Studies on effect of biofertilizers in combination with inorganic nutrients on yield parameters and quality parameters of sprouting broccoli (Brassica oleracea var. italica L.)

N Vara Prasad, K Uma Jyothi, V Sudhavani, RV Sujatha and P Pratyusha Bhagavati

Abstract

The present investigation was conducted to study the “effect of biofertilizers in combination with inorganic nutrients on yield and quality parameters of sprouting broccoli (Brassica oleracea var. italica L.)” was conducted during rabi, 2017 at College of Horticulture, Venkataramannagudem, West Godavari District, Andhra Pradesh. The experiment was laid out in a randomized block design with three replications comprising fourteen treatments. The results indicated that there was a significant differences among the fourteen treatments and treatment T6 (100% RDF+ Azotobacter + PSB + KSB) was recorded the maximum head diameter (14.02 cm), head weight per plant (0.305 kg), yield per plot (10.07 kg), estimated yield per hectare (111.83 q), ascorbic acid content (132.14 mg/100g), total proteins (3.027%) and total chlorophyll (0.461 mg/g).

Keywords: Biofertilizers, sprouting broccoli, head diameter, head weight, yield per plot, yield per hectare, ascorbic acid, total proteins, total chlorophyll

Introduction

Broccoli (Brassica oleracea var. italica L.) with chromosome number 2n=18 belongs to cruciferous family. The name broccoli has been derived from Italian word ‘brocco’ means shoot and the word sprouting broccoli refers to development of young flower bud which have been used as vegetable. Broccoli has good organoleptic properties and is a very delicious vegetable. It contains high protein (3.3%), vitamin C (137 mg/100g), vitamin A (3500 IU), vitamin B2 (0.12 mg/100g), Iron (205 mg/100g) and Calcium (0.80 mg/100g). Cancer Research Centre of USA indicated that broccoli has several anti-cancerogenic properties due to the presence of sulforaphane (Damato et al., 1994) [5].

Material and methods

The present investigation entitled “Effect of biofertilizers in combination with inorganic nutrients on growth, yield and quality of sprouting broccoli (Brassica oleracea var. italica L.)” was conducted during rabi, 2017 at College of Horticulture, Venkataramannagudem, West Godavari District, Andhra Pradesh. The soil is of red sandy loam with good drainage and moderate water holding capacity. The physical composition of soil was sand 70%, silt 20% and clay 10% and the chemical composition of soil was soil pH 6.96, E.C. 0.24 dS m⁻¹, Organic Carbon 0.34%, available nitrogen 136.26 kg/ha, available phosphorus 38.74 kg/ha and available potassium 166.22 kg/ha. The experiment was carried out on Pusa KTS-1 of sprouting broccoli. The experiment was laid out in a randomized block design with three replications comprising fourteen treatments. The experimental area was prepared by ploughing once with a mould board plough followed by two harrowing and divided into plots of 3m x 3m. The seedlings of thirty five days old and a height of 15 cm with three to four leaves were transplanted in the experimental field during second week of November, 2017. At the time of final field preparation, farm yard manure @ 20 t/ha was applied to the soil as a basal dose as per the recommendation. Biofertilizers such as Azotobacter, PSB (Phosphorous Solubilizing Bacteria) and KSB (Potassium Solubilizing Bacteria) were thoroughly mixed with FYM for rapid multiplication under shade, prior to application in main field. They were applied as basal dressing (5 kg/ha). Both organic and inorganic fertilizers were applied on treatment basis.
Irrigation and other intercultural operations were done when necessary. The effect of biofertilizers in combination with inorganic nutrients on yield and quality parameters was observed. The data was recorded on five randomly selected plants from each treatment and each replication on yield parameters and quality parameters like head diameter, head weight per plant, yield per plot, estimated yield per hectare, ascorbic acid content, total proteins and total chlorophyll were subjected to statistical analysis as per method suggested by Panse and Sukhatame (1967).

