Winter December 15, 2012

Effect of potassium fertilizer and different fertilization methods on the growth of tuberose

A Mohammadi Torkashvand
Yaser Shariati
R Onsinejad

Available at: https://works.bepress.com/y_shariati/1/
The Effect of Potassium Fertilizer and Different Fertilization Methods on the Growth of Tuberose

Mohammadi Torkashvand, A.*, Shariati, Y.*# and Onsinejad, R.*

Abstract: An appropriate fertilization method is an important topic in nutrition of ornamental plants for obtaining suitable quality and quantity yield. This study was conducted in Farvardin greenhouse of Mashhad Township, Khorasan province, Iran, in summer and autumn 2011 to find appropriate fertilization method on the growth of tuberose as the test plant. The experiment was performed by 21 treatments and 3 replications in a randomized completely design. Different methods of fertilization by different fertilizers in three levels of basic potassium were evaluated. The treatment containing 100 kg potassium as base + one-third N and P as base and two-third N as two equal divided + half phosphorus as base, half phosphorus as two equal divided + 3 times potassium foliar spray + N foliar spray had the most length of branch (119 cm) in compared to control (71.5 cm). Treatments with nitrogen and divided phosphorus in different parts of plant growth had more weight.

Keywords: Fertilizer, Potassium, Tuberose, Mashhad, Spray.

INTRODUCTION

Iran is a talented country in producing flowers and ornamental plants due to the suitable diversity of weather and 40°F difference between the coldest and warmest region in country, Energy and cheap forces at work, enough light (more than 250 days light and, 120-150 thousand lux in year), cellulose wastes and consumption markets. The cultivation area of tuberose is about 200 hectare in Iran, in which, the greatest area is related to Khouze stan, Tehran, Markazi and Khorasan provinces and 47575200 branches of tuberose are produced. The number of employees is 357 in this part and Khorasan and Markazi provinces have the most yields with producing 14375100 branches. Tuberose is one of the most important flowers in tropical and subtropical regions (Edwards, 2006) those are usually cultivated in Iran as garden plant. It has aromatic florets. Tuberose is cultivated as an essence source in perfumery industries in India and France (Sing and Kumar, 1999).

Several factors affect on the availability of potassium in soil that they can be classified in two groups. First, it is soil factor which affect on solution and exchange potassium. Theses factors can refer to minerals kind, organic matter, solution-exchange K equilibrium, the ratio of K/Ca activity in soil solution, The relation between exchange and non-exchange K, effect of NH₄⁺ ion and pH (Malakouti and Shahabi, 2005). Second factor is plant that root characteristics, root cation exchange capacity, the effect of features and development of root, temperature around roots, root environ and the effect of kind and digit of plant (Salardini, 1998). Verma et al. (2000) reported that the application of macro and micronutrients is necessity for biochemical processes of plants. From factors to reduce efficiency of NPK fertilizers, the use of these fertilizers, separately, because simultaneous applications cause to be had the better role in vital processes of plant because of its interactions (FSSA, 2003).

Sajid et al. (2009) investigated the effect of foliar spray of growth regulators and nutritious material in Lily plant. The results showed that the spraying nutrient solution increased 25% stem length and spraying nutrient solution and hormone increased it amounted 33%. Gopalakrishman et al. (1995) reported that the greatest number of floret and flower diameter in Tuberose obtained by the use of 120 kg N, 60 kg P₂O₅, and 30 kg K₂O. Niaiefard and Tabatabaei (2007) investigated optimized nutrition of Lily with nitrogen and potassium. They applied nitrogen in four levels (100,200,300,400 mg/L) and potassium in two levels

* Islamic Azad University, Rasht Branch, Rasht, Iran, (*Corresponding author e-mail: shariatiyaser@yahoo.com)
(100,200 mg/L) and achieved the best resulting with the treatment of 400 mg nitrogen and 200 mg potassium per liter. Jamil et al. (2008) investigated the relations between potassium and pollination in Aralia and found that potassium stimulate the speed of water attraction and inflates the seed of pollens which cause to improve the operation of pollination in plant.

In most countries, foliar spray of cutting flowers in greenhouse is a common and vital factor in order to improve the quality and the quantity of plants. Leaf fertilizer spray is always as effective way for substitution of nutrients deficiency in soil. El-Naggar (2009) investigated fertilization with leaf spray method on the growth of carnation and found that the content of chlorophyll a & b, carotenoids, carbohydrates and nutrients in leaf (N, P, K, Zn, Cu) increased significantly than other fertilization method. Reid (2003) reported that the use of 10 kg ammonium nitrate, 9.6 kg potassium sulphate and 2 kg magnesium sulphate in 100 liter water and its spraying on carnation twice in week at the 1:200 ratios caused to the highest postharvest of flower branches.

