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# RAISING *Polianthes tuberosa* L. PLANTS BY NUTRIENT FILM TECHNIQUE

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**ABSTRACT: The present work proved the efficiency of using tap water ; of E.C. 1.24 ds/m , total soluble salts 793.6 ppm and containing 8.09 ppm sodium , in preparing Hogland solution for growing tuberose plants (*Polianthes tuberosa* L.) until flowering in nutrient film technique (NFT). Hogland solution containing ammonium and nitrate as nitrogen forms proved to be better than that containing nitrate form only. Deduced prepared commercial fertilizer formula solution was nearly similar to Hogland solution and resulted in significant enhancing effect than Hogland solution for the vegetative and flowering characters.**

**Using tap water and the commercial fertilizers formula decreased the costs of production , taking in consideration that this technique produced high yields (about 100 spikes/m$^2$).**

*Key words: Polianthes tuberosa* L. , **Nutrient film technique.**

## INTRODUCTION

According to FAO (1990), the nutrient film technique, referred to as (NFT) was a noval system of water solution culture characterized by using only a very shallow stream of solution flowing from troughs or gullies. The concept of NFT was developed by Cooper (1976 ,1979). Its future was highly questionable unless better means of disease and nutrient solution control are found. Cooper (1996) has just recently published a revision of his 1976 book on NFT. However, this technique has great advantages in mass production in soilless culture.

The production of ornamental bulbs through this technique did not have any attention. So this work was conducted aiming to raise *Polianthes tuberosa* L. plant,

in limited area. Using low cost nutrient solution for the production of *Polianthes tuberosa* L.

## MATERIALS AND METHODS

This work was conducted in Horticulture Department , Faculty of Agriculture, Zagazig University during 2002 and 2003 seasons, under saran house allowing 65% shading of light intensity1700-2000 Ft.C. The nutrient film technique (NFT) system was designed by using plastic pipes of 4.0 inches diameter and 4.0 meter length with upper holes every 20 cm with 8.0 cm diameter. They were fixed with a gentle slope of 1.0%. Accordingly the nutrient solution flowed under the influence of gravity. The nutrient solution tank was white plastic tank of 20 liters capacity. The nutrient solution was supplied from PVC pipes of 0.5 inch diameters started at the highest end to allow the high flowing of the nutrient solution. The drain of the used nutrient solutions was re-collected within the nutrient tank and re-cycled again by the emerged pump to the upper side. The emerged plastic pump was used to avoid the metal concentration engaged by salt corrosion, a pumped solution running continuously with a given flow rate of 120 l./hour.

*Polianthes tuberosa* L. mother bulbs of about 3cm diameter and 20 gm weight were planted on April 1st in both seasons in a small plastic cups 5.0 cm in diameter and 5.0 cm depth filled with peat moss and sand 1:1 (*V/V*) to obtain similar sprouting and rooting . The planted bulbs were left until 1st June ,then similar sprouted rooted bulbs were transplanted in the NFT pipes and supported from the two sides with spongy longitudinal strips .The bulbs were transplanted in holes of the plastic pipes each hole contained two bulbs. As such the four plastic pipes contained 160 bulbs . In the 1st season the four tested treatments included :

1. Hogland A solution (Lorenz and Maynard, 1980) prepared with distilled water.
2. Hogland A solution (Lorenz and Maynard, 1980) prepared with tap water.
3. Hogland B solution (Lorenz and Maynard, 1980) prepared with distilled water.
4. Hogland B solution Lorenz and Maynard (1980) prepared with tap water.

So, the first season was represented by four pipes each contained 40 bulbs, consequently all pipes contained 160 bulbs and occupied 1.6 $m^2$ (100 bulbs/ $m^2$)

The used salts for preparing Hogland A and B solutions are presented in Table A. They were differed in the source of nitrogen only ,where nitrogen sources in Hogland A were nitrates calcium nitrate and potassium nitrate in the form of nitrate and in Hogland B were calcium nitrate , potassium nitrate and monoamomium phosphate in the forms of nitrate and ammonium.

