Effect of *Azotobacter* on growth and yield of onion 
(*Allium cepa* L.)

Devendra Kumar Kurrey, Mahendra Kumar Lahre and Gaurav S Pagire

**Abstract**

*Azotobacter* is been studied for nitrogen fixation bacteria is soil and effect positively on growth, yield, biochemical properties along with soil quality. Thus present study was carried out to evaluate the response of bio-fertilizer (*Azotobacter*) in case on onion. Doses (T 0: NPK, T 1:33g/m², T 2:66g/m², T 3:99g/m², T 4:132g/m², T 5:166g/m², T 6:199 g/m²) were decided on the basis of nitrogen requirement by the onion crop. The results shows significant increase in germination percent T 5(85%), bulb weight T5(120.7g), maximum diameter of bulb T 5(6.2cm), bulb dry weight T 5(23.9g), plant dry weight T 5(28.2g), harvest index T 5(69.35%) and plant height T 6(57.3cm), No. of leaves T 6(11.4), chlorophyll- a T6(0.86mg/g FW), chlorophyll b(0.47 mg/g FW) and carotenoid(0.75 mg/g FW), leaves protein T 6(0.45 mg/g), bulb protein T6(1.2 mg/g), bulb sulphur T6(5.64 mg/g).

**Keywords:** *Azotobacter*, biofertilizer, nitrogen fixation, growth, onion, germination, yield, quality

**Introduction**

Onion (*Allium cepa* L.) is important bulb crop of India. As a vegetable, it is a low in fat and calories. It also contributes significantly to the human diet and has a therapeutic property. India, the world’s second largest producer. The indiscriminate use of chemicals resulted in degradation of soil health, erosion, and loss of organic matter, nitrate pollution and also health hazard for human beings. (Yang *et al.*, 2004) [21], Onion is a source of ascorbic acid and dietary fiber too. It also possesses a high content of flavanoids (mainly quercetin and its conjugates) and sulphur compounds (i.e. thiosulphinates), both of which have a high level of antioxidant activity (Griffiths *et al.*, 2002) [6]. So, application of biofertilizers results in increased mineral and water uptake, root development, vegetative growth and nitrogen fixation also stimulate production of growth promoting substance like vitamin-B complex, Indole acetic acid (IAA) and Gibberellic acids etc. They liberate growth promoting substances and vitamins and help to maintain soil fertility. (Pratap 2012) [15] Sevral studies shows that presence of *Azotobacter* spp. in soils has beneficial effects on plants, i.e, soil physico-chemical and microbiological properties. So, keeping in view the above facts the present experiment was undertaken to find out the most effective dose of *Azotobacter* for growth and yield of onion (*Allium cepa* L.).

**Materials and Methods**

The study was conducted at Department of Biological Sciences, SHUATS, Allahabad (U.P.), to evaluate the response of bio-fertilizer (*Azotobacter*) in case on onion plantation. Dose decided on the basis of nitrogen percent by *Azotobacter* in provided on powder form requirement by recommended doses on the onion crop. The experiment consists of seven treatment and three replications with RBD design viz. T₀ (control NPK 100% RDF), T₁:0.33g/m², T₂:0.66g/m², T₃:0.99g/m², T₄:1.32g/m², T₅:1.66g/m², T₆:1.99g/m²). Treatment of *Azotobacter* are applied before transplanting and 30: 60 days after transplanting.

**Results and Discussion**

The results of the experiments are presented separately under the following results, The maximum seed germination percentage was observed in T 5(85%) in followed by T 4(83%) whereas the minimum was observed in T 1(71%). Similarly 90% germination was observed under 50% *Azotobacter* (Mahato *et al.*, 2009) [12] cumin 80% (Rezai *et al.*, 2005) [16]. However, in studies on effect of *Azotobacter* inoculation on seed germination of onion found that combined inoculation with *Azotobacter chroococcum* and *Azospirillum brasilense* found increased germination (96.5%) over un inoculated control (85.5%) (Musmade and Konde 1987) [13]. The maximum plant height was observed in T₆(57.3cm) followed by T₅(55.8 cm). Similarly there was increase in plant height 59.67cm (Bhandari *et al.*, 2012) [4] in case of garlic and onion.
plant height 61.39 cm (Singh et al., 2007) [17]. It suggests that plant height was significantly influenced due to nitrogen amendment with Azotobacter inoculation (Balemi et al., 2007) [1].

The maximum number of leaves was noted in the T6(11.4), followed by T5(11.1), and the minimum number of leaves was observed in T1(10.5). Similarly case of onion for number of leaves per plant was (8.67) in Azotobacter inoculation (Balemi et al., 2007) [1]. The number of leaves per plant was (9.1) recorded on organic and inorganic combination on onion (Pratap et al., 2012) [15] while number increases for onion to 12.08 (Singh et al. 2007) [17].

The average weight of bulb (g/bulb) was observed in T6(120.7 g) followed by T5(112.3 g). Similarly for observed fresh weight of bulb (175.67 g) (Yadav et al., 2015) [20]. Maximum weight of bulb (66.98 g) on onion in organic substances (Banjare et al., 2015) [2]. Maximum bulb weight (67.45g). (Ghanti and Sharangi 2009) [3].

The Maximum bulb diameter (cm) was observed in T5(6.2cm) followed by T6 and T4(5.8cm) Similarly result was recorded for bulb equatorial diameter (5.23 cm) on onion in organic substances (Banjare et al., 2015) [2], maximum diameter of bulb (4.60 cm) in organic and in organic combination. (Yadav et al., 2015) [20], average diameter of bulb (5.34 cm) (Bhandari et al., 2012) [4].