Tantawy et al. (2010) investigated foliar spray of phosphorus and potassium on squash; found that the greatest height of plant, number of leaves, dry and fresh weight of branches and total weight of fruits obtained at 3g/l treatment. Other reports pointed the positive aspects of foliar spray in Rose (Mazrou, 1991, Sharaf El-Naggar, 2003), Chrysanthemum (Eraki et al., 1993), Tuberose (Pal and Biswas, 2005) and Iris (Mahgoub et al., 2006).

The aim this study is to investigate different methods of fertilization by NPK fertilizers in different stages of tuberose growth and the effect of these methods on growth indices of plant.

**MATERIAL AND METHODS**

This study was conducted in Farvardin greenhouse of Mashhad Township, Khorasan province, Iran, in summer and autumn 2011. The experiment was performed by 21 treatments and 3 replications in a randomized completely design. Treatments were:

1. Without potassium + all N and P as base + using fertilizer “A” in 3 times.
   A is a fertilizer with 20-20-20% N-P-K
2. Without potassium + all N and P as base + using fertilizer “A” in 3 times + potassium foliar spray.
3. Without potassium + all N and P as base + using fertilizer “A” in 2 times + potassium foliar spray.
4. Without potassium + all N and P as base + using fertilizer “A” in 1 times + 2 times potassium foliar spray.
5. Without potassium + half N and P as base and half divided + 3 times potassium foliar spray + N foliar spray.
6. Without potassium + one-third N and P as base and two-third N as two equal divided + half phosphorus as base, half phosphorus as two equal divided + 3 times potassium foliar spray + N foliar spray.
7. One-fourth N as base, three-fourth N as three equal divided + all phosphorus as base + three times potassium foliar spray.
8. Treatments no. 8-14 with 50 kg potassium and other fertilization similar to treatments no. 1-7.
9. Treatments no. 15-21 with 100 kg potassium and other fertilization similar to treatments no. 1-7.

**Bulb Preparation**

First, tuberose bulbs were purchased from the flower and plant of Mashhad Company, then after cleaning, they classified based on size. The bulbs were 4 till 6 diameter in this experiment.

**Cultivation Bed**

The applied soil had a light texture in this experiment. 250 kg/ha of urea fertilizer and 300 kg/ha of triple superphosphate fertilizer were mixed with vase soil as the base fertilizer. The selective bulbs inside of vases (25cm diameter and 20 cm height) were cultivated with depth of 2cm. Then, vases were irrigated. Plant irrigation was performed by hand operated and sprinkler and this continued ongoing till 120 days after the plant growth and flowering. The greenhouse temperature set on 24°c. This causes, plant comes back to its usual growth.

**Postharvest**

After the first floret of below cluster was opened or half-opened, harvest of flowers and cutting of branches was initiated from plant and quantitative indexes containing height of branch, length of cluster, number of floret, weight of fresh bulb, number of scallions and the lifetime after harvest of flower branches were measured as qualitative index. After the needed measurements were performed, each branch placed in a container of water and temperature of 17-20°c in environment. The water of containers
changed in each three days. During this operation, end of branches were cut. The end of flower longevity was the appearance of brown color in 4-5 florets at the end of branch.

RESULTS

The result of analyzing data variance showed that the effect of different treatments on height of branch, length of cluster, number of florets, weight of fresh bulb, number of lateral bulb and postharvest of branches were significant at 1% level. Table 2 indicated the effect of different fertilization methods on the characteristics of plant growth.

**Height of Branch**

The result showed that the most height was related to treatments no. 6 in treatments without basic potassium. The lower height of branches was achieved at treatment 4. In groups of treatments with 50 and 100 kg potassium, it obtains the greatest height at the same treatment of fertilization method (treatments no. 13 and 20). In general, results showed that the most length of branch belonged to treatment 20.

