

## Impact of Bio-organics on Yield, Quality of Broccoli and soil Properties

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(Received: 01 December 2022; Revised: 14 January 2023; Accepted: 18 January 2023; Published: 23 January 2023)

(Published by Research Trend)

**ABSTRACT:** A field experiment was carried out at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during *rabi* season of the year 2021-22. The fifteen treatments were tested which included different components *viz*, Farm yard manure, Vermicompost, *Jeevamrut* and *Anubhav Bio-NPK* in different combinations with different compositions and which was evaluated in randomized block design with three replications. Application of Farm yard manure @ 15 t/ha + Vermicompost @ 3.75 t/ha + *Jeevamrut*@ 3 % (Drenching and Foliar spray at 30 and 60 DAP) + *Anubhav Bio-NPK* (Drenching and Foliar spray at 30 and 60 DAT) was resulted significantly increase in curd diameter, weight of curd and yield, quality parameters *viz*. as iron (mg/100g), potassium (mg/100g) and ascorbic acid (mg/100g). Significant difference was recorded for soil available Iron (kg/ha) and soil microbial count (GM<sup>-1</sup>). Recently people become more sensitive towards health and are very conscious; therefore, organic products have gained a wide adaptability in the markets with good remuneration. The research findings of this experiment will help to growers for the better and more sustainable production of broccoli which will be more acceptable among end users because of its organic production. It will also help to producers to fetch better prices and will help for the economic upliftment of farmers.

**Keywords:** Broccoli, Bio organics, Soil properties, Quality and yield.

### INTRODUCTION

Broccoli (*Brassica oleracea* L. var. *italica*) is a valuable *rabi* season vegetable crop and it has exclusive place among vegetables. The edible portion of the broccoli plant is composed of tender stem and unopened flower buds; plants form a type of head composed of green buds and a thick fleshy flower stalk. The terminal head is loose and green, and the flower stalks are longer than cauliflower (Bose *et al.*, 2002). Broccoli can grow in all soil types; however, the best growing conditions include high humidity, sunlight, temperatures ranging from 18° to 27 °C, and a pH of 6.0 to 6.5 (Chuanphongpanich *et al.*, 2006). Comparison with other nutritional antioxidants this crop has significant source of carotenoids and calcium, acids like ascorbic acid and folic acid and fight against the breast and prostate cancer (Beecher, 1994). The true nutritional value of broccoli is found in compounds known as "isothiocyanates." Anti-cancer compounds found in broccoli significantly protected mice from stomach cancer in tests (Abdullah and Koyama 2009). Sprouting broccoli has about 130 times more vitamin A

contents than cauliflower and 22 times more than cabbage (Singh, 2007). In India, the last couple of years demand for broccoli crop has become increasing due to its more health benefits and export potential. There is a hasty use of chemical fertilizer, pesticide, herbicide, etc. in agriculture which adverse effect on the environment as well as human health. Bio-fertilizer, organic manure and vermicompost are the best source of minerals for improving soil structure, increased nutrition retention and also increases the microbial biomass in soil. *Jeevamrut* is also enhances the quality of fruits and vegetables and added indigenous microorganisms in soil for mineralization. Organic manure and biofertilizers not only maintain better quality but also sustainable higher level of soil fertility and production (Bhushan *et al.*, 2010). Day by day demand for organically grown fruits and vegetables are increased in market due to people are more concern about health. Thus, keeping this view in present experiment was conducted with aim to produce good quality broccoli with sustainable production and soil health.

## MATERIALS AND METHODS

An experiment was carried out during *Rabi* season of the year 2021-22 at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand. The soils of middle Gujarat region is locally known as “*Goradu*” soil and texture of this soil is loamy sand with moisture-retentive.