In the 2nd seasons six treatments of nutrient solution were prepared with tap water as follows :

1-Hogland A
2-Hogland B
3-D.C.F.F.*I
4-D.C.F.F*II
5-0.5 gm/l. Singeral**
6-1 .0 gm/l. Singeral**

The sources of nutrient elements in D.C.F.F. solution are illustrated in Table B.

Concentration of the elements in the used solutions are illustrated in Table C.

The six treatments were represented by six pipes 4.0 meter length ,4.0 inch diameter each pipe contained 20 holes for every one and two planted bulbs per hole .All pipes contained 240 bulbs per 2.4 $m^2$ (100 bulb/$m^2$.) .

All used nutrient solutions were changed weekly to avoid the changes in pH and the electrical conductivity (E.C.) since every used solution was adjusted at pH 6.0 -6.5 and the E.C. of every solution is illustrated in Table C.

The analysis of the used tap water was as follows:

N 0.0125 ppm, P 8.09 ppm, K 5.08 ppm and Na 8.09 ppm , the E.C. 1.24 dS.m, total soluble salts 793.6 ppm and pH 7.66.

All experiments were arranged in complete randomized design .At the beginning of the flowering stage (15 July) the following data were recorded :

1. Number of leaves /plant,
2. Leaf length (cm),
3. Leaf width (cm),
4. Leaves area/plant ($cm^2$),
5. Leaves fresh weight /plant (gm), and .
6. Chlorophyll A, B and Carotenoides according to Wettestein (1957).

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* Deduced commercial fertilizer formula
* * compound commercial fertilizer formula

At flowering stage, the flowing data were recorded :

1.Spike length (cm),

2.Number of florets/spike,

3.Spike fresh and dry weight (gm).

Samples of vegetative leaves at the beginning of flowering were dried at 70 °C and used for chemical analysis.

After normal leaves drying on the plant, the bulbs were collected, dried and the following data were recorded :

1. The fresh and dry weight of the bulb (gm), and
2. The number of bulblets/bulb .

Samples of the dried bulbs at 70 °C and leaves were subjected to chemical analysis as follows :

1.Total nitrogen percentage in the leaves and bulbs was determined according to Naguib (1969).

2.Total phosphorus percentage in the leaves and bulbs was determined according to Troug and Mayer (1939).

3.Total potassium percentage in the leaves and bulbs was determined according to Jackson (1970).

4.Total carbohydrate percentage in leaves and bulbs was determined according to the method described by Dubois *et al.* (1956).

The data were subjected to statistical analysis according to Snedecor and Cochran (1980).

## RESULTS AND DISCUSSION

### 1.RESULTS

#### 1.1 Effect of Hogland Solution, Water Type and Commercial Fertilizers in the Nutrient Film Technique on Vegetative Characters of *Polianthes tuberosa* L Plant:

Data in Table1 indicate that, in the first season, there was no significant difference in leaves number /plants , leaf length , or leaf width due to Hogland type solution with either distilled water or tap water. However, slight increase was observed when distilled water was used in the two Hogland solutions; A and B. Hogland B with distilled water resulted in the highest increase in this regard .On the other hand, the other characters; i.e., leaves fresh and dry weight per plant, root length, root fresh and dry weight per plant, bulb fresh and dry weight and number of bulblets/bulb showed significant differences in this regard. Using distilled water in both Hogland solutions significantly surpassed

the tap water . In the same time , Hogland B solution with distilled water resulted in the highest significant values for these characters.

The comparison of Hogland solutions and commercial fertilizers dissolved in tap water, in the second season (Table 2), indicates that the D.C.F.F. II and Singeral at 1.0 gm./l. resulted in the highest significant values for leaves number /plant compared to D.C.F.F. I or 0.5gm/l Singeral ,but still similar to Hogland A and B .On the other side, leaf length and width showed significant increase with Hogland B in most cases. However, leaf width had the highest values with Hogland B or 1.0 gm/l Singeral. Neverthless leaves fresh weight/plant showed insignificant differences for except with Hogland B solution,it led to the highest significant value(72.5 gm) .

