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INFLUENCE OF ORGANIC MANURE AND PGPRS ON THE QUALITY ATTRIBUTES OF POMEGRANATE CV. BHAGWA

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ABSTRACT

The study was conducted on the pomegranate cv. 'Bhagwa' to investigate efficacy of organic manures and PGPRs on quality attributes in a farmer's field, Challakere (Chitradurga district) during the year 2023-2024 on "Influence of organic manures and PGPRs on yield and quality attributes of pomegranate cv. Bhagwa is under the central dry zone of Karnataka. Pomegranate is an important fruit crop grown in the dry regions of India. Recently, the use of chemical fertilizers has increased significantly. However, the excessive use of these fertilizers and chemicals leads to degradation of soil health and nutritional status. The quest to enhance the yield and quality of pomegranate while maintaining soil health has prompted the exploration of innovative agricultural practices. Integration of organic manure and Plant Growth-Promoting Rhizobacteria (PGPRs) is one such approach. The experiment was laid out in Randomized Block Design, comprising nine treatments *viz.,* T_1- Control, T_2- FYM, T_3- Poultry manure, T_4- Vermicompost, T_5- Composted coir pith, T_6- FYM+PGPRs, T_7- Poultry manure + PGPRs, T_8- Vermicompost + PGPRs, and T_9- Composted coir pith + PGPRs with three replications, applied after first irrigation. Among the treatments, T_8- Vermicompost + PGPRs recorded significant differences for the viz., Maximum juice percentage (58.69 %), reducing sugars (11.94 %), total sugars (13.78 %), total soluble solids level (15.91 °B), sugar to acid ratio (30.53), total anthocyanin content (23.57 mg/100 g) total phenolic content (249.21 mg GAE/ 100g), 100 aril weight per fruit (44.70 g), maximum Fruit colour L^*(31.10), a^* (50.24), b^* (22.72) and Aril colour L^*(15.60), a^* (15.82), b^* (1.10) coordinates representing Lightness (L^*), Redness (a^*) and Yellowness (b^*) respectively. Hence Vermicompost + PGPRs (T_8) proved to be promising in enhancing the quality of pomegranate.
***Keywords*: Organic manure, PGPRs, quality attributes, pomegranate.**

Introduction

Pomegranate (*Punica granatum* L.) is a commercially significant fruit crop known for its high nutritional value, medicinal properties, and adaptability to arid and semi-arid climates. Among the popular cultivars, Bhagwa stands out for its vibrant red arils, high juice content, and export-quality traits. Because of its nutraceutical and antioxidant qualities, it has a very high export potential (Newman and Lansky, 2007). Demand from customers for fresh and processed goods such as anardana, wine, syrup, and juice Additionally, acidulant levels are rising daily (Saxena *et al.,* 1984). With growing consumer demand for organically produced fruits and the escalating focus on sustainable agriculture, the role of organic manures and plant growth-promoting rhizobacteria (PGPRs) in enhancing the quality attributes of pomegranate has gained considerable attention.

The indiscriminate use of, fertilizers, pesticides and other chemicals has resulted in irrecoverable deterioration of soil physical, chemical and microbiological health coupled with unsustainable productivity. Organic manures, such as farmyard manure, vermicompost, and bio-compost, serve as a natural reservoir of essential nutrients, improving soil fertility and enhancing plant growth (Mir *et al.,* 2015). These amendments not only sustain long-term soil health but also contribute to the production of fruits with superior taste, texture, and nutritional quality. On the other hand, PGPRs, including beneficial microbes like *Azotobacter*, *Azospirillum*, and *Pseudomonas fluorescens, Trichoderma*, PSB, KSB are known for their role in nitrogen fixation, phosphate solubilization, and production of plant growth-promoting substances. Their application has been reported to enhance nutrient uptake, stress tolerance, and overall crop productivity.

The combined use of organic manure and PGPRs is a promising approach to improve the yield and quality of pomegranate while adhering to environmentally friendly practices. However, limited research has been conducted to comprehensively evaluate their influence on the quality attributes of pomegranate fruits, particularly in the Bhagwa cultivar.

This study aims to explore the synergistic effects of organic manures and PGPRs on the physical, chemical, and sensory characteristics of pomegranate cv. Bhagwa offers insight into sustainable cultivation practices that enhance both productivity and fruit quality.