Total fifteen treatments were tested in Randomized block design with three replications. FYM and Vermicompost were applied 15 days before transplanting while bio-stimulants *Jeevamrut* @ 3% applied as drenching and *Anubhav Bio-NPK* @ 1 lit./ha applied as foliar spray at 30 and 60 DAT. Five plants were tagged at random in each treatment of respective replication for estimated yield and estimated of quality parameters. Soil analysis for various available nutrients was carried out before sowing and at harvest of the

crop. Representative sample up to 0-15 cm depth was taken from net plot and used for analysis purpose. The composite samples of soil were grinded to pass through 2 mm sieve for analysis.

The soil microbial analysis was carried out for bacteria count by serial dilution method for initial soil and after harvest. Microbial count of soil was done by general Colony Formation Unit (CFU) count per gram. Bacterial growth study was done using Nutritional Agar (NA) media. Total count of bacterial population in the soil samples were made by the plate count method as described by Ismail and Yap (1994). The mean data of iron (mg/100g), potassium (mg/100g) and ascorbic acid (mg/100g) were recorded for quality parameters and for soil health mean data of Ec, pH, available Nitrogen, Phosphorus, Potash, Iron (kg/ha) and soil microbial count ( $GM^{-1}$ ) were recorded.

### Treatment combination

Sr. No.	Symbol	Treatments details
1.	T <sub>1</sub>	Farm yard manure 30 t/ha
2.	T <sub>2</sub>	Vermicompost 7.5 t/ha
3.	T <sub>3</sub>	Farm yard manure 25 t/ha + <i>Jeevamrut</i> 3% (Drenching and Foliar spray at 30 and 60 DAT)
4.	T <sub>4</sub>	Vermicompost6.25 t/ha + <i>Jeevamrut</i> 3% (Drenching and Foliar spray at 30 and 60 DAT)
5.	T <sub>5</sub>	Farm yard manure25 t/ha + <i>Anubhav Bio-NPK</i> (Drenching and Foliar spray at 30 and 60 DAT)
6.	T <sub>6</sub>	Vermicompost 6.25t/ha + <i>Anubhav Bio-NPK</i> (Drenching and Foliar spray at 30 and 60 DAT)
7.	T <sub>7</sub>	Farm yard manure20 t/ha + <i>Jeevamrut</i> 3% (Drenching and Foliar spray at 30 and 60 DAT)
8.	T <sub>8</sub>	Vermicompost5 t/ha + <i>Jeevamrut</i> 3% (Drenching and Foliar spray at 30 and 60 DAT)
9.	T <sub>9</sub>	Farm yard manure 20 t/ha + <i>Anubhav Bio-NPK</i> (Drenching and Foliar spray at 30 and 60 DAT)
10.	T <sub>10</sub>	Vermicompost 5 t/ha + <i>Anubhav Bio-NPK</i> (Drenching and Foliar spray at 30 and 60 DAT)
11.	T <sub>11</sub>	Farm yard manure15 t/ha + Vermicompost3.75 t/ha + <i>Jeevamrut</i> 3% (Drenching and Foliar spray at 30 and 60 DAT)
12.	T <sub>12</sub>	Farm yard manure15 t/ha + Vermicompost 3.75 t/ha + <i>Anubhav Bio-NPK</i> (Drenching and Foliar spray at 30 and 60 DAT)
13.	T <sub>13</sub>	Farm yard manure15 t/ha + Vermicompost3.75 t/ha + <i>Jeevamrut</i> 3 % (Drenching and Foliar spray at 30 and 60 DAP) + <i>Anubhav Bio-NPK</i> (Drenching and Foliar spray at 30 and 60 DAT)
14.	T <sub>14</sub>	Farm yard manure30 t/ha + <i>Jeevamrut</i> 3% (Drenching and Foliar spray at 30 and 60 DAT) + <i>Anubhav Bio-NPK</i> (Drenching and Foliar spray at 30 and 60 DAT)
15.	T <sub>15</sub>	Vermicompost 7.5 t/ha + <i>Jeevamrut</i> 3% (Drenching and Foliar spray at 30 and 60 DAT) + <i>Anubhav Bio-NPK</i> (Drenching and Foliar spray at 30 and 60 DAT)

