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Effect of integrated nutrient management on growth
and yield of garlic (Allium sativum L.) CV.AAS-2

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Abstract
The experiment was laid out in a Randomized Block Design with eleven treatments and replicated three
times. The result indicated that Plants supplied with 75% RD N + RD PK + RD FYM + Azatobacter
beijerinckii + PSB + Trichoderma viride registered maximum plant height (52.83 cm), maximum
number of leaves (7.53), maximum collar diameter (0.36) and Highest bulb yield per plot (3.90 kg) and
per hectare (10.39 t/ha) was recorded with the application of 75% RD N + RD PK + RD FYM +
Azatobacter beijerinckii + PSB + Trichoderma viride. Higher benefit cost ratio (3.4:1) was recorded with
plants received Vermicompost (2.5 t /ha) + Azospirillum brasilense (325g/ha) + PSB (325 g/ha) +
Trichoderma viride (5 kg/ha).

Keywords: Garlic, Allium sativum, Organic, in organic, Bio- fertilizers, growth, Yield, cloves,
Azatobacter, Azospirillum, Trichoderma.

Introduction
Garlic (Allium sativum L.) is one of the most important and widely consumed bulbous spice
crops belong to the family Alliaceae. West Asia and Mediterranean region is considered to be
the centre of origin of garlic. The bulb can be consumed as spice or condiment in the form of
garlic paste, pickle, chutney, curried vegetables, curry powders and meat preparation, etc.
Garlic has higher nutritive value than other Alliums. It is rich in protein, phosphorus, calcium,
magnesium, carbohydrates and vitamin C. Garlic bulb contains colourless and odourless water
soluble amino acid called allin. On crushing the garlic, the enzyme allinase breaks down allin
to produce allicin in which the principle ingredient is the odoriferous diallyl disulphide. Garlic
contains 0.1 per cent volatile oil. The chief constituents of the oil are diallyl disulphide (60%),
diallyl trisulphide (20%) and allyl propyl disulphide (6%). Garlic possesses insecticidal,
nematicidal, bactericidal and fungicidal properties. Garlic extracts and oil have potential uses
as an effective insecticide and fungicide in the present scenario of organic farming.
The area under garlic was 13.71 lakh hectares in the world with an annual production of
222.82 lakh MT during 2011. China, India, Korea, Spain, Egypt and USA are the major garlic
producing countries. China ranks first with an area of 7.79 lakh hectares and production of
179.68 lakh tonnes. India ranks second with an area of 2.47 lakh hectares and with the production of
12.49 lakh tonnes. (Anon., 2013) [4]. In India, Madhya Pradesh is the leading state in area (60,000 ha) and Gujarat is the leading state in production (2,77,000MT), whereas
maximum productivity is in Jammu and Kashmir (13.91 MT ha−1). In Karnataka, garlic is
cultivated in an area of 42,000 hectares with a production of 30,200 MT and a productivity of
7.19 tonnes per hectare. The average productivity in India is low (5.22 t ha−1) compared to
other countries.

Material and Method
The study was laid out in RBD with eleven treatment combinations having three replications
having T1 : RD NPK (125:62.5:62.5 kg NPK/ha) + RD FYM (25 t/ha), T2 : RD NPK
(125:62.5:62.5 kg NPK/ha)+ Vermicompost (2.5 t/ha), T3 : 100 % RD NPK + RD FYM (25 t/
ha)+PSB (325 g/ha) + Trichoderma viride(5 kg/ha) + Azospirillum(325 g/ha), T4:75% RDN

~ 387 ~
+ RD PK + Vermicompost (2.5 t/ha) + Azospirillum brasilense (325 g/ha) + PSB (325 g/ha) + Trichoderma viride (5 kg/ha), T₅: 75% RD N + RD PK + RD FYM (25 t/ha) + Azatobacter beijerinckii (325 g/ha) + PSB (325 g/ha) + Trichoderma viride (5 kg/ha), T₆: 50% RD N + RD PK + RD FYM (25 t/ha) + Azospirillum brasilense (325 g/ha) + PSB (325 g/ha) + Trichoderma viride (5 kg/ha), T₇: 50% RD N + RD PK + RD FYM (25 t/ha) + Azatobacter beijerinckii (325 g/ha) + PSB (325 g/ha) + Trichoderma viride (5 kg/ha), T₈: 100% RDF + RD FYM (25 t/ha) + Azotobacter beijerinckii (325 g/ha) + PSB (325 g/ha) + Trichoderma viride (5 kg/ha), T₉: RD FYM (25 t/ha) + Azospirillum brasilense (325 g/ha) + PSB (325 g/ha) + Trichoderma viride (5 kg/ha), T₁₀: Vermicompost (2.5 t/ha) + Azospirillum brasilense (325 g/ha) + PSB (325 g/ha) + Trichoderma viride (5 kg/ha).