Material and Methods

Experimental site

The present study was carried out in the farmer's field of Doddaullarthi village, Challakere taluk, in Chitradurga district. The experimental site was located in the Central Dry Zone (Zone IV) of Karnataka. It is situated at 14.36^0 north latitude and 76.75^0 east longitude at an elevation of 462.59 m above the mean sea level. The climate of Challakere is classified as a Central Dry Zone in Karnataka with an annual rainfall of 656.4 mm reported from July 2023 to June 2024. The mean maximum and minimum temperatures were 33.04 ^{0}C and 18.39 ^{0}C, respectively.

Experimental details

This study was conducted on pomegranate plants of the Bhagwa cultivar. Fifty-four uniform plants were selected and spaced 5 × 5 m apart. Pruning, fertilizer application, irrigation and other cultural practices were performed according to the standard cultural practices recommended for pomegranate. All the cultural practices for the selected plants were maintained uniformly throughout the experiment. The experimental block was set with three rows, with nine trees representing replicates of different treatments in each row, and the treatment in all three rows was randomized to avoid the treatment cross effect. The experiment was laid out in Randomized Block Design, comprising nine treatments *viz.,* T_1- Control, T_2- FYM, T_3- Poultry manure, T_4- Vermicompost, T_5- Composted coir pith, T_6- FYM+PGPRs, T_7- Poultry manure + PGPRs, T_8- Vermicompost + PGPRs, and T_9- Composted coir pith + PGPRs with three replications, applied after first irrigation.

Organic manures were applied by loosening the top soil around the tree using garden shovel. FYM (12.5 Kg/plant), poultry manure (4.13 kg/plant), vermicompost (5 kg/plant), and compost (5.50 kg/plant) were applied by making a ring of about 30 cm around the plant. The quantity of organic manure was calculated on an N-equivalent basis. Liquid PGPRs solutions like Trichoderma, Pseudomonas, PSB, KSB and Azotobacter were applied. Approximately 1 L of solution per plant was used (10 ml/litre). Other cultural operations were uniform irrespective of the treatments in the experimental plot, along with effective management of pests and diseases during the experimental period.

Quality parameters

Juice (%)

The fruits were cut into four to six parts using a clean stainless-steel knife, and the rind and arils were separated. The aril juice was extracted by pressing the arils with a polythene cover and weighed. The percentage of juice was calculated relative to the weight of the arils.

$$\text{Juice}\,(\%) = \frac{\text{Juice weight}}{\text{Weight of arils}} \times 100$$

Reducing sugars (%)

Reducing sugars present in the samples were estimated by DNSA (Dinitro salicylic acid) reagent method and was expressed in per centage. The clean and dried test tubes were taken to which 0.2, 0.4, 0.6, 0.8 and 1ml of prepared standard glucose was added. This was made up to 1ml using distilled water and 1ml of DNSA reagent was added to the test tube. The test tubes were closed with aluminium foil and were kept in boiling water bath for ten minutes then the test tubes were cooled and 4 ml of distilled water was added to it. The test tubes were vortexed and optical density was measured at 540 nm. Similarly test tubes with 0.25 ml of prepared sample were taken, volume was made up to 1 ml and DNSA reagent was added to the test tubes. These test tubes were kept for 10 minutes, cooled, then the optical density was measured at 540 nm in a spectrophotometer (Systronics visiscan 167). The amount of reducing sugar present in the sample was calculated using standard glucose curve and expressed in per centage (Ranganna, 1978).

$$\text{Reducing sugars (\%)} = \frac{\text{Glucose (mg) in sample from standard curve}}{\text{Aliquot taken for test (ml)}} \times \frac{\text{Vol. made (ml) after alcohol evaporation}}{\text{Vol. taken for alcohol evaporation (ml)}} \times \frac{\text{Vol. made(ml) after sample extraction}}{\text{Sample taken for extraction (mg)}} \times 100$$

Total sugars (%)

Total sugars present in the pomegranate fruit samples were estimated using the anthrone reagent method and was expressed in percentage. Sample aliquots (1.0 ml) were pipetted out and different concentrations (0.0, 0.2, 0.4, 0.6, 0.8, and 1.0 ml) of standard glucose solution were added to different test tubes. The volume was made up to 2.5 ml each with distilled water, and all the tubes were kept in an ice bath, 5 ml of anthrone reagent was added slowly, and the contents were stirred gently with a glass rod. Then the contents were heated on boiling water bath exactly for 7.5 minutes and cooled immediately in an ice bath. After cooling, the absorbance of the solution was measured at 630 nm in a spectrophotometer (Systronics visiscan 167) against the blank. Then the sugar content was calculated through standard glucose curve and expressed in percentage (Ranganna,1978).