## RESULTS AND DISCUSSION

**Yield parameters.** The result from Table 1 showed that application of Farm yard manure15 t/ha + Vermicompost 3.75 t/ha + *Jeevamrut* 3 % (Drenching and Foliar spray at 30 and 60 DAP) + *Anubhav Bio-NPK* (Drenching and Foliar spray at 30 and 60 DAT) recorded the maximum curd diameter (18.03 cm) which was statistically at par with T<sub>14</sub> (17.13 mm) and T<sub>15</sub> (17.07 mm). Maximum weight of curd(427.07 gm/plant) recorded in treatment T<sub>13</sub>which was statistically at par with treatment T<sub>15</sub> (419.60gm/plant), T<sub>14</sub> (411.73 gm/plant) and T<sub>12</sub> (398.40gm/plant). Maximum curd yield (13.31 t/ha) observed in treatment T<sub>13</sub>which was statistically at par with treatment T<sub>15</sub> (13.21 t/ha), T<sub>14</sub> (13.01 t/ha), T<sub>12</sub> (12.96 t/ha), T<sub>11</sub> (12.45 t/ha), T<sub>9</sub>(11.95 t/ha)and T<sub>8</sub> (11.75 t/ha).

It may be due to application of Vermicompost, Farm yard manure, bio-fertilizers and *Jeevamrut* in soil which may improves chemical, biological and physical properties of soil which resulted in better nutrient uptake by plants and improved yield. Similar results

were also obtained by Lal *et al.* (2015); Meena *et al.* (2017); Rawat and Maji (2018); Singh *et al.* (2018); Kumar *et al.* (2019) in broccoli.

**Quality parameters.** The data presented in Table 2revealed significant variation among the treatment on quality parameters. Treatment T<sub>13</sub> recorded significantly higher iron (0.88 mg/100g) content in plant which was statistically at par with treatment T<sub>11</sub> (0.84 mg/100g), T<sub>12</sub> (0.85 mg/100g), T<sub>14</sub> (0.87 mg/100g) and T<sub>15</sub> (0.86 mg/100g). Maximum potassium (295.57 mg/100g) content in plant recorded in treatment T<sub>13</sub> which was statistically at par with treatment T<sub>11</sub> (291.23 mg/100g), T<sub>12</sub> (292.20 mg/100g), T<sub>14</sub> (291.57 mg/100g) and T<sub>15</sub> (292.60 mg/100g). Highest ascorbic acid (82.63 mg/100g) content in plant was observed in treatment T<sub>13</sub> followed by with T<sub>12</sub> (80.77 mg/100g), T<sub>14</sub> (81.40 mg/100g) and (81.73 mg/100g).

As a whole result reveled that organic manures apply with *Bio-fertilizer* and *Jeevamrut* integrated application had significantly improve quality parameters. It might be due to presence of organic manure and its extract

promoted the efficiency of better organic nutrient utilization, which could be attributed to the faster decomposition of organic substances, which resulted easily supply of micro and macro nutrients to the plant, which boosts the nutrients and mineral levels in plant parts. Biofertilizer increases the levels of growth-promoting bio-chemicals, promote microbial activity in the soil, ultimately ensure the availability and uptake of nutrients by the plant. Same, results were observed by Kumar *et al.* (2015) in cabbage, Lal *et al.* (2015); Meena *et al.* (2017); Chaterjee *et al.* (2005); Alkobaisy *et al.* (2021) in broccoli.

**Soil properties.** The data summarized in Table 3 indicate significant variation among the treatment on soil chemical and biological properties of before the crop planting and after harvesting of the crop. Soil chemical properties viz. Ec, pH, Available Nitrogen (kg/ha), Phosphorus(kg/ha) and Potash (kg/ha) found non-significant effect due to treatments. However, application of Farm yard manure 15 t/ha + Vermicompost 3.75 t/ha + *Jeevamrut* 3 % (Drenching and Foliar spray at 30 and 60 DAP) + *Anubhav Bio-NPK* (Drenching and Foliar spray at 30 and 60 DAT) had higher nutrient value of Ec, pH, Available Nitrogen

(kg/ha), Phosphorus (kg/ha) and Potash (kg/ha) than other treatments.

