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Effect of different organic manures and PGPR consortium on quality of bottle gourd (*Lagenaria siceraria* MOL. STANDL.) CV. Anand bottle gourd-1

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Abstract
The present investigation was carried out on "Effect of different organic manures and PGPR consortium on quality of bottle gourd (*Lagenaria siceraria* MOL. STANDL.) cv. ABG-1" at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat during summer-2018. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) replicated thrice with six level of organic manures application and two level of PGPR consortium of total 12 combination. The control [75:50:50 NPK kg/ha + FYM 15 t/ha (RDF)] treatment was taken separately means without combination under experimentation. The quality parameters *viz.*, maximum TSS (3.45 ^{0}Brix), total sugar (3.38%), reducing sugar (2.63%), non-reducing sugar (0.75%) and ascorbic acid (7.96 mg/100 g pulp) were found superior with the application of M_1 (100% RDN from vermicompost). PGPR consortium showed significant effect on quality parameters, treatment of P_2 (With PGPR consortium 1 l/ha) recorded the maximum TSS (3.24 ^{0}Brix), total sugar (3.21%), reducing sugar (2.43%), non-reducing sugar (0.78%) and ascorbic acid (7.54 mg/100 g pulp).

Keywords: Bottle gourd, vermicompost, FYM, castor cake, PGPR consortium, quality

Introduction
Bottle gourd (*Lagenaria siceraria* Mol. Standl.) belongs to the family cucurbitaceae with chromosome number of 2n=22. Its native is tropical Africa and Asia. It is commonly known as white-flowered gourd, Lauki, Kaddu and Ghiya. In Gujarat, it is known as Dudhi. In India it is cultivated in about 155 thousand ha area with production of 2573 thousand MT (Anon., 2016-2017) [2].

The fruits in the green stage are used for vegetable and also for preparation of some sweets. The dry fruit are used as making musical instruments, floats for fishing nets and many other purposes. The pulp, tender stem and leaves have many medicinal values. It has cooling effect and has diuretic and having cardio-tonic properties. Fruit pulp is used as an antidote against certain poisons and is good for controlling constipation, night blindness and cough (Thamburaj and Singh, 2001) [1].

From nutritional point of view, bottle gourd can be considered as nutrition rich fruit vegetable. It contains considerable amount of water (96.1 g), carbohydrates (2.5 g), protein (0.2 g), fat (0.1 g), minerals (0.5 g), fiber (0.6 g), riboflavin (0.023 mg), vitamin A (10 IU), vitamin C (11 mg), calcium (16 mg), iron (0.4 mg), phosphorus (14 mg) and energy (12 K cal) per 100 g of edible fruit (Gopalan *et. al.* 1982) [5].

Organic manures like vermicompost, FYM and castor cake etc. supply important plant elements both macro and micro. Apart from supplying plant nutrients they favour aggregation of fine soil particles, there by promoting good soil structure and it is also essential for healthy development of soil micro organisms which further carry out biochemical transformation play active role in decomposing organic matter and help in releasing the essential plant nutrients.

PGPR consortium is bio-NPK liquid biofertilizers which contains living organisms when applied to the soil, colonize the rhizosphere or interior of the plant and promote growth by increasing the supply or availability of primary nutrients to the plant. It is an important

component of plant nutrient management for sustainable agriculture. In recent years, biofertilizer NPK consortium are gaining much popularity. Bio-NPK consortium contain five strains of agriculturally beneficial microorganism (two Nitrogen fixer, two Phosphate solubilizers and one potash mobilizer) is the one time solution for all the macronutrient (N, P, K) requirement of crops. Use of Bio-NPK consortium @ 1 litre/ha can save 25% N, P and K chemical fertilizer with increase in yield with reduction of soil, water and air pollution.

The use of high yielding crop varieties with application of heavy doses of chemical fertilizers without organic manures and bio-fertilizers causes deterioration of soil health in terms of physical and chemical properties of soil, declining of soil microbial activities, reduction in soil humus, increased pollution of soil, water and air. Hence, Nitrogen management through use of organic manures and biofertilizer replacing of present dose of chemical fertilizers of bottle gourd is not worked out so an experiment on "Effect of different organic manures and PGPR consortium on quality of bottle gourd cv. ABG-1" studied.