**Method of imposing the treatments**

Full dose of FYM applied one week before sowing and mixed well with soil. Nitrogen in the form of urea, phosphorous in the form of single super phosphate and potash in the form of muriate of potash were applied. Fifty per cent of nitrogen and full dose of phosphorous and potassium were applied to plot at 7-10 cm depth in the lines just before sowing of cloves and remaining fifty per cent of nitrogen was top dressed at 45 days after sowing. The bulbs from net plot area (4.5 m²) were harvested and cured completely and were weighed separately. The net plot yield was used to compute the yield per hectare.

**Result and Discussion**

The plant height was significantly influenced by integrated source of nutrients at all the stages of crop growth. The maximum plant height was found with plants provided 75% RD N + RD PK + RD FYM + Azatobacter beijerinckii + PSB + Trichoderma viride (T₅) registered maximum plant height (52.83 cm) at 90 DAS, which was on par with T₆ (50.00 cm). Increase in plant height was registered in the treatment (T₅) might be due to enhanced availability of nutrients and production of some growth promoting substances that might have caused cell elongation and multiplication. Further, nitrogen might have increased the chlorophyll content of leaves and resulted in increased synthesis of carbohydrates, which inturn has influenced cell elongation and multiplication and hence accelerated the vegetative growth Yadav (2003) [19]. The least plant height (42.67 cm) was recorded in plants received RD NPK + RD FYM (T₁) which could be attributed to in adequate and imbalance nutrients to the plants. The results of this study are in agreement with the findings of Wange (1995) [16] in garlic, Patil (1995) [13] and Sharma et al. (2003) [15] in onion. Maximum number of leaves produced per plant (7.53) was found with plants received 75% RD N + RD PK + RD FYM + Azatobacter beijerinckii + PSB + Trichoderma viride (T₅) which was on par with T₆ (7.30) followed by T₇ (7.09) T₈ (6.96) and T₁₀ (6.96) compare to other treatments. This increase in number of leaves per plant in T₅ treatment might be attributed to the effective functioning of bio-fertilizers, in terms of nitrogen fixation, Phosphorus solubilization and its mobilization and production of plant growth promoting substances and enhanced the availability of nutrients at appropriate time. Increase in number of leaves, might have resulted in increased photosynthetic rate and accumulation of photosynthates. The number of leaves per plant at 30DAS did not show significant difference among the treatments, which might be due to time requirement for acquaintance of introduced microbial inoculants at initial stages of crop growth. These results are in accordance with the findings of Sharma et al. (2003) [16], Ashok et al. (2001) [5], Patil (1995) [15] in onion and Suresh (1997) [17] in garlic.