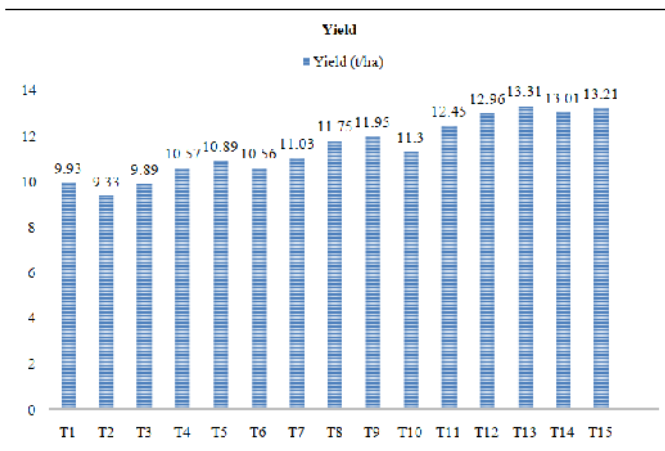
The maximum soil available iron (4.97 ppm) was recorded in treatment T<sub>13</sub> which was statistically at par with treatment T<sub>14</sub> (4.73 ppm) and T<sub>15</sub> (4.53 ppm). Whereas, the minimum available iron (3.37 ppm) in soil was recorded in T<sub>2</sub> (VC @ 7.5 t/ha). It might be due to synergistic effect of source of farm yard manure, vermicompost, *biofertilizers* and *Jeevamrut* which able to enhance mineralization of soil.

Higher number of soil microbial count ( $8.13 \times 10^7$  GM<sup>-1</sup>) was recorded in treatment T<sub>13</sub> which was statistically at par with treatment T<sub>9</sub> ( $7.27 \times 10^7$  GM<sup>-1</sup>), T<sub>11</sub> ( $7.34 \times 10^7$  GM<sup>-1</sup>), T<sub>12</sub> ( $7.46 \times 10^7$  GM<sup>-1</sup>), T<sub>14</sub> ( $8.08 \times 10^7$  GM<sup>-1</sup>) and T<sub>15</sub> ( $7.61 \times 10^7$  GM<sup>-1</sup>). Whereas, the lower number of soil microbial count ( $5.11 \times 10^7$  GM<sup>-1</sup>) was recorded in T<sub>2</sub> treatment (VC 7.5 t/ha). It may be due to the synergistic effect of manures, *jeevamrut* and bio-fertilizers increasing available organic matter of soil, which acted as carbon and energy source for microbes and quick buildup of micro flora and fauna. Similar, results were observed by Boraiah *et al.* (2017) in capsicum and Alkobaisy *et al.* (2021) in broccoli.

**Table 1: Effect of organic manure and liquid bio-stimulant on diameter of curd, weight of curd and yield of curd of broccoli.**

