium in the main parts of crops grown in soils and hydroponics. Ph. Thesis. Univ. Debrecen: 29pp.

Malik, J.A.; Kumar, S.; Thakur, P.; Sharma, S.; Kaur N.; Kaur, R.; Pathania, D.; Bhandhari, K.; Kaushal, N.; Singh, K.; Srivastava, A. & Nayyar H. (2011). Promotion of growth in mung bean (Phaseolus aureus Roxb.) by selenium is associated with stimulation of carbohydrate metabolism. Biol. Trace Elem. Res., 143(1): 530-539.

Mass, E. & Hoffman, G. (1976). Evaluation of existing data of crop salt tolerance. Proceeding Int. Salinity Conf. Texas: 20-23 1976, April: 187-189.

Matlub, A.N.; Mohammed, E.S.& Abdul, K.S. (1989). Vegetable Crops Production. 2nd ed. Min. Hig. Educ. Sci. Res. Univ. Mosul. (In Arabic).

Mazzafera, P. (1998). Growth and biochemical alterations in coffee due to selenite toxicity. Plant Soil, 201: 189-196.

Morsy, M. A.; Abdel-Gawad, A. & Tawfik, H.A. (1968). Fundation Agriculture Research, Anglo Egyptian Library, Cairo: 631pp.

Owusu-Sekyere, A.; Kontturi, J.; Hajiboland, R.; Rahmat S.; Aliasgharzad, N.; Hartikainen, H. & Seppanen, M.M. (2013). Influence of selenium (Se) on carbohydrate metabolism, nodulation and growth in alfalfa (Medicago sativa L.). Plant Soil, 373(112): 541-552.

Ren, Q.; Sun, R.R.; Zhao, X.F. & Wang, J.X. (2009). A selenium-dependent glutathione peroxidase (Se-GPx) and two glutathione S-transferases (GSTs) from Chinese shrimp (Fenneropenaeus chinensis). Comp. Biochem. Physiol. Toxicol. Pharmacol., 149(4): 613-623.

Said, M.T.; Abdul-Amir, M.R. & Said, K.S. (1991). Effect of bacterial vaccine, nitrogen and molybdenum on the formation of root nodules and the proportion of nitrogen in the soil on the annual plant Medicago spp. J. Iraqi Agric. Sci., 22(2): 125-136.

Shedeed, S.L.; Fawzy, Z.F. & El-Bassiony, A.M. (2018). Nano and Mineral selenium foliar application effect on pea plants (Pisum sativum L.). Biol. Sci. Res., 15(2): 645-654.

Tahir, M.; Sher, A. & Majeed, M.A. (2014). Effect of molybdenum on yield and quality of Black gram (Vigna mungo L.). Pak. J. Life. Soc. Sci., 12(2): 101-105.
Timothy, P. (2001). Implication of effect of selected selenium status; oxidative stress. Biochem. Pharm., 62: 273-281.

Whiting, D. & Wilson, C. (2003). Colorado master gardens. Academic Press, Colorado state Univ., 5pp.

Xue, T.; Hartikainen, H. & Piironen, V. (2001). Antioxidative and growth-promoting effect of selenium on senescing lettuce. Plant Soil, 237(1): 55-61.

Zilanirabbi, A.K.M. (2007). Effect of nitrogen and molybdenum on the growth and yield of garden pea (Pisum Sativum L.). M. Sc. Thesis., Agric., Univ. Dha: 70pp.