Concerning root characters; i.e., root length, fresh weight and dry weight, it was clear that Hogland B, D.C.F.F.II or 1.0 gm/l Singeral treatments were the promising in enhancing these characters without significant differences among them. Also the bulb fresh weight , dry weight and bulblets number had the same trend of roots characters.

### 1.2 Effect of Hogland Solutions, Water Type and Commercial Fertilizers in Nutrient Film Technique (NFT) on Flowering Characters of *Polianthes tuberose* L. Plant

Data, of the first season, in Table 3 show that insignificant enhancement was detected when distilled water was used in preparing either Hogland A or B. In the same time, Hogland B solution prepared with distilled water resulted in insignificant values of spike length, number of florets/spike and spike fresh weight, while it resulted in significant increase in spike dry weight. Comparing Hogland solutions and the commercial fertilizers prepared with tap water during the second season, Table 4 indicated that Hogland B and D.C.F.F. II fertilizer enhanced flowering characters significantly without significant differences between them for these flowering characters (spike length ,florets number/spike, spike fresh and dry weights).

### 1.3 Effect of Hogland Solutions, Water Type and Commercial Fertilizers on Some Chemical Constituents in Leaves and Bulbs of *Polianthes tuberosa* L. Plant

Data in Table5 indicate insignificant differences between

Hogland A and B solutions prepared with tap or distilled water regarding all studied chemical constituents during the first season si.e., total carbohydrate, nitrogen, phosphorus, potassium, chlorophyll A and B and total carotenoides contents. However, slight increase was observed for these constituents with Hogland B prepared with distilled water comparing to Hogland A and B prepared with tap water.

Data of the comparison among Hogland solutions (A,B) and commercial fertilizers prepared with tap water during the second season are shown in Table 6. The results indicate that Singeral at 1.0 gm/l was the promising treatment in most cases for enhancing these chemical constituents. Moreover, the total carbohydrates, total nitrogen, phosphorus and potassium percentages had had higher values in the bulb compared to leaves. This was expected trend considering that bulb is the storage organ for these constituents

## 2. DISCUSSION

The previous results indicated that tap water can be used safely in preparing Hogland A and B solutions in raising *Polianthes tuberosa* plant for flowering using nutrient film technique considering this water contained 793.6 ppm total soluble salts with E.C. 1.24 dS/m and 8.09 ppm sodium. This can be assured when considering the relative increase in the flowering characters due to using distilled water with either Hogland A or B solutions (Table 7). These increases were 5.27, 5.06, 9.96 and 18.84% for spike length, number of florets/spike, spike fresh weight and spike dry weight for Hogland A solution, respectively. Where they were 8.57,15.19,10.43 and 12.42 % for the same characters with Hogland B. solution, respectively. These increases due to using distilled water can be ignored from the commercial production view since the costs of using distilled water is high. In this regard, Benton Jones (1997) mentioned that treatment should be employed only if the chemical and physical composition of the water warrants, obviously, business, financial, and managerial planting must incorporate the costs of developing nutrient pure water in a grower's specified environment. For example, it may be financially prudent to accept some crop loss from the use of impure water rather than attempting to recover the cost of water treatment; treatment may be as simple and inexpensive a task as acidifying the water to remove bicarbonates ($HCO_3$) and carbonates($CO_3$).