Treatments	Diameter of curd (mm)	Weight of curd (g)	Yield (t/ha)
T <sub>1</sub>	13.83	298.73	9.93 <sup>DE</sup>
T <sub>2</sub>	13.17	284.07	9.33 <sup>E</sup>
T <sub>3</sub>	14.40	310.67	9.89 <sup>DE</sup>
T <sub>4</sub>	14.23	321.47	10.57 <sup>CDE</sup>
T <sub>5</sub>	15.27	330.20	10.89 <sup>BCDE</sup>
T <sub>6</sub>	14.87	339.73	10.56 <sup>CDE</sup>
T <sub>7</sub>	15.27	343.53	11.03 <sup>BCDE</sup>
T <sub>8</sub>	15.23	351.93	11.75 <sup>ABCD</sup>
T <sub>9</sub>	14.47	363.00	11.95 <sup>ABCD</sup>
T <sub>10</sub>	16.07	369.67	11.30 <sup>ABCDE</sup>
T <sub>11</sub>	15.67	372.93	12.45 <sup>ABC</sup>
T <sub>12</sub>	16.17	398.40	12.96 <sup>AB</sup>
T <sub>13</sub>	18.03	427.07	13.31 <sup>A</sup>
T <sub>14</sub>	17.13	411.73	13.01 <sup>AB</sup>
T <sub>15</sub>	17.07	419.60	13.21 <sup>A</sup>
S. Em. ±	0.41	17.66	0.62
C.D. at 5%	1.18	51.15	1.80
C.V. (%)	4.58	8.59	9.37

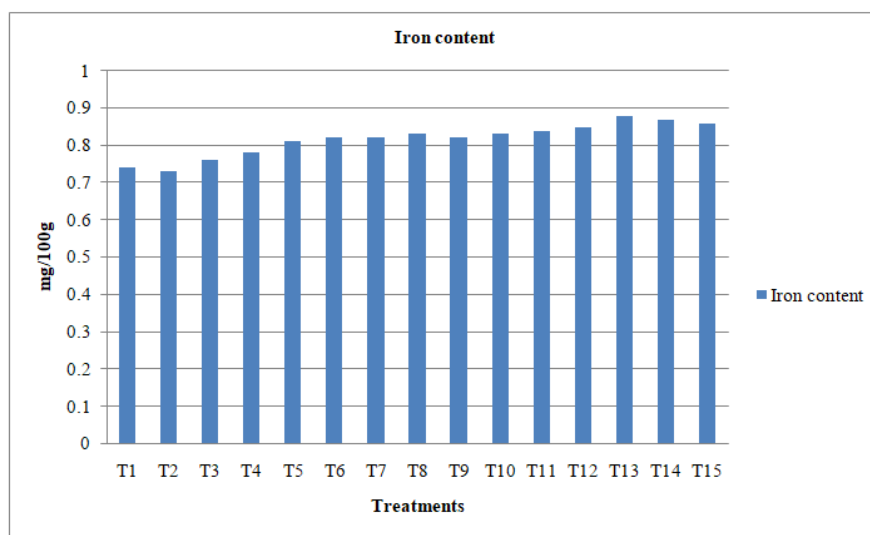
(Yield: Duncan's New Multiple Range Test)



**Fig. 1.** Effect of organic manure and liquid bio-stimulant on yield (t/ha) of broccoli.

**Table 2: Effect of organic manure and liquid bio-stimulants on iron, potassium and ascorbic acid content of broccoli.**

Treatments	Iron content (mg/100g)	Potassium content (mg/100g)	Ascorbic acid (mg/100g)
T <sub>1</sub>	0.74	286.50	73.67
T <sub>2</sub>	0.73	285.97	73.40
T <sub>3</sub>	0.76	287.17	74.97
T <sub>4</sub>	0.78	286.90	75.53
T <sub>5</sub>	0.81	287.77	75.27
T <sub>6</sub>	0.82	288.30	76.60
T <sub>7</sub>	0.82	288.63	76.53
T <sub>8</sub>	0.83	289.60	77.70
T <sub>9</sub>	0.82	288.27	77.13
T <sub>10</sub>	0.83	290.20	78.30
T <sub>11</sub>	0.84	291.23	79.37
T <sub>12</sub>	0.85	292.20	80.77
T <sub>13</sub>	0.88	295.57	82.63
T <sub>14</sub>	0.87	291.57	81.40
T <sub>15</sub>	0.86	292.60	81.73
<b>S. Em. ±</b>	0.02	1.49	1.15
<b>C.D. at 5%</b>	0.04	4.34	3.33
<b>C.V. (%)</b>	3.23	0.90	2.56