### Table 1

**Variance Analysis of Data Relate to the Effect of Different Treatments on the Growth of Plant**

<table>
<thead>
<tr>
<th>Variation resources</th>
<th>Branch height (cm)</th>
<th>Cluster length (cm)</th>
<th>Floret number</th>
<th>Fresh weight of bulb (g)</th>
<th>Lateral bulb number</th>
<th>Postharvest (day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td><strong>1004.1</strong> **</td>
<td><strong>66.5</strong> **</td>
<td><strong>17.7</strong> **</td>
<td><strong>6845.9</strong> **</td>
<td><strong>28.1</strong> **</td>
<td><strong>55.6</strong> **</td>
</tr>
<tr>
<td>Error</td>
<td>0.136</td>
<td>0.016</td>
<td>0.433</td>
<td>0.885</td>
<td>0.421</td>
<td>0.361</td>
</tr>
</tbody>
</table>

**Significant at 1% level.**

### Table 2

**The Effect of Treatments on the Growth of Tuberose**

<table>
<thead>
<tr>
<th>Number of treatment</th>
<th>Treatment</th>
<th>Cluster length (cm)</th>
<th>Branch height (cm)</th>
<th>Fresh weight of bulb (g)</th>
<th>Floret number</th>
<th>Postharvest (day)</th>
<th>Lateral bulb number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Without potassium + all N and P as base + using fertilizer “A” in 3 times</td>
<td>19.3 i</td>
<td>71.5 p</td>
<td>155.5 h</td>
<td>16.3 k</td>
<td>8.3 j</td>
<td>5.3 e</td>
</tr>
<tr>
<td>2</td>
<td>Without potassium + all N and P as base + using fertilizer “A” in 3 times + potassium foliar spray</td>
<td>21.3 j</td>
<td>73.8 o</td>
<td>159.4 m</td>
<td>17.3 jk</td>
<td>8.6 ij</td>
<td>5.6 e</td>
</tr>
<tr>
<td>3</td>
<td>Without potassium + all N and P as base + using fertilizer “A” in 2 times + potassium foliar spray</td>
<td>18.0 l</td>
<td>70.1 q</td>
<td>160.2 m</td>
<td>18.3 hj</td>
<td>8.3 j</td>
<td>5.3 e</td>
</tr>
<tr>
<td>4</td>
<td>Without potassium + all N and P as base + using fertilizer “A” in 1 times + 2 times potassium foliar spray</td>
<td>16.8 m</td>
<td>68.6 r</td>
<td>153.2 o</td>
<td>18.0 ij</td>
<td>8.6 j</td>
<td>6.0 de</td>
</tr>
<tr>
<td>5</td>
<td>Without potassium + half N and P as base and half divided + 3 times potassium foliar spray + N foliar spray</td>
<td>23.1 i</td>
<td>75.0 n</td>
<td>163.3 l</td>
<td>18.6 ghij</td>
<td>10.0 hi</td>
<td>7.3 cd</td>
</tr>
<tr>
<td>6</td>
<td>Without potassium + one-third N and P as base and two-third N as two equal divided + half phosphorus as base, half phosphorus as two equal divided + 3 times potassium foliar spray + N foliar spray</td>
<td>23.6 i</td>
<td>77.2 m</td>
<td>166.1 k</td>
<td>19.3 fghi</td>
<td>10.3 h</td>
<td>7.6 c</td>
</tr>
<tr>
<td>7</td>
<td>Without potassium + One-fourth N as base, three-fourth N as three equal divided + all phosphorus as base + three times potassium foliar spray</td>
<td>21.6 j</td>
<td>73.5 o</td>
<td>168.3 j</td>
<td>18.6 ghij</td>
<td>10.6 h</td>
<td>8.3 c</td>
</tr>
<tr>
<td>8</td>
<td>50 kg potassium as base + all N and P as base + using fertilizer “A” in 3 times</td>
<td>26.5 g</td>
<td>87.6 j</td>
<td>228.7 i</td>
<td>19.6 fghij</td>
<td>15.6 g</td>
<td>11.6 b</td>
</tr>
<tr>
<td>9</td>
<td>50 kg potassium as base + all N and P as base + using fertilizer “A” in 3 times + potassium foliar spray</td>
<td>27.6 f</td>
<td>88.4 i</td>
<td>232.4 jh</td>
<td>20.0 efgij</td>
<td>15.3 g</td>
<td>12.3 b</td>
</tr>
<tr>
<td>10</td>
<td>50 kg potassium as base + all N and P as base + using fertilizer “A” in 2 times + potassium foliar spray</td>
<td>28.2 ef</td>
<td>89.2 i</td>
<td>235.8 ef</td>
<td>20.0 efgij</td>
<td>16.3 fg</td>
<td>11.6 b</td>
</tr>
<tr>
<td>11</td>
<td>50 kg potassium as base + all N and P as base + using fertilizer “A” in 1 times + 2 times potassium foliar spray</td>
<td>25.5 h</td>
<td>82.2 l</td>
<td>230.3 hi</td>
<td>19.3 fghi</td>
<td>15.3 g</td>
<td>11.6 b</td>
</tr>
<tr>
<td>12</td>
<td>50 kg potassium as base + half N and P as base and half divided + 3 times potassium foliar spray + N foliar spray</td>
<td>28.6 e</td>
<td>90.4 h</td>
<td>275.9 c</td>
<td>20.6 ef</td>
<td>16.6 efg</td>
<td>12.0 b</td>
</tr>
<tr>
<td>13</td>
<td>50 kg potassium as base + one-third N and P as base and two-third N as two equal divided + half phosphorus as base, half phosphorus as two equal divided + 3 times potassium foliar spray + N foliar spray</td>
<td>30.1 cd</td>
<td>92.6 g</td>
<td>278.0 bc</td>
<td>21.3 de</td>
<td>17.3 def</td>
<td>12.6 b</td>
</tr>
</tbody>
</table>

