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Comparative Study on The Effect of Some Nutritional Fertilizers on Growth and Yield of Lettuce Plants.

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ABSTRACT

Two field experiments were conducted for two successive seasons under sandy soil conditions to study the response of lettuce plants to the foliar spraying of four nutrient fertilizers. Four mineral nutrient fertilizers: Greenzite, Vitaforte, Folifertile and Wxal, were used alone at two concentrations (0.75% and 1.5%). The obtained results indicated that all nutrient fertilizer treatments gained the highest plant growth of lettuce expressed by length of plant, number of leaves, leaves fresh and dry weight and total yield per feddan compared to control plants. The results revealed that the best plant height and stem diameter, stem length, stem weight measurements of lettuce plants were recorded when plants sprayed with Greenzite especially with the lower level. The same trend was observed concerning leaves number, leaves fresh and dry weight and total yield per feddan. Chemical analysis of leaves showed that the highest potassium level was noticed with Wxal treatments.

Key words: Lettuce, nutrient fertilizers, yield.

Introduction

Lettuce is one of the essential salad crop for diet program and nutritional fertilizers are required for successful lettuce production and can influence lettuce quality. The objective of this study was to evaluate changes in yield and quality of lettuce plants (cv. Balady) in response to four different mineral fertilizers. However, the head leaves yield could be enhanced by improving the agricultural treatment s.i.e. The better application method of fertilizers, or providing the plants by some macro / micro – nutrients, through untraditional application method i.e., through foliar application could improve yield and quality of lettuce. It is known that, rooting media can affect the solubility and/or particularly in sandy soil, most soil dressing fertilizers lost with irrigation water. For this main reason, the foliar application of nutrients as an individual method for fertilizer application or as a complete nutrition system is important in such conditions. whereas, Alschler et al., (1997) added that every plant like any other organisms needs certain components for growth and the basic components of living cells are proteins. The main source of protein in plant tissues is nitrogen. Moreover, nitrogen is the fundamental ingredients for process of protein synthesis. Squeeze et al. (1988) reported that lettuce crop responded strongly to nitrogen fertilizer as it increases the yield due to an increase in number and weight of leaves per plant. Whereas, Chance et al. (1999) stated that, potassium acts as catalyst of activator of enzymes that promote the overall growth.

In addition, zinc acts an enzyme activator in protein, hormones synthesis and metabolism. Youssef et al. (2001) revealed that cobalt remarkably increases fresh and dry weight of shoots of tomato plants. The influence of cobalt placements on plant growth was most pronounced in roots than shoots (Abd El-Fatah, 2008) and it was reported that low concentration of cobalt had favorable effect on lettuce plants. Also, Nadia and Zaghloul (2007) indicated that in most cases, the presence of nickel used to produce lettuce plants. Moreover, the response of many vegetables to nutritional elements were studied by many investigators, Al-Said and Kamal(2008), Karuppaiah et al. (2008), Xu-Flui et al. (2004), Awad et al. (2007), Shaheen et al. (2006).

The aim of this study was to investigate the effect of foliar application of four mineral nutrient fertilizers for lettuce plants (cv. Balady).

Materials and Methods

Two field experiment were carried out during 2007-2008 and 2008-2009 seasons to investigate the influence of treating lettuce plants (cv. Balady) by four different macro/and or micro nutrient fertilizers named:
Greenzit, Vitafortile, Foliferite and Wxal. Each used at two concentrations (0.75% and 1.5%). The chemical composition of each nutrient is:

- **Greenzit NPK 5144**, manufactured by CIBA-Giegy limits Basel, Switzerland, contains N (70g/L), P (30g/L), K (39g/L), Fe (1000mg/L), Mg (100mg/L), Mn (100mg/L), B (100mg/L), Cu (10mg/L), Mo (5mg/L), Ni (1mg/L), and Co (1mg/L).
- **Vitafortile**, manufactured by Foundation Chemical Company Sadat City, Egypt, contains N(21.0%), P (18.0%), K (15.0%), S (0.40%), Ca (0.05%), Mg (0.10%), Fe (895ppm), Mn (560ppm), Zn (317 ppm), Cu (240 ppm), B (100ppm), and Mo (10ppm).
- **Foliferite**, manufactured by Murphy Chemical Company Limited, England, contains N (22%), P (21%), K (17%), S (0.17%), Mg (0.10%), Fe (370 ppm), Mn (395 ppm), Zn (68 ppm), Cu (76ppm), B (33ppm) and Mo (50ppm).
- **Wxal**, manufactured by Bayer com., W. Germany, contains N (14%), S (3.2%), Fe (1.4%), Zn (2.8%), Mn (4.2%), Cu (0.014%), B (0.014%) and Mo (0.007%).