In the present work the tap water contained 8.09 ppm sodium, the total dissolved salts were 793.6 ppm., the E.C. was 1.24 dS/m. So, these values can be considered suitable for irrigation water .In this regard, the quality guideline for irrigation water mentioned by Benton Jones (1997) as the degree of problem was sodium <3.0 non, 3.0-9.0 increasing and >9 severe ;total dissolved salts <0.75 ppm non, 0.75-3.0 ppm increasing and >3.0 severe and E.C., ds /m ,0.75 non, 0.75-3.0 incerasing and >3.0 severe . On using the tap water the E.C. of the used solutions were 2.89 for Hogland A,2.81 for Hogland B, 3.17 for D.C.F.F.I, for 3.35 for D.C.F.F. II, 2.75 0.5 gm/l Singeral and 3.00 1.0gm/l Singeral. All these values did not reach the severe case of the advised E.C. of the nutrient solutions. Also, Hassan (1988) mentioned that the water used for the nutrient solution may not contain more than 50 ppm sodium chloride and the tap water which contain 0.1-0.6 ppm chlorine or 1.0-2.0 ppm sodium chloride can be used and when necessary having the water 0.4 atmosphere pressure (E.C. 1.11 millmose/cm) can be used .

Referring to the effect of Hogland solutions A and B on the vegetative growth, it was clear that the effect of Hogland B was more pronounced by significant increase than Hogland A for leaves area/ plant, leaves dry weight, root length, root fresh and dry weight, bulb dry weight and number of bulblets/bulb . On the other side, the increase in flowering characters was insignificant. These results can be explained on the base that Hogland B contains two forms of nitrogen (nitrate and ammonia) whereas Hogland A. contains nitrate form only. In this regard, Benton Jones (1997) mentioned that, some ammonium may by desirable in the nutrient solution as it stimulates the uptake of nitrate and has been shown that as little as 5% of total N in solution as ammonium in a flowing nutrient solution system is sufficient. Moreover, selecting the proper ratio of ammonium to nitrate in the nutrient solution to be considered in plant species. Also in this regard, Mohammed (2001) showed the enhancing effect of ammonia and nitrate in the solution than nitrate alone on vegetative growth of *Ficus hawaii* and *Ocimum canum*. Herein, it could be concluded that the effect of Hogland B was similar to D.C.F.F. II solution for obtaining the best results of vegetative growth and flowering .From economical point of view D.C.F.F.II is preferred since it prepared from commercial

fertilizers which have low costs comparing to Hogland solutions which prepared from pure salts.

On the other side, Singeral compound commercial fertilizer at 0.5 or 1.0gm. /l. came in the second order after Hogland B and D.C.F.F.commercial fertilizer.

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**Table A: The used salts for preparing Hogland A and B solutions**

| Hogland A | Hogland B |
|---|---|
| Calcium nitrate | Calcium nitrate |
| Potassium nitrate | Potassium nitrate |
| Potassium dihydrogen orthophosphate | Monoammonium phosphate |
| Magnesium salphate | Magnesium salphate |
| Boric acid | Boric acid |
| Manganese chloride | Manganese chloride |
| Zinc sulphate | Zinc sulphate |
| Cupper sulphate | Cupper sulphate |
| Ammonium molybdate | Ammonium molybdate |
| Iron chelated (10. 5 %Fe.) Commercial fertilizer. | Iron chelated (10. 5%Fe.) Commercial fertilizer. |

**Table B: The commercial fertilizers used for preparing D.C.F.F. nutrient solution**

| Element | Source |
|---|---|
| N | Ammonium nitrate(commercial fertilizer 33%N) |
| K | Potassium salphate (commercial fertilizer 48%$K_2O$) |
| P | Phosphoric acid (9. 5% $P_2O_5$) |
| Ca | Calcium sulphate |
| Mg | Magnesium sulphate |
| Zn | Zinc sulphate |
| Bo | Boric acid |
| Mn | Manganese sulphate |
| Cu | Cupper sulphate |
| Mo | Ammonium molybodate |
| Fe | Iron chelated (10. 5%Fe) |