Materials and methods

The experiment was conducted at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. The effect of different organic manures and PGPR consortium on quality of bottle gourd studied. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) replicated thrice with six level of organic manures application and two level of PGPR consortium of total 12 combination. The control [75:50:50 NPK kg/ha + FYM 15 t/ha (RDF)] treatment was taken separately means without combination under experimentation. Treatment details given in table no. 1 and treatment combination is given in table no. 2. The bottle gourd cv. Anand Bottle Gourd-1 was sown on 16th February, 2018 at a spacing of 2.0 m × 1.0 m. The gross plot size is 8.0 m x 6.0 m and net plot size is 4.0 m x 4.0 m. The soil of the experimental site was sandy loam, locally known as "*Goradu*" with the pH of soil is 7.06, 0.26% of organic carbon was determined by walkley and black method, 162.13 kg/ha of available nitrogen was determined by kjeldahl digestion method, 30.92 kg/ha of available phosphorus was estimated by Olson's extraction method, 176.78 kg/ha of available potassium was determined by flame photometric method. This type of soil is responds well to irrigation and manuring so it is suitable for bottle gourd cultivation. In this experiment three source of organic manurs used *viz.*, vermicompost, FYM, castor cake. Vermicompost having 1.8% N, FYM 0.5% N and castor cake 3.5% N. For 100% of nitrogen dose used quantity of vermicompost 4.16 t/ha, FYM 15 t/ha and castor cake 2.14 t/ha. For 75% of nitrogen dose used quantity of vermicompost 3.12 t/ha, FYM 11.25 t/ha and castor cake 1.61 t/ha. PGPR consortium used 1 l/ha. These fertilizers were applied in a single dose at the time of sowing as per treatment plan and application of 50% recommended dose of N and full dose of P and K given as a basal dose and remaining 50% of N was applied 30 days after sowing in control. Weeding and plant protection measure were followed as and when needed. Observations of quality parameters were recorded at 5th number of picking. The data were statistically analyzed by the method suggested by Panse and Sukhatme (1967) [9].

Table 1: Details of various treatments

S. No.	Treatments	Symbol
Factor A: Organic manures (M)		
1.	100% RDN from vermicompost (4.16 t/ha)	M_1
2.	75% RDN from vermicompost (3.12 t/ha)	M_2
3.	100% RDN from FYM (15 t/ha)	M_3
4.	75% RDN from FYM (11.25 t/ha)	M_4
5.	100% RDN from castor cake (2.14 t/ha)	M_5
6.	75% RDN from castor cake (1.61 t/ha)	M_6
Factor B: PGPR consortium (P)		
1.	Without PGPR consortium	P_1
2.	With PGPR consortium (1 lit/ha)	P_2

Control: 75:50:50 NPK kg/ha + FYM 15 t/ha (RDF)

Table 2: Treatment combinations

S. No.	Treatment combination	Notation
1.	100% RDN from vermicompost	M_1P_1
2.	100% RDN from vermicompost + PGPR consortium (1 l/ha)	M_1P_2
3.	75% RDN from vermicompost	M_2P_1
4.	75% RDN from vermicompost + PGPR consortium (1 l/ha)	M_2P_2
5.	100% RDN from FYM	M_3P_1
6.	100% RDN from FYM + PGPR consortium (1 l/ha)	M_3P_2
7.	75% RDN from FYM	M_4P_1
8.	75% RDN from FYM + PGPR consortium (1 l/ha)	M_4P_2
9.	100% RDN from castor cake	M_5P_1
10.	100% RDN from castor cake + PGPR consortium (1 l/ha)	M_5P_2
11.	75% RDN from castor cake	M_6P_1
12.	75% RDN from castor cake + PGPR consortium (1 l/ha)	M_6P_2
13.	Control 75:50:50 NPK kg/ha + FYM 15 t/ha (RDF)	M_0P_0

Note: Common dose of FYM 15 t/ha applied in treatment no. 1 to 12.

Results and discussion

The results obtained from experiment are presented in relevant Tables 3.

Total soluble solid (^{0}Brix)

Effect of organic manures

Total soluble solid (3.45 ^{0}Brix) were recorded significantly highest with the treatment M_1 and this is at par with M_5. It might be due to the vermicompost might have led to balance C:N ratio which resulted in satisfactory nutrient availability and increased plant metabolism, which ultimately lead to increased carbohydrate accumulation in fruit resulting total soluble solids (TSS), were found maximum. The results were also in accordance with the findings of Singh *et al*. (2018) [10] and Ghayal *et al*. (2018) [4] in cucumber.

Effect of PGPR consortium

Total Soluble Solid significantly affected by PGPR consortium. The highest value of TSS (3.24 ^{0}Brix) observed with treatment P_2 (With PGPR consortium 1 l/ha). It's due to application of biofertilizers could be attributed to higher metabolic activities, which helps in synthesis of higher amount of acids and might have contributed to total soluble solid. Similar finding were also reported Anjanappa *et al.* (2012) [1] in cucumber and Thriveni *et al.* (2015) [12] in bitter gourd.

Total sugar (%)

Effect of organic manures

Application of organic manures significantly influenced total sugar. Treatment M_1 were recorded the highest in total sugar (3.38%) and it was statistically at par with treatment of M_5. It might be due to conversion of complex substances into simple sugar, which perhaps enhanced the metabolic activity in fruits and resulted in increased total sugar of fruit. The results were similar to the findings of Ghayal *et al*. (2018) [4] in cucumber and Nayak *et al.* (2016) [7] in pointed gourd.

Effect of PGPR consortium

Treatment P_2 recorded significantly the highest in total sugar (3.21%) and lowest total sugar (2.82%) was recorded with treatment P_1. It might be due to bio fertilizer higher nitrogen fixation and uptake of nitrogen there by stimulating catalytic activity number of enzyme in the physiological process and increasing production of sugars and amino acids. The results were also in accordance with the findings of Nayak *et al.* (2016) [7] in pointed gourd.

