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The role of the essential element boron in plant growth / a comprehensive overview of the sustainable environment during the period of irrigation and germination

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Abstract : This article dealt with a comprehensive study on the role of boron in plants, as boron is considered one of the most important essential mineral elements that nourish plants because of its role in controlling the degree of absorption of water from the soil and the movement of sugars within the plant to their storage places, in addition to its effect on the absorption of nitrogen, potassium and calcium, and its importance in the formation of plant hormones (auxins). It helps in the germination of pollen and the growth of germination tubes, and the plant's need for it is greater during the flowering stage. Therefore, its importance in the formation of seeds and fruits becomes clear. Boron is usually present in the soil in limited quantities, as it is absorbed by plants in the form of borates an increase in calcium in the soil is considered one of the most important reasons for the occurrence of symptoms of boron deficiency on plants. There is a contradiction between these two elements, and the high ground water level and poor ventilation act as obstacle plant absorption of boron, main function of boron is to work on the elongation, development and division of cells, in addition to the formation of fruits, seeds, controlling the movement of sugars and the formation of hormones within plant tissues in order to achieve optimal growth.

Keywords: Element boron , Plant growth , Sustainable environment , Irrigation and ermination

1- INTRODUCTION

Boron is one of the microelements necessary for plant growth. There is present in most soils in small quantities, ranging from 7-80 ppm, it is found in high toxic concentrations in dry soils unless added to the soil in large quantities with chemical fertilizers. Boron is found mainly in soil in the form of boric acid H3BO3 or in the form of borates in the soil solution or absorbed into the soil particles[1]. The compounds of this element are dissolved in water enough to make it toxic to plants, and content of water is taken into consideration when evaluating the quality of irrigation water, and it is absorbed on BO2 form, this element is affected to a degree by the degree of soil interaction and the quality of clay prevailing, and the increase in organic matter is a storehouse of this element, also

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the circumstances humid climate reduces its presence in the surface layer of the soil[2]. Most of the ready-made boron in the soil binds to the organic fraction and retains it strongly and permanently part of it is the decomposition or decomposition of organic matter, which releases boron, which is taken up by plants little boron is retained, the other part is washed to the depths of the soil clay loss in wet areas with a soft texture is less than in those with a smooth texture the rough one[3]. Boron adsorbs to the mineral part of the soil and is believed to be the site of adsorption for boron they are compounds of iron and aluminum hydroxide that are found as coatings or accompanying clay mineral, Iron and aluminum oxides mica mineral and special clay minerals, it is known that the readiness of boron is reduced by adding lime (calcium carbonate), boron deficiency most often results in low boron readiness, it is due to the increase in borate adsorption by soil particles[4].

1-2 The most important mineral boron compounds spread in soil:

1- Hydrous borates, such as (Borax $Na_2B_4O_4.10H_2O$, Kernite $Na_2B_4O_7.4H_2O$, Colemanite $Ca_2B_6O_{11}.5H_2O$, Ulexite $Na_2CaB_5O_9.8H_2O$).

2- Bate Anhydrous borates such as (Iud wigite Mg_2FeBO_5, Kotoite $Mg_3(BO_3)_2$).

Factors involved in decreased boron ,I n general, the following factors can contribute to boron deficiency in plants according [5]:

1- Soils with low boron content include several soils, including:

- Alluviols are soils developed from river sediments and their parent material is poor

With the element boron due to its loss with the movement of water.

- Podzols are soils formed under moderate to moderate cold conditions

Also under humid conditions, these soils are characterized by the fact that they were formed under washing conditions intense water washes away most of the elements, including boron.

- Organic soils belonging to Histosols saturated with water and subjected to operations puncture and rough texture.

- Regosols, which are soils composed of loosely deposited minerals or on them, such as the sand . Such soils are free to drain and susceptible to washing.

- Haplaquepts are the soils that contain green forest plants, which are sodic soil has a high degree of reactivity, which leads to less solubility of boron compounds ready quantity.

2- Soils of areas with moderate and heavy rainfall.

3- Soils with a neutral or basic degree of reaction. Such soils have increased adsorption boron and the highest adsorption occur between the degree of reaction 7-9, and the degree of melting decreases boron compounds, in addition to the interaction of boron with tertiary oxides in such soils decreases.

4 - Dry conditions, especially in the summer, where there is a long period of drought, the movement of boron is almost non-existent, and its melting point is very low due to its lack humidity .

5- Soils with high clay content suffer from boron deficiency due to excess absorption rate of clay minerals.

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* Dissolved boron levels in soils of humid areas range between 5.2 - 05.0 ppm. As for soil in dry areas, it may contain more than 5 parts.

1-3 Boron and cell wall structure

Both boron (B) and calcium (Ca) participate in the composition of the cell wall, where 90% of boron is present, in the form of a deformation of the cell wall and an imbalance in the cell wall, any deficiency in the plant's need for it appears first arrangement of the middle lamellae between the cell walls factors affecting its absorption heavy rains wash away the available boron around the roots of plants, and irrigation by flooding leads to the same heavy rains damage the soil by washing away this element dry environmental conditions during seed setting lead to weak root system activity and thus absorption is affected boron, which the plant needs to a great extent during this period[5,6].

They are the vital functions of boron in transport of sugars in the plant, as it interacts with the sugars to form complex of sugar with boron and helps and stimulates the formation of phenolic compounds. Boron is necessary in the formation of plant cells and great importance in the formation of nucleic acids, that's leads to the accumulation of nitrates in the plant and a lack of protein formation due to low nitrate reduction rate and regulating enzymatic activity and regulating the formation and activity of plant hormones[7].