**Table C: The constituents of the used solutions (mg/l. of macroelements and microelements)**

| Elements | Hogland A | Hogland B | D.C.F.F. I | D.C.F. F.II | 0.5 gm./l. Singeral | 1.0 gm./l. Singeral |
|---|---|---|---|---|---|---|
| N | 271.57 | 259.20 | 120.00 | 180.00 | 100.00 | 200.00 |
| P | 30.98 | 30.98 | 30.98 | 46.47 | 100.00 | 200.00 |
| K | 234.19 | 234.23 | 134.25 | 201.37 | 100.00 | 200.00 |
| Ca | 287.87 | 230.29 | 46.45 | 69.68 | 46.45 | 92.91 |
| Mg | 48.62 | 48.62 | 24.60 | 36.90 | 60.00 | 120.00 |
| S | 64.15 | 64.15 | 124.5 | 186.70 | 2.00 | 4.00 |
| Fe | 14.61 | 14.61 | 7.30 | 10.95 | 35.00 | 70.00 |
| Mn | 0.5024 | 0.5024 | 0.7350 | 1.1025 | 21.00 | 42.00 |
| Bo | 0.4757 | 0.4757 | 0.007 | 0.0105 | 11.00 | 22.00 |
| Cu | 0.0203 | 0.0203 | 0.0505 | 0.0757 | 8.00 | 16.00 |
| Mo | 0.0100 | 0.0100 | 0.01645 | 0.0246 | 7.00 | 14.00 |
| Zn | 0.0500 | 0.0500 | 0.0454 | 0.06817 | 7.00 | 14.00 |
| E.C.*** | 2.89 | 2.81 | 3.14 | 3.35 | 2.75 | 3.00 |

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Table 1: Effect of Hogland solutions and water type in nutrient film technique on vegetative characters of *Polianthes tuberosa* L. during the 1st season (2002)

| Treatments | Leaves number /plant | Leaf length (cm) | Leaf width (cm) | Leaf area per plant ($cm^2$) | Leaves fresh weight (gm) | Leaves dry weight (gm) | Root length (cm) | Root fresh weight (gm) | Root dry weight (gm) | Bulb fresh weight (gm) | Bulb dry weight (gm) | Number of bulblets / bulb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hogland A With tap water | 13.86 a | 27.10 a | 1.82 a | 417.22 d | 31.87 c | 3.20 d | 9.06 c | 9.73 c | 1.16 d | 20.98 c | 4.76 b | 9.06 c |
| Hogland A With distilled water | 16.42 a | 33.50 a | 1.86 a | 513.19 b | 43.95 a | 4.76 b | 12.95 b | 11.72 b | 1.51 c | 23.00 b | 4.96 b | 11.92 b |
| Hogland B With tap water | 15.85 a | 31.97 a | 1.90 a | 486.49 c | 39.31 b | 3.89 c | 10.80 c | 12.52 b | 1.69 b | 22.25 b | 5.15 b | 11.28 b |
| Hogland B With distilled water | 18.00 a | 35.53 a | 1.92 a | 584.65 a | 48.92 a | 4.86 a | 16.07 a | 14.07 a | 2.03 a | 26.71 a | 6.21 a | 15.28 a |

**Table 2 : Effect of Hogland solutions and some commercial fertilizers in nutrient film technique on vegetative characters of *Poliathes tuberosa* L. during the 2nd season (2003)**

