Effect of nutrients and growth regulator on growth and leaf yield of off-season coriander, *Coriandrum sativum* L.

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**ABSTRACT**

Coriander (*Coriandrum sativum* L.) belongs to the family Apiaceae (Umbelliferae) which is mainly cultivated from its seed throughout the year (Mhemdi et al., 2011). It is one of the earliest known spices by mankind grown for its leaves, seeds, essential oil and oleoresin. The green leaves are consumed as fresh herbs, in salads and as garnishes due to its attractive green colour and aroma. Growing of leafy coriander in off-season (summer) fetch premium price in the market. The investigation was undertaken to study the effect of nutrients and growth regulator on growth and leaf yield of off season coriander in Randomized Block Design with three replications during the year 2012-13 and 2014-15. Among the various treatments, application of 45:40:20 kg of NPK ha⁻¹ (T₃) recorded the highest plant height (34.09 cm). The highest leaf yield was recorded by the treatment T₆ (30:40:20 NPK+ GA, 15 ppm at 20 DAS) (4824 kg ha⁻¹) with highest B: C ratio of 2.37 followed by the treatment T₈ (45:40:20 NPK+ GA, 10 ppm at 20 DAS) (4448 kg ha⁻¹). Among the different treatments, the treatment T₆ (30:40:20 NPK+ GA, 15 ppm at 20 DAS) recorded the highest essential oil content (0.023%) and oleoresin content (7.67%) followed by T₈ (45:40:20 NPK+ GA, 10 ppm at 20 DAS) (0.021% and 7.45% respectively) and T₁ (control) noticed the lowest content of essential oil (0.013%) and 5.01% respectively.

**Keywords:** Coriander, gibberellic acid, leaf yield nutrients and off season vegetables

Coriander is a dual purpose crop grown for green leaf as well as for seed. It is one of the earliest known spices by mankind grown for its leaves, seeds, essential oil and oleoresin. The green leaves are consumed as fresh herbs, in salads and as garnishes due to its attractive green colour and aroma. Growing of leafy coriander in off-season (summer) fetch premium price in the market especially during summer months. The shade net houses during off season reduce the temperature up to 5°C and increase the relative humidity, thereby providing optimum environmental conditions for the growth of coriander.

Application of nutrients becomes essential for any crop production in order to get a good yield. Among the primary nutrients, nitrogen has a considerable effect, not only on quality of produce but on quantity of produce also. Nitrogen is one of the major elements for growth and development of plant. It is involved in photosynthesis, respiration and protein synthesis. It impart the dark green colour of the leaves, promotes vigorous vegetative growth and more efficient use of available inputs finally leads to higher productivity. Plant growth regulators leads to better growth and yield without substantial increase in the cost of production. Gibberellic acid is found to induce stem and internode elongation, flowering and fruit setting and growth.

Hence, there is a need to improve the green leaf yield of coriander in the off-season. The nutrient recommendation adopted for the seed coriander is followed for the leaf production. The duration of the leafy coriander production is 45 - 50 days when compared to seed crop which accounts for 120 days. Therefore, with this background this trial was formulated with an objective to standardize the nutrient requirement of off – season production of coriander leaf.

**MATERIALS AND METHODS**

The field experiments were conducted at College Orchard, Horticultural College and Research Institute,
Tamil Nadu Agricultural University, Coimbatore for three years (2012-13, 2013-14 and 2014-15). The field is located at 11° N latitude, 77° E longitude with an altitude of 411 m above mean sea level. The soil of the experimental area belongs to black clay loam in texture and pH of the soil is 7.00. The experiment was laid out in a Randomized Block Design with nine treatments and replicated thrice. The treatment details are as follows:

- **T1**: Control – No fertilizer
- **T2**: 30:40:20 NPK kg ha⁻¹ (Lal et al., 2010)
- **T3**: 45:40:20 NPK kg ha⁻¹ (Lal et al., 2010)
- **T4**: 30:40:20 NPK kg ha⁻¹ + spraying with GA₃ 5 ppm at 20 DAS.
- **T5**: 30:40:20 NPK kg ha⁻¹ + spraying with GA₃ 10 ppm at 20 DAS.
- **T6**: 30:40:20 NPK kg ha⁻¹ + spraying with GA₃ 15 ppm at 20 DAS.
- **T7**: 45:40:20 NPK kg ha⁻¹ + spraying with GA₃ 5 ppm at 20 DAS.
- **T8**: 45:40:20 NPK kg ha⁻¹ + spraying with GA₃ 10 ppm at 20 DAS.
- **T9**: 45:40:20 NPK kg ha⁻¹ + spraying with GA₃ 15 ppm at 20 DAS.