Reducing sugar (%)

Effect of organic manures

The highest reducing sugar (2.63%) were recorded with treatment M_1 and it was statistically at par with treatment of M_5. This might be due to application of vermicompost enhanced the carbon nitrogen ratio in the soil which might have increased the reducing sugar content in the fruits. The present results are in accordance with the findings of Ghayal *et al*. (2018) [4] in cucumber.

Effect of PGPR consortium

Application of PGPR consortium significantly influenced reducing sugar. Treatment P_2 recorded the highest reducing sugar (2.43%) and lowest reducing sugar (2.29%) was recorded with treatment P_1. This is due to biofertilizers improve metabolic activities which result improve the reducing sugar. The results were also in accordance with the findings of Meena *et al*. (2017) [6] in broccoli.

Non-reducing sugar (%)

Effect of organic manures

Treatment M_1 recorded significantly the highest in non-reducing sugar (0.75%**)** and it was statistically at par with treatment of M_5. Increase in non-reducing sugar might be due to continuous increased supply of nutrients and growth promoting substance. Similar finding were also reported Meena *et al*. (2017) [6] in broccoli.

Effect of PGPR consortium

The non-reducing sugar (%**)** significantly influenced by application of PGPR consortium. Between the two treatments, treatment P_2 recorded significantly the highest in non-reducing sugar (0.78%**)** and lowest non-reducing sugar (0.54%**)** was recorded with treatment P_1. This is might be due to bio fertilizer fix the higher nitrogen there by increase the physiological process and metabolic activity which result were increasing the production of non-reducing sugar. The results were also in accordance with the findings of Meena *et al*. (2017) [6] in broccoli.

Table 3: Effect of different organic manures and PGPR consortium on quality of bottle gourd

Treatment	TSS (^{0}Brix)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Moisture percentage	Ascorbic acid (mg/100 g pulp)	Chlorophyll content (mg/ 100 g)
Factor A: Organic manures (M)							
M_1	3.45	3.38	2.63	0.75	93.92	7.96	2.62
M_2	2.95	2.93	2.28	0.64	92.66	7.22	2.50
M_3	3.17	3.12	2.44	0.68	93.11	7.56	2.53
M_4	2.63	2.61	2.05	0.56	91.80	6.77	2.41
M_5	3.34	3.30	2.58	0.71	93.36	7.78	2.58
M_6	2.79	2.76	2.16	0.61	92.21	6.93	2.47
S.Em.±	0.08	0.06	0.06	0.01	1.54	0.19	0.06
CD at 5%	0.22	0.19	0.17	0.04	NS	0.54	NS
Factor B: PGPR consortium (P)							
P_1	2.87	2.82	2.29	0.54	92.55	7.20	2.48
P_2	3.24	3.21	2.43	0.78	93.15	7.54	2.55
S.Em.±	0.04	0.04	0.03	0.01	0.89	0.11	0.03
CD at 5%	0.13	0.11	0.10	0.02	NS	0.31	NS
Interaction (MxP)	NS	NS	NS	NS	NS	NS	NS
Control vs Rest treatment							
Control	2.14	2.05	1.65	0.40	90.70	6.16	2.01
Rest treatment	3.06	3.02	2.36	0.66	92.85	7.37	2.52
S.Em.±	0.08	0.07	0.06	0.01	1.61	0.19	0.06
CD at 5%	0.23	0.19	0.17	0.04	NS	0.56	0.18
CV%	6.20	5.33	6.06	5.22	4.08	6.23	5.85

Ascorbic Acid (mg/100 g pulp)

Effect of organic manures

The ascorbic acid significantly influenced by application of organic manures. The treatment M_1 recorded significantly the highest in ascorbic acid (7.96 mg/ 100 g pulp) and it was statistically at par with treatment of M_5. It might be due to vermicompost slow but continuous supply of all major and micronutrients which might have helped in the assimilation of

carbohydrates and in turn synthesis of ascorbic acid. The results were also in accordance with the findings of Das *et al.* (2015) [3] in bottle gourd.

Effect of PGPR consortium

Treatment P_2 recorded significantly the highest in ascorbic acid (7.54 mg/100 g pulp) and minimum ascorbic acid (7.20 mg/100 g pulp) was recorded with treatment P_1. This might be due to higher metabolic activities, which helps in synthesis of higher amount of acids and might have contributed to ascorbic acid. Similar finding were also reported Das *et al.* (2015) [3] in bottle gourd.

Conclusion

The results obtained from research experiment, it can be concluded that the application of 100% RDN from vermicompost (4.16 t/ha) exhibited the maximum total soluble solid, total sugar, reducing sugar, non-reducing sugar and ascorbic acid of bottle gourd cv. Anand Bottle Gourd-1.

Application of PGPR consortium (1 l/ha) recorded maximum total soluble solid, total sugar, reducing sugar, non-reducing sugar and ascorbic acid of bottle gourd cv. Anand Bottle Gourd-1.

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