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**N Vara Prasad**
College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

**K Uma Jyothi**
College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

**V Sudhavani**
College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

**RV Sujatha**
College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

**P Pratyusha Bhagavati**
College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

**Correspondence**
**N Vara Prasad**
College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

# Studies on effect of biofertilizers in combination with inorganic nutrients on yield paramters 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 $T_4$ (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 proteain (3.3%), vitamin C (137 mg/100g), vitamin A (3500 IU), vitamin $B_2$ (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 $p^H$ 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 $T_4$ (100% RDF+ *Azotobacter* + PSB + KSB) recorded maximum head diameter (14.02 cm). These findings are in line with Bashyal (2011) [1], Kumar *et al.* (2013) [11] and

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

| T. No | Treatments | Head diameter (cm) | Head weight per plant (kg) | Yield per plot (kg) | Estimated yield per hectare (q) | Ascorbic acid content (mg/10) | Total proteins (%) | Total chlorophyll (mg/100g) |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 100% RDF + *Azotobacter* | 13.65 | 0.276 | 9.10 | 101.07 | 122.08 | 2.806 | 0.421 |
| $T_2$ | 100% RDF + PSB | 12.89 | 0.267 | 8.82 | 98.02 | 124.08 | 2.653 | 0.389 |
| $T_3$ | 100%RDF + KSB | 12.77 | 0.243 | 8.01 | 88.98 | 120.25 | 2.535 | 0.347 |
| $T_4$ | 100% RDF + *Azotobacter* + PSB + KSB | 14.02 | 0.305 | 10.07 | 111.83 | 132.14 | 3.027 | 0.461 |
| $T_5$ | 75% RDF + *Azotobacter* | 11.97 | 0.201 | 6.64 | 73.82 | 115.51 | 2.203 | 0.281 |
| $T_6$ | 75% RDF + PSB | 12.41 | 0.188 | 6.20 | 68.93 | 116.05 | 2.112 | 0.254 |
| $T_7$ | 75% RDF + KSB | 11.47 | 0.182 | 6.01 | 66.73 | 114.49 | 2.013 | 0.249 |
| $T_8$ | 75% RDF + *Azotobacter* + PSB + KSB | 13.92 | 0.286 | 9.43 | 104.74 | 126.04 | 2.948 | 0.408 |
| $T_9$ | 50% RDF + *Azotobacter* | 11.23 | 0.174 | 5.74 | 63.80 | 110.59 | 1.902 | 0.232 |
| $T_{10}$ | 50% RDF + PSB | 10.82 | 0.168 | 5.54 | 61.60 | 112.25 | 1.819 | 0.229 |
| $T_{11}$ | 50% RDF + KSB | 10.57 | 0.159 | 5.25 | 58.30 | 108.31 | 1.715 | 0.207 |
| $T_{12}$ | 50% RDF + *Azotobacter* + PSB + KSB | 12.03 | 0.212 | 6.99 | 77.61 | 118.28 | 2.336 | 0.270 |
| $T_{13}$ | *Azotobacter* + PSB + KRB | 10.21 | 0.146 | 4.82 | 53.53 | 118.77 | 2.421 | 0.304 |
| $T_{14}$ | 100% RDF (100:60:40 NPK kg $ha^{-1}$) | 12.19 | 0.225 | 7.44 | 82.62 | 104.95 | 1.672 | 0.195 |
| | S Em ± | 0.362 | 0.012 | 0.402 | 4.463 | 0.431 | 0.061 | 0.007 |
| | CD at 5% | 1.059 | 0.036 | 1.174 | 13.044 | 1.259 | 0.177 | 0.020 |