Contd...
Mohammadi Torkashvand, A., Shariati, Y. and Onsinejad, R.

<table>
<thead>
<tr>
<th>Number of Treatment</th>
<th>Cluster length (cm)</th>
<th>Branch height (cm)</th>
<th>Fresh weight of bulb (g)</th>
<th>Floret number</th>
<th>Postharvest (day)</th>
<th>Lateral bulb number</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>32.2 a</td>
<td>84.7 k</td>
<td>281.8 a</td>
<td>22.6 cd</td>
<td>20.3 ab</td>
<td>15.0 a</td>
</tr>
<tr>
<td>15</td>
<td>30.2 cd</td>
<td>113.6 e</td>
<td>232.6 g</td>
<td>20.3 ef</td>
<td>18.3 cd</td>
<td>12.3 b</td>
</tr>
<tr>
<td>16</td>
<td>30.4 cd</td>
<td>115.5 d</td>
<td>234.8 f</td>
<td>20.6 ef</td>
<td>18.6 cd</td>
<td>12.0 b</td>
</tr>
<tr>
<td>17</td>
<td>29.7 d</td>
<td>116.9 c</td>
<td>237.1 e</td>
<td>21.3 de</td>
<td>17.6 def</td>
<td>12.0 b</td>
</tr>
<tr>
<td>18</td>
<td>28.9 e</td>
<td>110.6 f</td>
<td>230.8 ghi</td>
<td>20.6 ef</td>
<td>17.3 de</td>
<td>11.6 b</td>
</tr>
<tr>
<td>19</td>
<td>31.4 b</td>
<td>117.8 b</td>
<td>272.0 d</td>
<td>26.6 a</td>
<td>18.0 cde</td>
<td>12.3 b</td>
</tr>
<tr>
<td>20</td>
<td>30.5 c</td>
<td>119.0 a</td>
<td>275.9 c</td>
<td>24.6 b</td>
<td>19.3 bc</td>
<td>12.3 b</td>
</tr>
<tr>
<td>21</td>
<td>30.4 cd</td>
<td>114.3 e</td>
<td>279.3 b</td>
<td>23.3 bc</td>
<td>21.3 a</td>
<td>14.6 a</td>
</tr>
</tbody>
</table>

*A is a fertilizer with 20-20-20% N-P-K

**Length of Cluster**

In treatments without potassium, the highest length of clusters belonged to treatments 5 and 6. The lowest length of clusters belonged to treatment 4 which was applied 20-20-20 fertilization during plant growth one time. The result showed that the most length of cluster belonged to treatment 14, which nitrogen was applied as four equal divided and a process of three times potassium foliar spray performed during plant growth.

**Number of Floret**

Result showed in treatments without potassium, there is no significant difference in treatments 2, 4, 3, 5 and 7. The most number of floret obtained in treatment 6. When it is used 50 kg K as base, the most number of floret was observed in treatment 14 which had no difference with treatment 13. The highest effect on the number of floret belonged to treatment 19 which has a lot of difference with other treatments. The lowest number of floret belonged to control.

**Weight of Fresh Bulb**

Investigation of treatments without base potassium (treatments 1-7) showed that the most weight in fresh bulb belonged to treatment 7 and the lowest weight belonged to treatment 4, which was lower than control treatment, too. There is same status for treatments with 100 kg base potassium. Treatments without the base potassium had a remarkable decrease in weight, compared to other treatment.