About consequences of boron deficiency, boron is the nutrient most commonly caused by deficiency symptoms in crops around the world, and its deficiency affects vegetative and reproductive growth, leading to ailment kind of in its productivity as well severe decline cell expansion, meristematic tissue death, and decreased fertility[8].The plant contains boron in two forms dissolved form in water and an insoluble form, where the percentage of dissolved is affected by the amount of available boron, while the insoluble form does not affected is the form from which the plant benefits, while the aerobic form represents its surplus, boron is mainly involved in the formation of the cell wall, and it also protects and regulates the plasma membrane vital physiological processes in plants[5,9].

Boron deficiency also causes a decrease in the vitality of pollen grains, the fall of buds and flowers, and thus a decrease in production seeds and fruits. The quality of fruits, seeds, and transportation also decreases. Nuts. Legumes are considered one of the most sensitive plants due to boron deficiency, unlike grasses severe deficiency in boron leads to the appearance of deficiency symptoms on young leaves at a rate of 3-4 times. The percentage of its appearance on old leaves in dicotyledons, especially clover and soybeans, and this indicates its ability and limited in its movement within this type of plant[10].

1-4 Treatment of boron deficiency

Due to the fundamental differences in soil composition and types, it becomes necessary to estimate the amount of boron in fruits, seeds, and transportation need it by analyzing soil and plant tissues to estimate boron and determine its deficiency in its quantity or not, to take measures to correct this percentage without experiments have proven that spraying vegetable plants with boron compounds dissolved in water has completely treated its deficiency, the need for soil treatments[11]. In other cases, plants needed

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irrigation along with spraying working the soil side by side for the vegetative group. Although boron is quickly absorbed by leaves and flower buds, spraying may not be effective enough. Plants vary in their ability to move boron through to compensate for the decrease in its concentration in the soil, the texture of the bark in them: some of them have boron moving freely enough, and some have boron unable to move in their bark in the first case, spraying with boron is sufficient for the plant's needs, and in the second case, the plant needs a supply of it with boron in other ways[12].

• The most important vital functions of boron in plants is its role in caring for pollen grains, their growth, and then working on knotting seeds, fruit formation, grain production, and nuts transportation before or knowing the concentration of boron available to the plant and the environmental conditions that occur and negatively affect it is also important during the critical period of plant growth, which is the seed setting period[7,13].

1-5 The effect of boron deficiency on plant structure:

Degeneration of the meristematic tissue, including the cambium, destruction of the parenchyma cell walls, and a weakness in the formation of the vascular system, especially the xylem tissue, when the concentration of this element increases, whether in the soil or in foliar fertilizers, this leads to yellowing of the growing tips of the leaves as a result of the difficulty of its movement in the vascular system and local death tissues and leaves burn and then fall symptoms of boron deficiency divided in general symptoms poor growth and death of the developing tips of the stems and roots such as of symptoms of boron deficiency on some plants greens in beet of rot heart in sugar beets shows this presentation occurs in the middle of the plant's lifespan or shortly thereafter, where it appears on the inner young leaves symptoms of discoloration then turn into and black color and die, this is followed by the appearance of dry rot on the root, it started from the top and resulted in a severe crop failure low sugar content in the roots[14].

As like brown or gray heart in turnips or gray heart of turnip brown or gray spots or rings appear inside the roots when they are incised without appearing symptoms[9]. External to the root, this symptom is taken as an indication of boron deficiency in soil, as it analyzes the growth of peanuts is higher, the soil surface has been shown to have a sufficient percentage of boron for growth between plants grow at 20-60 ppm naturally note that this percentage being less than 20 ppm leads to symptoms of boron deficiency appear on plants increasing it up to 100 ppm , the leaves appear brown spots, especially at the edges occasional cracks occur on the middle vein and spread outside and take on a brown color, structures then die. An interaction may occur between boron and calcium in apples, causing a watery pulp to appear in the fruits, as it appears inside the fruit has a frozen appearance treatments of boron deficiency [15].

2- Conclusions and Recommendations

The importance of that the plant needs it in limited proportions, the plant has very limited levels, and some people may be confused about its unimportance is not true, plants vary in their need for it, as its percentage in the leaves of different crops was

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estimated and found to range between 20-100 parts per million (ppm) (noting that a percentage exceeding this range leads to toxicity to the plant in their tolerance to this toxicity. Boron is closely related calcium deficiency in plants even though it does not perform the function of calcium and absorption is affected by the presence of a high percentage of lime in the soil, which works to limit its absorption. Boron is affected by dehydration and its absorption decreases. In some alkaline soils, it remains in a non-absorbable form on the other hand, sandy soil lacks this element as a result of continuous drainage, so it is recommended to repeat it treat the soil with it more than once to provide the plants need for it. t is possible to correct the percentage of boron in the soil using either boric acid (16% boron) or borax (3.11%), the necessary rate per hectare (4.2 acres) was estimated at about 1.1 kg/ha (46.0 kg per acre), To be affected form can be dissolved in water and sprayed on the surface of the soil or used as fogging, but the former is preferable due to its some plants have a negative effect, and it is noted that in some alkaline soils this treatment is not suitable as used a spell and remains in an unobservable form, but in sandy lands, boron may leak out with wastewater Therefore, it is necessary to repeat the treatment to provide the necessary needs of the plants.

Author contributions

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