The experiments were carried out at the main research station, National Research Center located in Nubaria region (West of Nile Delta of Egypt). The soil of the experimental site was deep and well-drained with 85.5% sand, 11.7% silt and 2.8% clay, an alkaline pH of 8.2, an EC of 0.85 dS m−1, and with 1.5% CaCO3. The average available N, P and K in the top soil was 0.2 and 17 mg kg−1 soil, respectively before the onset of the experiment. Lettuce seeds were sown on the 1st week of October in 2007 and 2008 seasons. The seedlings were transplanted at 20 cm apart on one side of the ridge. The methods of application were distributed randomly within a complete block design with three replicates. All experimental treatments received the recommended fertilizer for soil preparation. The normal other cultural practices commonly used for growing i.e., irrigation, pest and diseases control, etc. of lettuce plant were followed. The following parameters were recorded for lettuce plants (plant height, leaves number, leaves fresh and dry weight, stem (length, diameter and weight), and total yield per feddan. However, samples of lettuce leaves from the tested treatments in mid harvesting season were taken for analysis nitrogen, phosphorus and potassium according to the methods described by cottonie et al., (1982) and Black (1982).

Data were subjected to statistical and analysis of variance according to Snedecor and Cochran (1980). Treatment means were compared using the least significant differences (L.S.D.) at 5% level.

**Results and Discussions**

**Vegetative Growth Characters and Yield:**

Lettuce plant growth characters and yield as expressed by plant length, number of leaves, fresh and dry weight of leaves, stem length, stem diameter and total yield per feddan as influenced by the application of the two concentrations of the four mineral nutrient fertilizers are shown in tables (1 and 2) for the two successive experimental seasons. It is clear that foliar application of Greenzit, at (0.75%) , Foliferite at concentration (1.5%), Vitafortile at (1.5%) and Wxal at (1.5%) resulted in the highest plant length, number of leaves and leaves fresh and dry weight. The maximum stem length, stem diameter, stem fresh weight and total yield per feddan were obtained when lettuce plants sprayed with Greenzit concentrations compared with none treated plants (control) and compared with other fertilizer treatments. Moreover, the statistical analysis of obtained data revealed that the differences within various fertilization applications were significant at 5% level. These findings are in the same trend for the two experimental seasons. It could be concluded that foliar spraying of the studied fertilization treatments caused an enhancement in plant growth parameters of lettuce plant compared to control plant.

The presented data in tables (1 and 2) show clearly that all mineral nutrients fertilizers which used in this study caused a promotion effect on plant growth of lettuce plants compared with none treated plants (control). Moreover, within the four mineral nutrient treatments used, that plants which applied by Greenzit, Vitafortile and foliferite resulted in the highest plant growth, followed in decreasing order by plants that treated with Wxal. The statistical analysis of the collected data reveals that the differences within the all used treatments were significant at 5% level. These findings were true in both seasons.

The high number and fresh weight of leaves of lettuce plants in response to nutrient fertilization treatments might be attributed to the high nutrient contents such as nitrogen element which is directly involved in plant metabolism (structure, constituent, enzyme activator, etc.). It is known that the elements is identified as essential for plant growth and the plant can not complete its life cycle without it. However, nitrogen is part of nucleic acid, chlorophyll and protein.