There was no significant differences were observed during 30, 60 and 90 DAS of different treatments with reference to collar diameter at all the stages of crop growth. There was no significant differences were observed during 30, 60 and 90 DAS of different treatments with reference to collar diameter at all the stages of crop growth. Integrated nutrient management on number of bulbs per plot showed significant difference among the treatments. The highest bulb yield per plot (3.90 kg) was registered in T₅: 75% RD NPK + RD FYM + Azatobacter beijerinckii + PSB + Trichoderma viride and was on par with T₆ (3.70 kg) and T₇ (3.66 kg), T₁₁ (3.43 kg) and least bulb yield per plot (2.66 kg) was observed in T₁ - RD NPK + FYM. These results are in conformity with the findings of Wange and Singh (1999). Bulb yield per hectare was significantly influenced by the treatments. The highest bulb yield per hectare (10.39 t/ha) was obtained in T₅ - 75% RD N + RD PK + RD FYM + Azatobacter beijerinckii + PSB + Trichoderma viride and was on par with T₆ (9.86 t/ha) and T₇ (9.77 t/ha), T₁₁ (9.15 t/ha) while least bulb yield per hectare (7.10 t/ha) was found in T₁ - RD NPK + RD FYM. Increase in yield could be attributed to balances nutrition with different sources increases soil microbial activity which facilitate increased nutrient uptake, increased root proliferation, increased vegetative growth, more photosynthesis and enhanced photosynthate accumulation and better yield attributes. The results are in conformity with the findings of Gurubatham et al. (1989) [9] and Patil (1995) [15] in onion, Mahendran and Kumar (1996) [12], Suresh (1997) [17], Wange (1995) [18] and Mallanagouda et al. (1995) [13] in garlic. The highest bulb diameter (27.04 mm) was recorded in the plants provided with 75% RD N + RD PK + RD FYM + Azatobacter beijerinckii + PSB + Trichoderma viride (T₅) which was on par with T₆ (26.42 mm), T₇ (25.78 mm), T₈ (25.75 mm), T₉ (25.61 mm), T₁₀ (25.38 mm), T₁₁ (25.24 mm) and the lowest bulb diameter (23.14 mm) was found with RD NPK + RD FYM (T₁). Increased vegetative growth, dry matter production and translocation of photosynthates contributed better development of bulbs, which resulted in increased diameter of bulbs. Similar findings are reported by Suresh (1997) [17] and Mallanagouda et al. (1995) [13] in Garlic; Sharma et al. (2003) [16] and Patil (1995) [13] in onion. The maximum number of cloves per bulb (20.77) was observed in T₅:50% RD N + RD PK + RD FYM + Azospirillum brasilense + PSB + Trichoderma viride which was on par with T₆ (20.40), T₁₂ (20.39), T₁₃ (19.82), T₁₄ (19.50), T₁₅ (19.46) and minimum number of cloves per bulb (15.75) was recorded in T₁₋VC + Azospirillum brasilense + PSB + Trichoderma viride. Similar findings are reported by Suresh (1997) [17] and Mallanagouda et al. (1995) [13] in Garlic.
Table 1: Growth and yield of garlic as influenced by integrated nutrient management

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Number of leaves per plant</th>
<th>collar diameter (cm)</th>
<th>Bulb diameter (mm)</th>
<th>Number of cloves</th>
<th>Yield (Kg/plot)</th>
<th>Yield (t/ha)</th>
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</thead>
<tbody>
<tr>
<td>T1</td>
<td>42.67</td>
<td>6.46</td>
<td>0.27</td>
<td>23.14</td>
<td>17.91</td>
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<td>T2</td>
<td>40.33</td>
<td>6.78</td>
<td>0.31</td>
<td>24.38</td>
<td>20.39</td>
<td>3.23</td>
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<tr>
<td>T3</td>
<td>43.00</td>
<td>7.09</td>
<td>0.36</td>
<td>25.75</td>
<td>20.40</td>
<td>3.20</td>
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<tr>
<td>T4</td>
<td>44.00</td>
<td>6.86</td>
<td>0.32</td>
<td>25.24</td>
<td>19.82</td>
<td>3.03</td>
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<tr>
<td>T5</td>
<td>52.83</td>
<td>7.53</td>
<td>0.36</td>
<td>27.04</td>
<td>19.46</td>
<td>3.90</td>
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<td>T6</td>
<td>50.00</td>
<td>7.30</td>
<td>0.34</td>
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<td>T7</td>
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<td>25.79</td>
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<td>T8</td>
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<td>6.96</td>
<td>0.27</td>
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<td>3.10</td>
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<td>T9</td>
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<td>25.61</td>
<td>18.56</td>
<td>3.66</td>
<td>9.77</td>
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<tr>
<td>T10</td>
<td>44.17</td>
<td>6.96</td>
<td>0.30</td>
<td>25.22</td>
<td>19.50</td>
<td>2.93</td>
<td>7.81</td>
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<td>T11</td>
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<td>6.83</td>
<td>0.28</td>
<td>23.63</td>
<td>15.75</td>
<td>3.43</td>
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<td>CV (%)</td>
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<tr>
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<td>7.91</td>
<td>10.23</td>
<td>13.39</td>
<td>4.95</td>
<td>4.64</td>
<td>11.78</td>
<td>11.79</td>
</tr>
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</table>

Note: RD= Recommended Dose, FYM= Farm yard manure VC= Vermicompost, PSB= Phosphorous soluble bacteria, T.v= Trichoderma viride, Azo.= Azospirillum brasilense, Aza= Azotobacter beijerinckii, DAS= Days after sowing

References