Results and discussion

The results obtained from the present investigation are presented in the Table 1. The treatment T₄ (100% RDF+ Azotobacter + PSB + KSB) recorded maximum head diameter (14.02 cm). These findings are in line with Bashyal (2011) [11], Kumar et al. (2013) [11] and Tekasangla et al. (2015) [21] in cauliflower, Mohapatra et al. (2013) [19], Srichandan et al. (2015) [21] and Goutam and Biradar (2017) [21] in broccoli and Kumar (2018) [9] in knol-khol. The treatment T₆ (100% RDF+ Azotobacter + PSB + KSB) was recorded the maximum head weight per plant (0.305 kg). Azotobacter inoculation helped in increasing nitrogen availability because it is a micro acrophilic nitrogen fixer. It colonizes the root mass, fixes nitrogen in loose association with plants and these bacteria induce the plant root to secrete a mucilage which creates low oxygen involvement and help to fix atmospheric nitrogen which as reflected by producing better yield attributes. The solubilization effect of PSB is mainly due to the production of organic acids and produced in root zone of the crop resulting from its solubilization by organic acid and produced from the decaying of the organic material which might have added growth regulators, vitamins and hormones to the soil and ultimately to the plants. These findings are in line with Bashyal (2008) [19], Bashyal (2011) [11] in cauliflower, Sarma et al. (2011) [16] in cabbage, Verma and Choudhary (2017) [24], Shivran et al. (2017) [17] in broccoli and Kumar (2018) [9] in knol-khol. The treatment T₆ (100% RDF+ Azotobacter + PSB + KSB) was recorded the maximum total proteins (3.027%) is due to better availability of desired and required quantity of N in root zone of the crop resulting from its solubilization by organic acid and produced from the decaying of the organic matter, since protein content is function of N content in seeds. The increased uptake of nutrients by broccoli roots may also be due to increased availability of nitrogen resulting from the integration of inorganic sources of N with organic sources and atmospheric N-fixation by biofertilizers and enhanced synthesis of protein facilities by the supply of growth principles like enzymes and growth regulators received from the manures and biofertilizers. These findings are in line with Sable et al. (2016), Hanaa et al. (2016) [18], Singh et al. (2016) [19], Ekta et al. (2017) [16], Goutam and Biradar (2017) [7], Kumar et al. (2017) [10] in broccoli, Sable et al. (2016), Kumar and Devi (2016) [21] and Chaudhary et al. (2018) [4] in cabbage and Kumar (2018) in knol-khol. The treatment T₄ (100% RDF+ Azotobacter + PSB + KSB) recorded maximum ascorbic acid content (132.14 mg/100g) is due to the increase in vitamin-C content in broccoli might be due to increase in microbial activity of soil which might have added growth regulators, vitamins and hormones to the soil and ultimately to the plants. These findings are in line with Bashyal (2008) [19].

Table 1: Effect of biofertilizers in combination with inorganic nutrients on yield and quality parameters in sprouting broccoli (Brassica oleracea var. italica L.)

<table>
<thead>
<tr>
<th>T. No</th>
<th>Treatments</th>
<th>Head diameter (cm)</th>
<th>Head weight per plant (kg)</th>
<th>Yield per plot (q)</th>
<th>Estimated yield per hectare (q)</th>
<th>Ascorbic acid content (mg/10)</th>
<th>Total proteins (%)</th>
<th>Total chlorophyll (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>100% RDF + Azotobacter</td>
<td>13.65</td>
<td>0.276</td>
<td>9.10</td>
<td>101.07</td>
<td>122.08</td>
<td>2.80</td>
<td>0.421</td>
</tr>
<tr>
<td>T₂</td>
<td>100% RDF + PSB</td>
<td>12.89</td>
<td>0.267</td>
<td>8.82</td>
<td>98.02</td>
<td>124.08</td>
<td>2.65</td>
<td>0.389</td>
</tr>
<tr>
<td>T₃</td>
<td>100% RDF + KSB</td>
<td>12.77</td>
<td>0.243</td>
<td>8.01</td>
<td>88.98</td>
<td>120.25</td>
<td>2.55</td>
<td>0.347</td>
</tr>
<tr>
<td>T₄</td>
<td>100% RDF + Azotobacter + PSB + KSB</td>
<td>14.02</td>
<td>0.305</td>
<td>10.07</td>
<td>111.83</td>
<td>132.14</td>
<td>3.027</td>
<td>0.461</td>
</tr>
<tr>
<td>T₅</td>
<td>75% RDF + Azotobacter</td>
<td>11.97</td>
<td>0.201</td>
<td>6.64</td>
<td>73.82</td>
<td>115.51</td>
<td>2.203</td>
<td>0.281</td>
</tr>
<tr>
<td>T₆</td>
<td>75% RDF + PSB</td>
<td>12.41</td>
<td>0.188</td>
<td>6.20</td>
<td>68.93</td>
<td>116.05</td>
<td>2.112</td>
<td>0.254</td>
</tr>
<tr>
<td>T₇</td>
<td>75% RDF + KSB</td>
<td>11.47</td>
<td>0.182</td>
<td>6.01</td>
<td>66.73</td>
<td>114.49</td>
<td>2.013</td>
<td>0.249</td>
</tr>
<tr>
<td>T₈</td>
<td>75% RDF + Azotobacter + PSB + KSB</td>
<td>13.92</td>
<td>0.286</td>
<td>9.43</td>
<td>104.74</td>
<td>126.04</td>
<td>2.948</td>
<td>0.408</td>
</tr>
<tr>
<td>T₉</td>
<td>50% RDF + Azotobacter</td>
<td>11.23</td>
<td>0.174</td>
<td>5.74</td>
<td>63.80</td>
<td>110.59</td>
<td>1.902</td>
<td>0.232</td>
</tr>
<tr>
<td>T₁₀</td>
<td>50% RDF + PSB</td>
<td>10.82</td>
<td>0.168</td>
<td>5.54</td>
<td>61.60</td>
<td>112.25</td>
<td>1.819</td>
<td>0.229</td>
</tr>
<tr>
<td>T₁₁</td>
<td>50% RDF + KSB</td>
<td>10.57</td>
<td>0.159</td>
<td>5.25</td>
<td>58.30</td>
<td>108.31</td>
<td>1.715</td>
<td>0.207</td>
</tr>
<tr>
<td>T₁₂</td>
<td>50% RDF + Azotobacter + PSB + KSB</td>
<td>12.03</td>
<td>0.212</td>
<td>6.99</td>
<td>77.61</td>
<td>118.28</td>
<td>2.336</td>
<td>0.270</td>
</tr>
<tr>
<td>T₁₃</td>
<td>Azotobacter + PSB + KRB</td>
<td>10.21</td>
<td>0.146</td>
<td>4.82</td>
<td>53.53</td>
<td>118.77</td>
<td>2.421</td>
<td>0.304</td>
</tr>
<tr>
<td>T₁₄</td>
<td>100% RDF (100:60:40 NPK kg ha⁻¹)</td>
<td>12.19</td>
<td>0.225</td>
<td>7.44</td>
<td>82.62</td>
<td>104.95</td>
<td>1.672</td>
<td>0.195</td>
</tr>
<tr>
<td></td>
<td>CD at 5%</td>
<td>0.362</td>
<td>0.012</td>
<td>0.402</td>
<td>4.463</td>
<td>0.431</td>
<td>0.061</td>
<td>0.007</td>
</tr>
</tbody>
</table>