Tekasangla *et al*. (2015) [23] in cauliflower, Mohapatra *et al.* (2013) [13], Srichandan *et al* (2015) [21] and Goutam and Biradar (2017) [7] in broccoli and Kumar (2018) [9] in knol-khol. The treatment $T_4$ (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 acrophillic 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 by this organism. They are also known to produce amino acids, vitamins, growth promoting substance like indole acetic acid and gibberellic acid which helps in achiving better growth of plant as well as yield and yields attributes. Potassium solubilizing bacteria can solubilize K-bearing minerals and convert the insoluble K to soluble forms of K and make them available to plant uptake. KSB can dissolve silicate minerals and release K through the production of organic and inorganic acids. The more plants growth and dry mater production in turn resulted in better head development and ultimately the higher yield. More number of leaves may accelerate the synthesis of chlorophyll, more photosynthetic activity, amino acids, enzymes, carbohydrate use, enhanced food accumulation and better mobilization of plant nutrients particularly nitrogen and phosphorus during later stage of plant growth thus resulting ultimately in the increased head weight. These findings are in line with Singh *et al* (2016) [20], Goutam and Biradar (2017) [7], Verma and Choudhary (2017) [24] in broccoli, Kumar (2018) [9] in knol-khol and Chaudhary *et al.* (2018) [4] in cabbage. The treatment $T_4$ (100% RDF+ *Azotobacter* + PSB + KSB) was recorded the maximum yield per plot (10.07 kg) and estimated yield per hectare (111.83 q). It was due to the highest number of leaves and leaf area which enhances the synthesis and translocation of photosynthates from leaves to head. This might have resulted in the maximum head weight and head diameter of the crop. Higher uptake of N, P and K by plants was also observed in treatment $T_4$ (100% RDF+ *Azotobacter* + PSB + KSB). Hence it can be concluded that, the cumulative effect of all the above parameters have resulted in maximum yield in $T_4$ (100% RDF+ *Azotobacter* + PSB + KSB) treatment. These findings are in line with Tekasangla *et al*. (2015) [23] in cauliflower, Srichandan *et al.* (2015) [21], Hanaa *et al.* (2016) [8], Singh *et al* (2016) [20], Ekta *et al*. (2017) [6], Goutam and Biradar (2017) [7], Kumar *et al*. (2017) [10] in broccoli, Sable *et al.* (2016), Kumar and Devi (2016) [12] and Chaudhary *et al.* (2018) [4] in cabbage and Kumar (2018) in knol-khol. The treatment $T_4$ (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 Singh (2008) [19], Bashyal (2011) [1] 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 $T_4$ (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 solublization 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) [15], 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 $T_4$ (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) [19] in cauliflower, Talat *et al*. (2014) [22] in cabbage and Chaterjee *et al*. (2005), Goutam and Biradar (2017) [7] in broccoli.

**Conclusion**

From the above study, it was concluded that, among the different treatment combinations, treatment $T_4$ (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**