| Treatments | Leaves number /plant | Leaf length (cm) | Leaf width (cm) | Leaf area per plant ($cm^2$) | Leaves fresh weight (gm) | Leaves dry weight (gm) | Root length (cm) | Root fresh weight (gm) | Root dry weight (gm) | Bulb fresh weight (gm) | Bulb dry weight (gm) | Number of bulblets /bulb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hogland A | 16.58 ab | 35.55 b | 1.68 ab | 564.59 b | 51.09 a | 5.36 b | 11.69 a | 11.92 ab | 1.47 a | 21.22 ab | 4.62 b | 10.25 bc |
| Hogland B | 17.91 ab | 40.21 a | 1.90 a | 702.11 a | 72.50 a | 6.94 a | 12.93 a | 13.32 a | 1.65 a | 23.79 a | 5.53 a | 12.50 a |
| D.C.F.F.* I | 15.50 b | 31.26 bc | 1.59 b | 385.95 c | 45.75 a | 4.67 bc | 10.80 b | 9.85 b | 1.04 b | 19.54 b | 4.34 b | 9.91 bc |
| D.C.F.F. II | 19.91 a | 35.87 b | 1.71 ab | 602.12 a | 63.46 a | 4.16 c | 11.89 a | 13.34 a | 1.58 a | 22.82 a | 5.13 a | 11.83 ab |
| Singeral 0.5gm./l. | 15.91 b | 28.13 c | 1.57 b | 352.91 c | 45.78 a | 4.45 bc | 11.41 ab | 10.30 ab | 1.41 a | 21.37 ab | 4.58 b | 9.50 c |
| Singeral 1.0gm./l | 19.58 a | 32.59 b | 1.78 a | 570.07 b | 60.32 a | 5.67 b | 11.95 a | 12.89 a | 1.45 a | 24.13 a | 5.32 a | 12.66 a |

* Deduced commercial fertilizer formula

**Table 3: Effect of Hogland solutions and water type in nutrient film technique on flowering characters of *Polianthes tuberosa* L. during the 1st season(2002)**

| Treatments | Spike length (cm) | Number of florets/spike | Spike fresh weight (gm) | Spike dry weight (gm) |
|---|---|---|---|---|
| Hogland A with tap water | 56.91 a | 30.00 a | 32.11 a | 4.14 c |
| Hogland A with distilled water | 59.91 a | 31.52 a | 35.31 a | 4.92 b |
| Hogland B With tap water | 59.34 a | 30.60 a | 35.74 a | 5.15 b |
| Hogland B with distilled water | 64.43 a | 35.25 a | 39.47 a | 5.79 a |

**Table 4: Effect of Hogland solutions and some commercial fertilizers in nutrient film technique on flowering characters of *Polianthes tuberosa* L. during the 2nd season (2003)**

| Treatments | Spike length (cm) | Number of florets/spike | Spike fresh weight (gm) | Spike dry weight (gm) |
|---|---|---|---|---|
| Hogland A | 59.90 b | 29.80 a | 37.70 bc | 4.84 ab |
| Hogland B | 64.40 ab | 28.00 a | 42.60 a | 5.58 a |
| D.C.F.F.* I | 63.90 ab | 22.90 bc | 37.90 b | 4.79 ab |
| D.C.F.F.II | 67.50 a | 30.00 a | 41.40 ab | 5.38 a |
| Singeral 0.5 gm./l. | 50.80 c | 20.10 c | 31.8 c | 3.96 c |
| Singeral 1.0 gm./l. | 56.70 bc | 23.70 bc | 36.90 bc | 4.71 b |

* Deduced commercial fertilizer formula

**Table 5: Effect of Hogland solutions and water type in nutrient film technique on chemical composition of *Polianthes tuberosa* L. during the 1st season(2002)**

| Treatments | Carbohydrates | | Nitrogen | | Phosphorus | | Potassium | | Chlorophyll pigments mg./gm .fresh weight | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Leaves | bulbs | Leaves | Bulbs | Leaves | Bulbs | Leaves | Bulbs | A | B | Carotenoids |
| Hogland A with tap water | 19.51 a | 35.96 a | 2.17 a | 3.02 a | 0.375 a | 0.558 a | 2.34 a | 3.18 a | 0.526 a | 0.604 a | 0.265 a |
| Hogland A with distilled water | 20.75 a | 42.09 a | 2.20 a | 3.10 a | 0.675 a | 0.750 a | 2.68 a | 2.90 a | 0.473 a | 0.454 a | 0.292 a |
| Hogland B with tap water | 23.02 a | 41.78 a | 2.87 a | 3.40 a | 0.437 a | 0.625 a | 2.51 a | 2.85 a | 0.504 a | 0.474 a | 0.312 a |
| Hogland B with distilled water | 25.00 a | 43.32 a | 3.02 a | 3.80 a | 0.700 a | 0.883 a | 2.76 a | 2.98 a | 0.521 a | 0.426 a | 0.255 a |