The total sugars of the fruit can be calculated by the formula.

$$\text{Total sugars (\%)} = \frac{\text{Glucose (mg) in a sample from standard curve}}{\text{Aliquot taken (ml) for test}} \times \frac{\text{Vol. made after hydrolysis (ml)}}{\text{Vol. taken for alcohol hydrolysis (ml)}} \times \frac{\text{Vol. made after alcohol evaporation (ml)}}{\text{Vol. taken for evaporation (ml)}} \times \frac{\text{Vol. made after sample extraction (ml)}}{\text{sample taken for extraction (ml)}} \times 100$$

Total soluble solids (°Brix)

The arils from the selected fruits from each treatment were taken for juice extraction, and the total soluble solids of the juice were determined using a digital refractometer (Atago PAL-3) and expressed in °Brix.

Sugar: acid ratio

The sugar: acid ratio was calculated by dividing the total sugar percentage by the titratable acidity percentage and was expressed as the sugar: acid ratio.

Total anthocyanin content (mg/100g)

The quantitative determination of total anthocyanin content was done according to the method given by Lee *et al.* (2005).

i)Preparation of reagents

(a) pH 1.0 buffer (potassium chloride, 0.025 M) 1.86 g of KCl was weighed in a beaker and 980 ml of distilled water was added to it. The pH of it was measured and adjusted to pH 1.0 (±0.05) with HCl (6.3 ml). Then it was transferred to a 1 litre volumetric flask and diluted to volume with distilled water.

(b) pH 4.5 buffer (sodium acetate, 0.4 M) - 54.43 g $CH_3CO_2Na.3H_2O$ was weighed in a beaker and 960 ml of distilled water was added to it. The pH was measured and adjusted to pH 4.5 (±0.05) with HCl (20 ml). Then it was transferred to a 1 litre volumetric flask, and diluted to volume with distilled water.

ii) Preparation of test solution

The appropriate dilution factor was determined by diluting the test portion with pH 1.0 buffer until the absorbance at 520 nm is within the linear range of the spectrophotometer (Systronics visiscan 167). Using this dilution factor, two dilutions of the test sample were prepared: one with pH 1.0 buffer and the other with pH 4.5. The absorbance of the test portion diluted with buffer (pH 1.0) and pH 4.5 buffer was measured at 520 and 700 nm using a spectrophotometer. The diluted test portions were read against a blank cell filled with distilled water and expressed in mg per 100 g.

$$\text{Anthocyanin pigment (cyanidin-3-glucoside equivalents, mg/L)} = \frac{A \times MW \times DF \times 10^3}{\varepsilon \times 1}$$

Where,

A = (A520nm – A700nm) pH 1.0 – (A520nm – A700nm) pH 4.5

MW (molecular weight) = 449.2 g/mol for cyanidin-3-glucoside (cyd-3-glu)

DF = dilution factor

l = pathlength in cm

ε = 26 900 molar extinction coefficients, in L × mol^{-1} × cm^{-1}, for cyd-3-glucoside

10^3 = factor for conversion from g to mg

Total phenolic content (mg GAE / 100 g)

The Polyphenolic content of the fruit was determined using Folin-Ciocalteu reagent. Fruits that were fully ripened and reached maturity were sampled at the time of harvest. One millilitre of the extract solution was added to a flask containing 9 ml of distilled water. The extract solution was thoroughly mixed with 1 ml of Folin-Ciocalteu's phenol reagent. After 5 min, 10 ml of 7 per cent Na_2CO_3 was added. The mixture was further shaken and made up to 25 ml with the addition of 4 ml distilled water. The absorbance was measured at 750 nm after 90 min of incubation at room temperature using a spectrophotometer (Systronics visiscan 167). The polyphenolic content was expressed as milligrams of gallic acid equivalent (GAE) per 100 g (AOAC, 1980).

$$\text{Polyphenolic content}\left(\text{mg}\frac{\text{GAE}}{\text{g}}\right) = \text{C}\frac{\text{V}}{\text{m}}$$

Where,

c = Concentrations of gallic acid obtained from calibration curve in mg per ml

V= Volume of extract in ml

m = Mass of extract in gram.

100 aril weight per fruit (g)

Arils from the selected fruits for each treatment were removed, from which 100 arils were weighed using an electronic balance (Mettler Toledo-JE303GE). The average weight of 100 arils per fruit was calculated and expressed in grams.