The maximum bulb dry weight was observed in treatment T5(23.9g) followed by T6(22.2g). However, maximum dry weight of plant (7.65g) of the Azotobacter treatment on garlic (Pratap et al., 2012) [15]. In a study on dipping the root zone of onion during the transplantation in azotobacter slurry showed 8 to 10% increase in bulb dry weight (Balemi et al., 2007) [1].

There is also a significant increase in dry matter accumulation in onion bulb when applied in form of fertilizer (Azotobacter chroococcum) along with organic fertilizers in different combinations (Jaytilake et al., 2003).

The maximum harvest index was noted in treatment T5 (66.71%), followed by T6(66.42%) coincides with the harvest index 66.9% for combined treatment with organic manure (Jaytilake et al., 2006), further in case of sesame plant HI was increased by 66% in comparison to control (Kushwaha 2010) [11]. However in case of Wheat there was no significant difference between Harvest index (35.7 -36.8%) when compare with NPK dose (Soleimanzadeh and Gooshchi, 2013) [19].

Chlorophyll “a and b” and carotene was observed maximum in T6(0.863mg/g, 0.75mg/gram and 0.47.4mg/gm) which was significantly differ from rest of the treatments in a study on cabbage against BF+f states 2% and 3% increment over control for chlorophyll a” and b” (Jain and Boswal, 2015) [8]. However result estimated after 15 and 30 days of sowing (0.020 and 0.022 mg/g) amount of total chlorophyll content (Belhekar and Bhosale, 2010) [3] for fresh leaves of onion was less in comparison of mature leaf for Azotobacter treated soil but was higher to control states the positive effect of biofertilizer on chlorophyll content.

The maximum leaf & bulb protein content was observed in T6(0.45mg/g and 1.2 mg/g) which was approximately 40 % and 30% more in comparison to control. In a study on onion protein was increased by 56% in Azotobacter combination comparison to control (Parab et al., 2013) [14]. This confirms increase in protein content. may be due to biofertilizer as over recommended doses of 50% NPK in combination with organic and biofertilizer increases protein content (Singh and Pandey, 2010) [18].

The maximum sulfur content was observed in treatment T6(5.64ppm) which was significantly high from control. Azotobacter treatment improved sulphur content in onion by 0.682% when compare to organic 0.655% (Indira and Singh, 2014) [7] and even if use in combination with inorganic an organic (Bhandari et al., 2012) [4].

**Conclusion**

Present study may conclude that Azotobacter influences positively on various growth, yield and biochemical parameter in comparison to control. However among different treatments T5 and T6 show optimum results.
### Table 1: Soil characteristics of the experimental site

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Sand (0-30cm depth)</th>
<th>Silt</th>
<th>Clay</th>
<th>Textural class</th>
<th>Soil pH</th>
<th>EC (dsm⁻¹ at 25º C)</th>
<th>Organic carbon</th>
<th>Available nitrogen (kg ha⁻¹)</th>
<th>Available phosphorus (kg ha⁻¹)</th>
<th>Available potassium (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>48.15%</td>
<td>20.30%</td>
<td>30.50%</td>
<td>Sandy Loam</td>
<td>7.5</td>
<td>0.703 dsm⁻¹</td>
<td>0.38%</td>
<td>198.2</td>
<td>18</td>
<td>332</td>
</tr>
</tbody>
</table>

### Table 2: Effect of different doses of Azotobacter on growth and yield parameter of onion

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Treatment amount g/m²</th>
<th>Germination % 12 DAS</th>
<th>Plant Height (Cm)</th>
<th>No. of Leaves Per plant</th>
<th>Fresh weight of bulb(g)</th>
<th>Diameter of bulb (cm)</th>
<th>Dry weight of bulb (g/bulb)</th>
<th>Dry weight of plant (g/plant)</th>
<th>Harvest index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>Control</td>
<td>0.74</td>
<td>0.436</td>
<td>0.45</td>
<td>0.26</td>
<td>0.85</td>
<td>4.32</td>
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</tr>
<tr>
<td>T₁</td>
<td>0.33</td>
<td>0.737</td>
<td>0.437</td>
<td>0.341</td>
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<td>3.88</td>
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<tr>
<td>T₂</td>
<td>0.66</td>
<td>0.746</td>
<td>0.451</td>
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<td>0.97</td>
<td>4.06</td>
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</tr>
<tr>
<td>T₃</td>
<td>0.99</td>
<td>0.793</td>
<td>0.459</td>
<td>0.522</td>
<td>0.34</td>
<td>1.01</td>
<td>4.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₄</td>
<td>1.32</td>
<td>0.753</td>
<td>0.466</td>
<td>0.579</td>
<td>0.35</td>
<td>1.04</td>
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<td></td>
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<tr>
<td>T₅</td>
<td>1.66</td>
<td>0.863</td>
<td>0.459</td>
<td>0.655</td>
<td>0.39</td>
<td>1.12</td>
<td>5.09</td>
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<tr>
<td>T₆</td>
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<td>0.474</td>
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<td>1.2</td>
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### Table 3: Effect of different doses of Azotobacter on biochemical parameter of onion

<table>
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<tr>
<th>Treatment</th>
<th>Treatment amount g/m²</th>
<th>Chlorophyll a (mg/g FW)</th>
<th>Chl. b (mg/g FW)</th>
<th>Carotenoid (mg/g FW)</th>
<th>Leaves Protein (mg/g)</th>
<th>Bulb Protein (mg/g)</th>
<th>Bulb Sulphur (ppm)</th>
<th>F test</th>
<th>SE d+</th>
<th>C.D At 5%</th>
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<tr>
<td>T₀</td>
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<td>0.744</td>
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