The stimulation on vegetative growth characters aspects in response to Vitafortile, Foliferite and Wxal treatments might be ascribed to the positive action of sulphur on enhancing the biosynthesis of proteins, natural hormones, root formation and cell division (Schung, 2001), Saleh et al. (2006) and Hanan et al. (2008) on lettuce plant. The various benefits of using sulphur as an essential as well as an absent and present macronutrient
for growth, nutritional status of the plants, yield and yield quality are emphasized the necessity of using such promising element for fertilizing (Broyan and Murphy, 1980).

Potassium acts as a catalyst or activator of enzymes and promotes growth (Buwalda et al., 1987). The high levels of P in Greenzit, Folifertile and Wxal resulted in a significant increase in the fresh weight of leaves of lettuce plants. This may be attributed to the important role of phosphorus on growth and metabolism, which increased nutrients absorption leading to an increase in dry weights. These results are confirmed by Mengel and Kirkby (1987), Mehala et al. (2004) and Hanan et al. (2008). Greenzit foliar applications gave the greatest total yield per feddan followed by Vitafort and Folifertile. Moreover, the highest stem length obtained with plants treated with Greenzit followed by Vitafort, Folifertile, and Wxal application treatments. The highest stem weight shown when lettuce plants treated with Greenzit followed by Vitafort and Folifertile applications.

The obtained results indicated that the best lettuce yield was correlated with the plants that received Greenzit treatments and that might be related to the fact that Greenzit contains most of the mineral elements including nickel and cobalt. These results are in agreement with Nadia and Zaghloul (2007) who indicated the presence of nickel in soils used to produce lettuce. However, it could be concluded that the vigorous growth of lettuce plants which received all the mineral nutrient fertilizers treatments is due to the high availability of macro and micro nutrients in these nutrient fertilizers.

The responses of vegetable plants to macro or micro nutrients were studied by many workers such as Chance et al. (1999), Buwalda et al. (1987), Kolota and Osinska (2001) on squash, Shaheen et al. (2006) on okra.

Data in table (2) shows clearly that, the foliar spraying of Greenzit, Vitafort, Folifertile and Wxal resulted in a high total yield per feddan compared with untreated plants. Stem length, stem weight and total yield were highly increased when plants treated with Greenzit compared with the other nutrients. These findings are in accordance for the two experimental seasons.

The statistical analysis recorded no great differences within the four mentioned nutrients. These results were true in both experimental seasons. It could be summarized that, the foliar application of lettuce plant by mineral nutrients i.e. Greenzit, Vitafort, Folifertile and Wxal recorded the highest total yield per feddan as well as the best physical quality. This might be attributed to the chemical constituents of the four nutrients, where as, nitrogen, potassium, calcium, sulfur, nickel and cobalt play a major role in plant metabolism and reflected on the plant growth and hence on the yield, and its physical quality. The previous literature which reported by Al-Saied and Kamal (2008), Shaheen et al.(2006), Shaheen et al.(2008), Saleh et al.(2006) revealed that vegetative plants responded positively to the application of some macro and/or micro – elements, as the obtained results showed almost the same trend.

### Table 1: Effect of the mineral nutrients fertilizers on growth characters of lettuce plants. (Combined analysis of two seasons).

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Concentrations (%)</th>
<th>Plant length (cm)</th>
<th>Number of leaves</th>
<th>Leaves Fresh Weight (g)</th>
<th>Leaves Dry Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0%</td>
<td>29.33</td>
<td>48</td>
<td>297.7</td>
<td>42.35</td>
</tr>
<tr>
<td>Greenzit</td>
<td>0.75%</td>
<td>38.97</td>
<td>83.33</td>
<td>579.83</td>
<td>70.17</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>36.83</td>
<td>72.33</td>
<td>530.00</td>
<td>60.5</td>
</tr>
<tr>
<td>Folifertile</td>
<td>0.75%</td>
<td>32.17</td>
<td>59.6</td>
<td>480.17</td>
<td>58.5</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>38.5</td>
<td>52.33</td>
<td>516.67</td>
<td>53.83</td>
</tr>
<tr>
<td>Vitafort</td>
<td>0.75%</td>
<td>38.67</td>
<td>67.67</td>
<td>447.83</td>
<td>59.67</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>43.00</td>
<td>60.00</td>
<td>366.00</td>
<td>56.33</td>
</tr>
<tr>
<td>Wxal</td>
<td>0.75%</td>
<td>30.1</td>
<td>59.00</td>
<td>286.5</td>
<td>38.17</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>31.00</td>
<td>60.00</td>
<td>294.33</td>
<td>40.33</td>
</tr>
<tr>
<td>L.S.D. at 5 %</td>
<td></td>
<td>3.1</td>
<td>2.11</td>
<td>19.12</td>
<td>2.37</td>
</tr>
</tbody>
</table>

