**Effect of different chemical fertilizers on chicory (Cichorium intybus L.)**

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**Abstract**

Chicory is a medicinal plant; its flowers and especially leaves and roots are used because of their pharmaceutical characteristics such as blood filtration, lenitive and antipyretic. This experiment was conducted in 2008 to study the effects of different chemical fertilizer in dry and semi dry climate of Torbat Jam, Iran, in the form of complete randomized design with three replications. Treatments of the experiment included control, urea (150 kg/ha), NPK as 12-6-40, NPK as 20-20-20, NPK as 28-14-14 and the complete fertilizer at two stages. Results showed that all traits were significantly affected at P≤0.01. The highest total fresh and dried weight of plant and dried weight of root were achieved when urea was applied (2050, 416 and 138 kg/ha, respectively); this treatment was most effective.

**Keywords:** chicory, mineral nutrients, chemical fertilizer.

**Introduction**

Chicory (Cichorium intybus L.) is a biennial or perennial member of Asteraceae family with pharmaceutical characteristics such as blood filtration; it is lenitive, antipyretic, appetizer, etc. Nowadays, chicory is getting more popular because of its culinary features, nutritional values and medicinal characteristics. This plant is one of the most important medicinal plants and is one of the most important insulin resources because of the high potential root yield and high concentration of sugar. Moreover, chicory is a forage crop with high digestibility and low fiber which is tolerant to drought stress (Barry, 1998; Omidbighi, 2001; Valizadeh et al., 2007; Lucchin et al., 2008; Nicoletto & Pimpini, 2009). Because of important role chicory plays in medicine and food technology, conducting agronomical researches on it is necessary to increase the yield. Proper nutrition management is a key factor in obtaining high yield and chemical fertilizers are one of the most reliable sources to provide plant nutritional requirements. Among the different nutrients, nitrogen (N), phosphorus (P) and potassium (K) are highly required by plants so are called macronutrients. NPK play so many vital roles in physiological and biochemical processes in plants. Sharifi & Abbaszadeh (2003) studied the effect of chemical N fertilizer on seed yield of fennel (Foeniculum vulgare Mill) and concluded that N application significantly increased seed yield. Among non-medicinal plants, Njuguna et al. (2010) represented that N application significantly enhanced the number of tillers/m², spikes/m² and grain yield. Mabapa et al. (2010) reported that applying 30 kg P/ha increased soybean biomass by 154%. The result of Khan et al. (2010) also proved the significant impact of P containing fertilizers on various growth factors of wheat.

Regarding the importance of chicory in medicinal and food industries, and the effect of proper nutrition on its yield, this research was conducted to investigate the effects of different fertilizers on yield and yield components of chicory.

**Materials and method**

This experiment was conducted in 2008 in Torbat Jam, Iran, an area with hot dry climate. It is 1000 m above the sea level and the minimum and maximum temperature is +43°C and -24.5°C, respectively. The soil of the test site was loam with pH of 8.2. This experiment was conducted in complete randomized design with three replications and one treatment in 6 levels including control, urea (150 kg/ha), NPK as 12-6-40 (1.7 kg/ha), 20-20-20 (1.7 kg/ha), 28-14-14 (1.4 kg/ha) and complete fertilizer (macro + micronutrients). Chicory was planted on June 12th, 2008, and sampling was conducted on October 31st. Plots were

**Table 1. Analysis of the variances of the measured traits.**

<table>
<thead>
<tr>
<th>SOV</th>
<th>df</th>
<th>Plant height Mean Squares (MS)</th>
<th>Root weight Mean Squares (MS)</th>
<th>Shoot weight Mean Squares (MS)</th>
<th>Total weight Mean Squares (MS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fresh</td>
<td>Dry</td>
<td>Fresh</td>
<td>Dry</td>
</tr>
<tr>
<td>Replication</td>
<td>2</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Treatment</td>
<td>5</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>Error</td>
<td>10</td>
<td>0.4464</td>
<td>630.55</td>
<td>21.61</td>
<td>11597.22</td>
</tr>
<tr>
<td>CV (%)</td>
<td>-</td>
<td>2.14</td>
<td>30</td>
<td>12.6</td>
<td>25.5</td>
</tr>
</tbody>
</table>

ns, non significant; *, significant at P≤0.05; **, significant at P≤0.01.
Fig. 1. The effect of fertilizer treatments on plant height.

Fig. 2. The effect of fertilizer treatments on root fresh weight.

Fig. 3. The effect of fertilizer treatments on root dry weight.

Fig. 4. The effect of fertilizer treatments on shoot fresh weight.

Fig. 5. The effect of fertilizer treatments on shoot dry weight.

Fig. 6. The effect of fertilizer treatments on total plant fresh weight.
Fertilizers were applied at two times: the first spray was at December 1st and the second spray was at mid December. During the growth period, weeds were manually controlled twice and sampling was conducted using 0.5 m x 0.5 m quadrates after removing the border effects. The measured traits were: dry and fresh weight of roots & shoots and the total dry and fresh weight of plant. Data were analyzed by SAS (2002) and means were compared according to Duncan's multiple range test.

**Result and discussion**

Results of analysis of the variances indicated that application of the chemical fertilizers significantly affected plant height and total fresh weight at P≤0.01, and rest of the measured traits at P≤0.05 (Table 1). Mean comparison also showed that the application of urea gave the highest plant height. These results showed that the best treatment to obtain the highest economical yield (fresh and dried) was urea fertilizer. Root and shoot weight (fresh and dry) were also the highest in urea treatment. Application of urea increased plant height by 39.84%, fresh root weight by 39.83% and fresh shoot weight by 39.84%, compared with the control (Fig. 1-7).

Results of this experiment indicated that application of chemical fertilizers, especially nitrogen, significantly affected the measured traits of chicory. Nitrogen, phosphorus and potassium are the macronutrients plants need at high rates. These mineral nutrients are responsible for so many critical functions of plants. Nitrogen is an important factor for chlorophyll, cell wall, amino acids, nucleic acids and proteins (Fageria, 2009; Wiedenhoeft, 2006). Njguna et al. (2010) represented that N application significantly increased the number of tillers/m², spikes/m² and grain yield in wheat. Abbasszadeh et al. (2006) found that N fertilizer significantly affected balm seed and oil yield; the highest seed and oil yield was achieved when 100 and 50 kg N/ha was applied, respectively. Sharifi & Abbaszadeh (2003) studied the effect of chemical N fertilizer on seed yield of fennel (Foeniculum vulgare Mill) and concluded that N application significantly increased seed yield. Phosphorus is another important macronutrient studied in this experiment. It has roles in energy transfer and is required for formation of cell membranes, nucleic acids, etc (Fageria, 2009; Wiedenhoeft, 2006). Mabapa et al. (2010) concluded that application of 30 kg P/ha increased soybean biomass by 154%. In another experiment it was reported that increasing P application rate enhanced grain yield and protein content of two cowpea cultivars (Magani & Kuchinda, 2009). Khan et al. (2010) also proved that the application of P containing fertilizers significantly affected growth factors of wheat.

**References**