**Number of Lateral Scallions**

Result showed that the most number of lateral bulbs belonged to treatments 14 and 21 which had the most divided N fertilization. Base potassium had no effect on number of lateral bulbs. The lowest number of lateral bulbs was related to treatments with no potassium. Treatment 4 and control were same significantly.

**Lifetime after Harvest of Branches**

Result of comparing data showed that the most lifetime after harvest belonged to treatment 21 which had no difference with treatment 14 significantly and the lowest ones were treatment 3 and control.

**DISCUSSION**

Various methods of fertilization had different results on tuberose. Six indexes of tuberose with 20 treatments, various fertilization, and compared them with treatment control, was examined and lead to a meaningful result. Length of branches increased in treatments with base potassium, remarkably. Potassium is important in cell expansion and the growth of different parts of plants is due to the accumulation of K in cells and vacuoles (Marschner, 1986). A greenhouse experiment was reported that the growth rate reduced due to decrease in potassium and a significant reduction in plant height, branch length, linear growth and trunk diameter were observed in plants that is associated with reduced assimilation.
In order to open stoma in leaves, it is needed to accumulate potassium in cells of stoma protector, so loss of potassium can be caused to close the stomas, the perspiration would decrease.

Treatment 20 with phosphorus and divided nitrogen and also foliar spray potassium and nitrogen, had the most length of branch (199 cm) in compared to control (71.5 cm). It is clear that fertilization of fertilize A (20-20-20 NPK) was effective on length of branch. Those treatments which were applied by this fertilization one time (4, 11 and 18), the decrease in length of branch was reported. Increase of base potassium was effective on length of branch, too. Mohiti et al. (2011) reported that the soil intake plus potassium spraying caused to the highest grain yield, straw and 100 seeds weight than the control, which respectively, was equal to 17.35, 21.6, and 2.08 grams per pot.

Treatments with nitrogen and divided phosphorus in different parts of plant growth had more weight. In this index, various amounts of base potassium (50 and 100 kg) had no effect on number of bulbs and all were in same level which had base potassium. The lowest number of bulbs belonged to treatment 3 which was as same as control treatment. These items were adjusted with the result of Amarjit et al., (1995). They reported that the increase in use of nitrogen, phosphorus (P2O5) and potassium (K2O) till 300-400, 200-100 and 200-100 kg in hectare led to increase height of tuberose. El-Naggar (2009) investigated leaf foliar fertilization on carnations in various parts of plant growth. He found content of chlorophyll a and b, carotenoids, carbohydrates and nutrients of leaves (N, P, K, Zn, Cu) increased in compared to other methods of fertilization, significantly. So, length, thickness of peduncle, freshness and weight of dry peduncle, number of leaves and weight of dry leaves were increased.

The most postharvest of flower branches was reported in treatments 21 (21.3 day) and 14 (20.3 day). One of the most important factors in the postharvest of branches is nutrition conditions (Eason et al., 2001). Role of internal sugary materials was known to increase flower’s lifetime. Sugar causes to improve the balance of water in plant and effective to regulate stomas. So, they cause to decrease the evaporation of water. Sugars improve osmotic potential and increase the measure of needed carbohydrates for growth and breath. This led to open petals and postpone the senility (Saraka, 2004). In an experiment, increase amount of N fertilization in growth era (21.4 mmole/l) in compared to the lower one (10.7 mmole/l), decreased the lifetime after harvest of rose flowers.

This showed, nitrogen caused to increase the amount of Abscisic acid in leaves and petals, however, cytokinin which postpone the senility, decreased. It is reported, loss of calcium and potassium decreased the lifetime of cutting carnations. Totally, division of fertilizers during the growth of plant caused to increase availability of nutrients and promote the efficiency of fertilizers, consequently it increase the growth indices of tuberose.

**CONCLUSION**

Treatments with base potassium were superior in compared to treatments with no base potassium. Treatments with 100 kg of base potassium were superior in length of branch. The most postharvest and number of lateral bulb belonged to treatments 14 and 21. Foliar spray and divided fertilization were just effective in weight of fresh bulb.

According to these achievements, the following suggestions were given:

1. A study of various kinds of tuberose can be conducted.
2. Various amounts of fertilization in foliar spray and soil fertilization can be used in next studies.
3. More indexes like cluster flowering, weight of dry bulb and etc can be measured.
4. Various fertilizers can be applied in nutrition of flowers.

**REFERENCES**


Mohammadi Torkashvand, A., Shariati, Y. and Onsinejad, R.