### Table 2: Effect of the mineral nutrients fertilizers on stem length, stem diameter, stem fresh weight and yield of lettuce plants. (Combined analysis of two seasons).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Concentrations (%)</th>
<th>Stem length (cm)</th>
<th>Stem diameter (cm)</th>
<th>Stem fresh weight (g)</th>
<th>Total yield (ton/Feddan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0%</td>
<td>16.17</td>
<td>4.91</td>
<td>83.23</td>
<td>19.99</td>
</tr>
<tr>
<td>Greenzit</td>
<td>0.75%</td>
<td>24</td>
<td>6.03</td>
<td>162</td>
<td>27.79</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>22.73</td>
<td>5.6</td>
<td>152</td>
<td>25.83</td>
</tr>
<tr>
<td>Folifertile</td>
<td>0.75%</td>
<td>21.7</td>
<td>5.43</td>
<td>126.33</td>
<td>22.35</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>22.32</td>
<td>5.53</td>
<td>146.83</td>
<td>23.75</td>
</tr>
<tr>
<td>Vitafort</td>
<td>0.75%</td>
<td>20.67</td>
<td>5.3</td>
<td>124.33</td>
<td>23.44</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>21.33</td>
<td>5.57</td>
<td>150.67</td>
<td>23.63</td>
</tr>
<tr>
<td>Wxal</td>
<td>0.75%</td>
<td>17.5</td>
<td>5.23</td>
<td>85.17</td>
<td>22.25</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>19.67</td>
<td>5.27</td>
<td>91</td>
<td>22.91</td>
</tr>
<tr>
<td>L.S.D. at 5 %</td>
<td></td>
<td>1.53</td>
<td>0.25</td>
<td>4.53</td>
<td>0.694</td>
</tr>
</tbody>
</table>
Nitrogen, Phosphorus And Potassium Contents In Lettuce Leaves:

Although foliar spraying of lettuce plants with the four plant growth nutrition substances caused an increase in the N, P and K contents of lettuce leaves during the two successive experiments of (2007 - 2008) and (2008 – 2009) as shown in table (3) compared to control plants, the differences were not significant at 5% level. However, many other investigators such as Adam et al. (2002), Faten et al. (2005), Yrildirim et al. (2007) and AL-Said and Kamal (2008) indicated that the application of nutrient elements for some vegetable plants gained an enhancement in mineral uptake, consequently increased its concentrations in plant tissues.

Table 3: Effect of the mineral nutrients fertilizers on nitrogen, phosphorus and potassium content of lettuce leaves (Combined analysis of two seasons).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N %</th>
<th>P %</th>
<th>K %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0 %</td>
<td>2.15</td>
<td>0.407</td>
</tr>
<tr>
<td>Greenzit</td>
<td>0.75%</td>
<td>2.61</td>
<td>0.459</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>3.23</td>
<td>0.492</td>
</tr>
<tr>
<td>Folifertile</td>
<td>0.75%</td>
<td>2.28</td>
<td>0.432</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>3.13</td>
<td>0.485</td>
</tr>
<tr>
<td>Vitaforte</td>
<td>0.75%</td>
<td>2.26</td>
<td>0.437</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>3.06</td>
<td>0.496</td>
</tr>
<tr>
<td>Wxal</td>
<td>0.75%</td>
<td>2.15</td>
<td>0.428</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>2.99</td>
<td>0.435</td>
</tr>
<tr>
<td>L.S.D. at 5 %</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

It could be concluded that spraying lettuce plants with Greenzite, Vitaforte, Folifertile and Wxal can improve the growth, yield and quality of lettuce plants. However, Greenzite treatment had the best results.

References