**Table 6 : Effect of Hogland solutions and some commercial fertilizers in nutrient film technique on chemical composition of *Polianthes tuberosa* L. during the 2nd season (2003)**

| Treatments | Carbohydrates | | Nitrogen | | Phosphorus | | Potassium | | Chlorophyll pigments mg./gm .fresh weight | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Leaves | bulbs | Leaves | Bulbs | Leaves | Bulbs | Leaves | Bulbs | A | B | Carotenoids |
| Hogland A | 20.60 ab | 37.05 ab | 2.80 b | 3.15 b | 0.575 a | 0.650 a | 2.62 ab | 2.69 b | 0.523 a | 0.396 a | 0.264 ab |
| Hogland B | 22.28 ab | 35.01 b | 2.95 ab | 3.38 ab | 0.800 a | 0.683 a | 2.83 a | 2.76 b | 0.538 a | 0.827 a | 0.280 ab |
| D.C.F.F.* I | 14.15 b | 33.58 b | 2.30 b | 3.00 b | 0.408 a | 0.450 a | 2.20 b | 2.34 b | 0.371 b | 0.324 a | 0.206 b |
| D.C.F.F. II | 17.04 ab | 39.26 a | 2.46 b | 3.10 b | 0.450 a | 0.575 a | 2.41 ab | 2.96 a | 0.473 a | 0.449 a | 0.291 ab |
| Singeral 0.5 gm. / l . | 18.96 ab | 37.26 ab | 3.30 ab | 3.85 a | 0.650 a | 0.750 a | 2.34 ab | 2.69 b | 0.316 b | 0.243 a | 0.282 ab |
| Singeral 1.0 gm. / l . | 23.27 a | 34.45 b | 3.85 a | 4.20 a | 0.650 a | 0.800 a | 2.69 a | 3.03 a | 0.330 b | 0.331 a | 0.364 a |

* Deduced commercial fertilizer formula

**Table 7: Relative increase percentages of using distilled water on the flowering characters of *Polianthes tuberos* L. plant**

| Treatments | Spike length | Number of florets/Spike | Spike fresh weight | Spike dry weight |
|---|---|---|---|---|
| Hogland A with tap water | - | - | - | - |
| Hogland A with distilled water | 5.27 | 5.06 | 9.96 | 18.84 |
| Hogland B with tap water | - | - | - | - |
| Hogland B with distilled water | 8.57 | 15.19 | 10.43 | 12.42 |

# انماء التيوبيروز من خلال تقنية الغشاء المغذى

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أجرى هذا البحث خلال صيف عامى ٢٠٠٢و٢٠٠٣ فى ملحق مشتل كلية الزراعة – جامعة الزقازيق، وأظهر هذا العمل فعالية استخدام ماء الصنبور ذو درجة توصيل كهربى E.C.1.24 dS/m وبة املاح ذائبة كلية ٧٩٣,٦ جزء فى المليون و٨,٠٩ جزء فى المليون صوديوم فى تحضير محلول هوجلاند لنمو نبات التيوبيروز، وكان محلول هوجلاند المحتوى على نيتروجين امونيومى ونتراتى افضل من المحتوى على صورة نتراتيه فقط. كما أمكن استخدام محلول مغذى محضر باستخدام ماء الصنبور واسمدة تجارية مشابهة لتركيب محلول هوجلاند، وأظهر هذا المحلول تأثيراً مغوياً مشجعاً عن استخدام محلول هوجلاند، وأدى استخدام الأسمدة التجارية بالصورة المقترحة مع ماء الصنبور الى تقليل تكاليف الانتاج اخذين فى الاعتبار ان هذا الاسلوب يؤدى الى انتاج عالى من الشماريخ الزهرية (حوالى ١٠٠شمراخ /متر مربع).