1. Bashyal LN, Response of cauliflower to nitrogen fixing biofertilizer and graded levels of nitrogen. The Journal of Agriculture and Environment. 2011; 12:41-50.
2. Bhagavantagoudra KH, Rokhade AK. Effect of Azospirillum and nitrogen on growth and yield of cabbage. Karnataka Journal of Agricultural Sciences. 2001; 14(3):858-861.
3. Chaterjee B, Ghanti P, Thapa U, Tripathy P. Effect of organic nutrition in sprouting broccoli (*Brassica Oleracea* L. var. *Italica* Plenck). Vegetable Science. 2005; 32(1):51-54.
4. Chaudhary SK, Yadav SK, Mahto DK, Sharma RP, Kumar M. Response of growth, yield attributes and yield of cabbage (*Brassica oleracea* var. *capitata*) to different organic and inorganic sources of nutrients in Magadha plain of Bihar. International Journal of Current Microbiological Applied Sciences. Special Issue. 2018; 7:4748-4756.
5. Damato GL, Trotta, Elia. Cell size, transplant age and cultivars effects on timing field production of broccoli for processing. Acta Horticulture. 1994; 371:53-60.
6. Ekta N, Shailaja P, Pant SC, Sandeep K, Pankaj B, Bengia M, Nautiyal BP. Effect of organic manures and biofertilizers on growth, yield, quality and economica of broccoli (*Brassica oleracea* L. var. *italica* Plenck) cv. Green Head under high hill conditions of Uttarakhand. International journal of advanced biological research. 2017; 7(1):96-100.
7. Goutam K, Biradar MS. Integrated nutrient management studies for protected cultivation of broccoli (*Brassica oleracea* var. *italica* L.). International Journal of Chemical Studies. 2017; 5(4):225-227.
8. Hanaa AAA, Zaki MF, EL-Behairy UA, Abou Hadid AF, Abou EL-Magd MM. Growing broccoli plants in the newly reclaimed soils of Egypt, as affected by different fertilizer sources. International Journal of Chemical Technology and Research. 2016; 9(5):01-11.
9. Kumar M, Singh V, Rana DK, Shah KN. Effect of integrated nutrient management on various horticultural traits of knol-khol (*Brassica oleracea var. gongylodes*) cv. White Vienna under Garhwal Hills. Journal of Pharmacognosy and Phytochemistry. 2018; 7(1):2285-2288.
10. Kumar P, Kumar S, Meena RK, Kumar R, Rawat R. Efficacy of biofertilizers on growth, yield and quality of sprouting broccoli (*Brassica oleracea* L. var. *italica* Plank) cv. Pusa KTS-1. *Plant* Archives. 2017; 17(2):1647-1650.
11. Kumar S, Singh JP, Rajbeer Nathi R, Braj M, Kaushik H, Kumar D. Influence of integrated nutrient management on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis* L.) cv NHB-1012. International Journal of Agricultural Sciences. 2013; 9(2):747-749.
12. Kumar V, Devi S. Effect of Bio-fertilizers and Inorganic Amendments on Mineral Composition and Quality of *Brassica oleracea*. Asian Journal of Advanced Basic Science. 2016; 4(2):20-26.
13. Mohapatra SK, Munsi PS, Mohapatra PN. Effect of Integrated Nutrient Management on growth, yield and economics of broccoli (*Brassica oleracea L. Var. italic plenck*). Vegetable Science. 2013; 40(1):69-72.
14. Panse VG, Sukhatame PV, *Statistcal methods for agricultural workers*. ICAR, New Delhi, 1985.
15. Sable PB, Bhamare VK. Effect of biofertilizer *(Azotobacter* and *Azospirillum*) alone and in combination with reduced levels of nitrogen on quality of cauliflower cv. Snowball-16. Asian Journal of Horticulture. 2007; 2(1): 215-217.
16. Sarma I, Phookan DB, Boruah S. Effect of organic manures and biofertilizer on yield and economics of Cabbage (*Brassica oleracea* var. *capitata*). Journal of Eco friendly Agriculture. 2011; 6(1):6-9.
17. Shivran BC, Meena ML, Ola AL, Choudhary GR, Meena JK, Atal MK. Impact of bio-fertilizers and zinc on biochemical parameters of sprouting broccoli (*Brassica oleracea* var. *italica* L. Plenck) under Lucknow conditions. Journal of Pharmacognosy and Phytochemistry. 2017; 6(6):2065-2067.
18. Singh A, Maji S, Kumar S. Effect of biofertilizers on yield and biomolecules of anti-cancerous vegetable broccoli. International Journal of Bio-resource and Stress Management. 2014; 5(2):256-262.
19. Singh JP, Effect of NPK and bio-fertilizers on growth and yield of cauliflower *(Brassica oleracea var. botrytis L.) cv.* Snowball-16. M.Sc. (Ag.) Thesis, submitted to Rajasthan Agricultural University, Bikaner, 2008.
20. Singh V, Shah KN, Rana DK. Combined effect of organic manures and bio-fertilizers on growth and yield of broccoli under Garhwal Himalayan region. HortFlora Research Spectrum. 2016; 5(4):345-347.
21. Srichandan S, Mangaraj AK, Behera KK, Panda D, Das AK and Rout M. Growth, yield and economics of broccoli (*Brassica oleracea var. Italica*) as influenced by organic and inorganic nutrients. International Journal of Agriculture, Environment and Biotechnology. 2015; 8(4):965-970.
22. Talat MA, Tahir A, Iqbal HG, Bangroo SA, Ur Rehman S, Fozia. Effect of nitrogen management on quality parameters of cabbage under temperate conditions. Journal of Progressive Agriculture. 2014; 5(1):69.
23. Tekasangla Kanaujia SP, Singh PK, Integrated nutrient management for quality production of cauliflower in acid alfisol of Nagaland. Karnataka Journal of Agricultural Sciences. 2015; 28(2):244- 247.
24. Verma R, Choudhary P. Nutritional quality evaluation of organically *visa-vis* conventionally grown broccoli (*Brassica oleracea*). An international quarterly journal of life sciences. 2017; 12(1):505-509
25. Yadav LP, Kavita A, Maurya IB. Effect of nitrogen and bio-fertilizers on growth of cabbage (*Brassica oleracea var. capitata L.*) var. Pride of India. Progressive Horticulture. 2012 44(2):318-320.