Takashangla et al. (2015) [21] in cauliflower, Mohapatra et al. (2013) [19], Srichandan et al. (2015) [21] and Goutam and Biradar (2017) [21] in broccoli and Kumar (2018) [9] in knol-khol. The treatment T₆ (100% RDF+ Azotobacter + PSB + KSB) was recorded the maximum head weight per plant (0.305 kg). Azotobacter inoculation helped in increasing nitrogen availability because it is a micro acrophilic nitrogen fixer. It colonizes the root mass, fixes nitrogen in loose association with plants and these bacteria induce the plant root to secrete a mucilage which creates low oxygen involvement and help to fix atmospheric nitrogen which as reflected by producing better yield attributes. The solubilization effect of PSB is mainly due to the production of organic acids and produced in root zone of the crop resulting from its solubilization by organic acid and produced from the decaying of the organic material which might have added growth regulators, vitamins and hormones to the soil and ultimately to the plants. These findings are in line with Bashyal (2008) [19], Bashyal (2011) [11] in cauliflower, Sarma et al. (2011) [16] in cabbage, Verma and Choudhary (2017) [24], Shivran et al. (2017) [17] in broccoli and Kumar (2018) [9] in knol-khol. The treatment T₆ (100% RDF+ Azotobacter + PSB + KSB) was recorded the maximum total proteins (3.027%) is due to better availability of desired and required quantity of N in root zone of the crop resulting from its solubilization by organic acid and produced from the decaying of the organic matter, since protein content is function of N content in seeds. The increased uptake of nutrients by broccoli roots may also be due to increased availability of nitrogen resulting from the integration of inorganic sources of N with organic sources and atmospheric N-fixation by biofertilizers and enhanced synthesis of protein facilities by the supply of growth principles like enzymes and growth regulators received from the manures and biofertilizers. These findings are in line with Sable and Bhamare (2007) [17], Singh (2008) [19] in cauliflower, Singh et al. (2014) [18], Talat et al. (2014) [22] in cabbage and Verma and Choudhary (2017) [24] in broccoli and The treatment T₄ (100% RDF+ Azotobacter +
PSB + KSB) was recorded the maximum total chlorophyll (0.461 mg/g) is due to application of biofertilizers in combination with inorganic nutrients. This might be due to increased nitrogen content which is a component of chlorophyll. Phosphorus plays an important role in many metabolic processes which are required for photosynthesis. These findings are in line with Singh (2008) in cauliflower, Talat et al. (2014) in cabbage and Chaterjee et al. (2005), Goutam and Biradar (2017) in broccoli.

Conclusion
From the above study, it was concluded that, among the different treatment combinations, treatment T5(100% RDF + Azotobacter + PSB + KSB) was superior in head diameter, head weight per plant, yield per plot, estimated yield per hectare, ascorbic acid content, total proteins and total chlorophyll is due to the combined effect of biofertilizers and inorganic fertilizers.

References