**Fig. 2.** Effect of organic manure and liquid bio-stimulant on Iron content of broccoli.

**Table 3: Effect of organic manure and liquid bio-stimulant on soil available Iron and total microbial count.**

Treatments	Available Iron (ppm) at harvest	Total microbial count [(g) × 10 <sup>7</sup> ] at harvest
<b>Initial value</b>	4.34	4.8 × 10 <sup>7</sup>
T <sub>1</sub>	3.40	5.38
T <sub>2</sub>	3.37	5.11
T <sub>3</sub>	3.43	5.98
T <sub>4</sub>	3.50	6.29
T <sub>5</sub>	3.47	6.71
T <sub>6</sub>	3.53	6.84
T <sub>7</sub>	3.60	6.60
T <sub>8</sub>	3.57	7.00
T <sub>9</sub>	4.00	7.27
T <sub>10</sub>	3.80	7.08
T <sub>11</sub>	4.23	7.34
T <sub>12</sub>	4.37	7.46
T <sub>13</sub>	4.97	8.13
T <sub>14</sub>	4.73	8.08
T <sub>15</sub>	4.53	7.61
<b>S. Em. ±</b>	0.13	0.31
<b>C.D. at 5%</b>	0.38	0.91
<b>C.V. (%)</b>	5.90	7.98

**Table 4: Effect of organic manure and liquid bio-stimulant on Ec, pH, available Nitrogen, Phosphorus and Potash.**

Treatments	EC (dS/m) at harvest	pH at harvest	Available Nitrogen (kg/ha) at harvest	Available P <sub>2</sub> O <sub>5</sub> (kg/ha) at harvest	Available K <sub>2</sub> O (kg/ha) at harvest
Initial value	0.34	8.20	203.25	20.5	229.20
T <sub>1</sub>	0.33	8.13	206.53	21.73	231.76
T <sub>2</sub>	0.34	8.17	205.88	21.40	230.11
T <sub>3</sub>	0.34	8.13	208.88	22.10	233.19
T <sub>4</sub>	0.33	8.10	210.55	22.00	234.23
T <sub>5</sub>	0.32	8.06	211.86	22.17	236.74
T <sub>6</sub>	0.33	8.00	213.85	22.77	237.23
T <sub>7</sub>	0.32	8.06	215.11	23.00	235.31
T <sub>8</sub>	0.32	8.10	212.72	23.43	236.44
T <sub>9</sub>	0.32	8.00	215.05	23.83	238.94
T <sub>10</sub>	0.32	7.97	217.61	23.67	240.44
T <sub>11</sub>	0.31	8.00	216.89	24.20	241.91
T <sub>12</sub>	0.31	8.10	218.38	24.57	239.63
T <sub>13</sub>	0.30	7.93	220.26	25.67	244.24
T <sub>14</sub>	0.30	7.97	218.60	24.50	243.91
T <sub>15</sub>	0.31	7.97	219.26	24.27	242.38
S. Em. ±	0.009	0.12	5.92	0.89	5.77
C.D. at 5%	NS	NS	NS	NS	NS
C.V. (%)	5.34	2.51	4.79	6.61	4.21

## CONCLUSION

Based on the results of research experiments, it can be concluded that application of Farm yard manure 15 t/ha + Vermicompost 3.75 t/ha + Jeevamrut 3 % (Drenching and Foliar spray at 30 and 60 DAP) + Anubhav Bio-NPK (Drenching and Foliar spray at 30 and 60 DAT) found the most effective treatment for increasing yield and improving quality of broccoli and soil.

**Acknowledgement.** Authors are thankful to the Horticulture Department, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) for providing facilities for carrying out the research work.

**Conflict of Interest.** None.

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**How to cite this article:** Mathukiya A.R., Panchal B.H. and Kotadiya R.H. (2023). Impact of Bio-organics on Yield, Quality of Broccoli and soil Properties. *Biological Forum – An International Journal*, 15(1): 559-563.