(*P as basal and N & K in two split applications – i.e. basal + top dressing @ 30 DAS)

Coriander variety CO (CR) 4 was raised in flat beds of 2.5 x 4 m during summer season of three consecutive seasons (2012-13 to 2014-15) and water soaked seeds were sown 25 cm apart between the rows in 50% shade net house. Recommended package of practices was followed uniformly for all the plots. Light irrigation was given on the third day after sowing and subsequent irrigations were scheduled at 5 to 7 days intervals depending on the soil and climatic conditions. Weeding was done on 20th and 30th days after sowing. Physiologically matured leaves were harvested from 45th day after sowing. Data on plant height, number of leaves, leaf yield and essential oil content was recorded during the crop growth period. Pooled analysis was done as per the method suggested by Jawahar (2006).

**RESULTS AND DISCUSSION**

The pooled analysis of the data (Table 1) revealed that significant difference was observed between the treatments. The plant height varied significantly from 26.42 to 34.09 cm. Application of 45:40:20 NPK (T3) treatments. The plant height varied significantly from 26.42 to 34.09 cm. Application of 45:40:20 NPK (T3) resulted in higher plant height (34.09 cm) followed by the treatments T6 (30:40:20 NPK+ GA₃ 15 ppm at 20 DAS) and T9 (30:40:20 NPK+ GA₃ 15 ppm at 20 DAS) at 45 DAS. With regard to the number of leaves it was on par in all the treatments. The highest number of leaves was recorded by the treatment T6 (30:40:20 NPK+ GA₃ 15 ppm at 20 DAS). Application of 30:40:20 NPK along with foliar spraying of GA₃ 15 ppm at 20 DAS (T₆) exhibited greater leaf weight (9.06 g) and stem weight (4.28 g). The highest plant weight was registered at T₆ (30:40:20 NPK+ GA₃ 15 ppm at 20 DAS) with 14.62 g, whereas, the lowest plant weight was observed in control (T₁) being, 9.71 g. The projected leaf yield per hectare was significantly influenced by different treatments and the data pertaining are furnished in Table 2. The highest projected leaf yield per hectare of 4824.07 kg ha⁻¹ was obtained with the application of 30:40:20 NPK+ GA₃ 15 ppm at 20 DAS under shade and the lowest projected leaf yield per hectare (3525.56 kg ha⁻¹) was registered in control (T₁). It is obvious from the findings that leaf yield increased with inorganic fertilizer along with GA₃. Balanced supply of nutrients plays a vital role in various metabolic processes, which resulted in increased plant growth and development thereby improving yield. These processes might be favourably improved with readily available nitrogen through inorganic chemical fertilizers and finally resulted in higher yield and harvest index. Similar result was observed by Bhati et al. (1988) and Patel et al. (2000) in fennel and Diovisalis et al. (2016) in sunflower.

The importance of endogenous growth regulators in affecting many growth and morphogenetic processes has been well documented (Jacobs, 1968). Growth of stems and other organs is promoted by GA₃ and results from enhanced cell division, increased carbohydrate hydrolysis, and increased cell wall plasticity (Sachs, 1961; Salisbury & Ross, 1978 and Boyle et al., 1994). GA₃ increased petiole length, leaf area and delayed petal abscission and color fading (senescence) by the hydrolysis of starch and sucrose into fructose and glucose (Khan and Chaudhry, 2006; Emongor, 2004). Khan et al. (1998) reported that foliar application of gibberellic acid at the pre-flowering stage of mustard plants causes 35.5% increase in leaf area, followed by increased trapping of sunlight, which apparently enhances dry matter. The treatment T₆ (30:40:20 NPK+ GA₃ 15 ppm...
**Table 1: Effect of nutrient and growth regulator on growth of off season coriander (Pooled)**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>No. of shoots plant(^{-1})</th>
<th>No. of leaves plant(^{-1})</th>
<th>Leaf weight (g)</th>
<th>Stem weight (g)</th>
<th>Plant weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T(_{1}) Control</td>
<td>26.42</td>
<td>3.23</td>
<td>23.32</td>
<td>6.84</td>
<td>3.81</td>
<td>9.71</td>
</tr>
<tr>
<td>T(_{2}) 30:40:20 NPK</td>
<td>27.92</td>
<td>4.04</td>
<td>23.84</td>
<td>7.02</td>
<td>4.04</td>
<td>11.02</td>
</tr>
<tr>
<td>T(_{3}) 45:40:20 NPK</td>
<td>34.09</td>
<td>4.19</td>
<td>22.57</td>
<td>7.29</td>
<td>4.19</td>
<td>12.23</td>
</tr>
<tr>
<td>T(_{4}) 30:40:20 NPK+GA 5 ppm at 20 DAS</td>
<td>31.46</td>
<td>3.64</td>
<td>24.06</td>
<td>7.43</td>
<td>4.24</td>
<td>12.05</td>
</tr>
<tr>
<td>T(_{5}) 30:40:20 NPK+GA 10 ppm at 20 DAS</td>
<td>30.45</td>
<td>4.55</td>
<td>23.69</td>
<td>6.74</td>
<td>3.64</td>
<td>11.01</td>
</tr>
<tr>
<td>T(_{6}) 30:40:20 NPK+GA 15 ppm at 20 DAS</td>
<td>32.39</td>
<td>5.34</td>
<td>26.05</td>
<td>9.06</td>
<td>4.28</td>
<td>14.62</td>
</tr>
<tr>
<td>T(_{7}) 45:40:20 NPK+GA 5 ppm at 20 DAS</td>
<td>30.43</td>
<td>4.16</td>
<td>23.51</td>
<td>7.47</td>
<td>3.89</td>
<td>12.62</td>
</tr>
<tr>
<td>T(_{8}) 45:40:20 NPK+GA 10 ppm at 20 DAS</td>
<td>28.75</td>
<td>4.24</td>
<td>24.68</td>
<td>8.17</td>
<td>4.15</td>
<td>13.15</td>
</tr>
<tr>
<td>T(_{9}) 45:40:20 NPK+GA 15 ppm at 20 DAS</td>
<td>28.92</td>
<td>3.81</td>
<td>22.94</td>
<td>6.71</td>
<td>3.81</td>
<td>11.21</td>
</tr>
</tbody>
</table>

SEm (±) 1.43 0.04 0.18 0.06 0.03 0.10

LSD (0.05) 3.03 0.07 0.36 0.12 0.06 0.21

**Table 2: Effect of nutrient and growth regulator on leaf yield and quality of off season coriander (Pooled)**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Leaf yield plot(^{-1}) (10 m(^2))</th>
<th>Projected leaf yield (kg ha(^{-1}))</th>
<th>Essential oil content (%)</th>
<th>Oleoresin content (%)</th>
<th>B:C</th>
</tr>
</thead>
<tbody>
<tr>
<td>T(_{1}) Control</td>
<td>3.53</td>
<td>3525.56</td>
<td>0.012</td>
<td>5.01</td>
<td>1.59</td>
</tr>
<tr>
<td>T(_{2}) 30:40:20 NPK</td>
<td>4.11</td>
<td>4112.78</td>
<td>0.015</td>
<td>5.72</td>
<td>1.96</td>
</tr>
<tr>
<td>T(_{3}) 45:40:20 NPK</td>
<td>4.38</td>
<td>4378.33</td>
<td>0.017</td>
<td>6.23</td>
<td>2.08</td>
</tr>
<tr>
<td>T(_{4}) 30:40:20 NPK+GA 5 ppm at 20 DAS</td>
<td>4.40</td>
<td>4398.70</td>
<td>0.018</td>
<td>6.56</td>
<td>2.10</td>
</tr>
<tr>
<td>T(_{5}) 30:40:20 NPK+GA 10 ppm at 20 DAS</td>
<td>3.82</td>
<td>3820.00</td>
<td>0.013</td>
<td>5.26</td>
<td>1.85</td>
</tr>
<tr>
<td>T(_{6}) 30:40:20 NPK+GA 15 ppm at 20 DAS</td>
<td>4.82</td>
<td>4824.07</td>
<td>0.023</td>
<td>7.67</td>
<td>2.37</td>
</tr>
<tr>
<td>T(_{7}) 45:40:20 NPK+GA 5 ppm at 20 DAS</td>
<td>4.16</td>
<td>4160.56</td>
<td>0.016</td>
<td>5.86</td>
<td>2.05</td>
</tr>
<tr>
<td>T(_{8}) 45:40:20 NPK+GA 10 ppm at 20 DAS</td>
<td>4.45</td>
<td>4448.33</td>
<td>0.021</td>
<td>7.45</td>
<td>2.24</td>
</tr>
<tr>
<td>T(_{9}) 45:40:20 NPK+GA 15 ppm at 20 DAS</td>
<td>3.90</td>
<td>3900.74</td>
<td>0.014</td>
<td>5.48</td>
<td>1.92</td>
</tr>
</tbody>
</table>

SEm (±) 0.24 236.17 0.002 0.14 -

LSD (0.05) 0.49 498.30 0.003 0.29 -

at 20 DAS) expressed a greater oil content (0.023 per cent) which was on par with the treatment T\(_{8}\) (45:40:20 NPK+GA 10 ppm at 20 DAS) (0.021 per cent) as against 0.012 per cent in the treatment T\(_{1}\) (control). The oleoresin content in leaf was highest in 30:40:20 NPK + GA\(_{3}\) 15 ppm at 20 DAS (7.67 per cent). The above results are in conformity with the findings of Meena et al. (2006), Panda et al. (2007), Singh et al., (2012) and Mary Haokip et al. (2016) in coriander. The economics worked out for different treatments (Table 2) showed that T\(_{6}\) (30:40:20 NPK+ GA\(_{3}\) 15 ppm at 20 DAS) recorded the highest benefit cost ratio of 2.37.

The study showed that different levels of nutrients and different concentrations of GA\(_{3}\) significantly influenced growth parameters, leaf yield and quality parameters. However, application of 30:40:20 NPK along with foliar spraying of GA\(_{3}\) 15 ppm at 20 DAS was found to be superior followed by the application of 45:40:20 NPK along with foliar spraying of GA\(_{3}\) 10 ppm at 20 DAS with benefit cost ratio of 2.24.

**REFERENCES**


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