Fruit colour and aril colour

The colour of the pomegranate fruits and arils were recorded using a colorimeter (Konica, Minolta CR-10, Japan). The instrument was calibrated using a black-and-white tile slide. The '*L**' value represents lightness or the degree of whiteness of the product and its value ranges between 0 (black) to 100 (white). Green colour of peel and aril is indicated by a negative or smaller value of '*a**' whereas, red colour is denoted by positive or higher '*a**' value. The '*b**' value represents variations from blue (-*b**) to yellow (+*b**).

Statistical analysis of experimental data

The data on quality parameters and physiological parameters were tabulated and subjected to statistical analysis using analysis of variance (ANOVA) for randomized block design (RBD) by Fisher and Yates (1963). Whenever the 'F' test was significant for comparing the means of the two treatments, the critical difference (C.D. at 5 %) was determined.

Results and Discussion

Juice (%)

Among the treatments, the application of Vermicompost + PGPRs showed the most significant results, with a maximum juice content of 58.69 per cent, whereas the control T_1 had the lowest juice content (52.82 %). Significant differences were observed between the moisture content treatments. The maximum moisture percentage (84.18%) was recorded in control T_1. The minimum moisture content (80.93 %) was recorded for T_6 –FYM + PGPRs.

Higher fruit and aril weights might have resulted in the maximum juice content per fruit. (Garhwal *et al.,* 2014). This might be because the optimum supply of proper plant nutrients through the application of organic matter in soil resulted in enriching soil fertility and ultimately the production of more photosynthates that accelerate the metabolic activities of the plants and juice content of the fruits (Marathe *et al.,* 2017). These results are in conformity with the findings of Vessey *et al. (*2003) and Mohamed *et al.* (2018) in pomegranate.

Table 1 : Effect of Organic manure and PGPRs on the quality attributes of pomegranate cv. Bhagwa.

Treatments	Juice (%)	Reducing sugars (%)	Total Sugars (%)
T_1- Control	52.82	10.27	12.20
T_2- FYM	54.21^{ns}	11.44^{*}	12.24^{ns}
T_3- Poultry manure	53.59^{ns}	11.47^{*}	12.32^{ns}
T_4- Vermicompost	57.37^{*}	11.51^{*}	12.40^{ns}
T_5- Composted coirpith	56.42^{*}	10.89^{ns}	12.21^{ns}
T_6- FYM + PGPRs	56.96^{*}	11.78^{*}	12.61^{ns}
T_7- Poultry manure + PGPRs	56.81^{*}	11.52^{*}	12.96^{ns}
T_8- Vermicompost + PGPRs	58.69^{*}	11.94^{*}	13.78^{*}
T_9- Composted coirpith + PGPRs	58.16^{*}	11.12^{ns}	12.44^{ns}
S. Em ±	0.63	0.26	0.24
C.D.@ 5%	1.89	0.78	0.72

*-significant @ 5%; ns- Non significant

Reducing sugars and Total sugars (%)

The data pertaining to the effect of organic manure and PGPRs indicates that the maximum reducing sugar (11.78 %) was recorded in T_6 - FYM + PGPRs while the minimum reducing sugar (10.27 %) was recorded in control T_1. The maximum total sugar (13.78 %) was observed in T_8 – Vermicompost + PGPRs. The lowest total sugar content was recorded in the control T_1 (12.24 %).

An increase in the total sugar content with vermicompost in combination with PGPRs application may be attributed to the rapid metabolic transformation of starch and pectin into soluble compounds, rapid translocation of sugars from leaves to developing fruits, and conversion of complex polysaccharides into simple sugars. These findings are in agreement with the results of Athani *et al.* (2009) in guava.

The significant improvement in reducing sugar might be due to the combined effect of organic manure and biofertilizers that exert regulatory roles and affect the quality of fruits, in which carbohydrate reserves of the roots and stem are drawn heavily by fruits. The similar results are reported by Hazarika and Ansari (2008) in banana, Osman and Rehman (2010) in fig and Yadav *et al.* (2007) in Aonla.

Table 2 : The effect of organic manure and PGPRs on the quality characteristics of pomegranate cv. Bhagwa.

Treatments	TSS (°Brix)	Sugar-acid ratio	Total anthocyanin content (mg/100g)
T_1-Control	14.80	20.61	18.13
T_2-FYM	15.08^{ns}	26.80^{*}	19.57^{ns}
T_3-Poultry manure	14.94^{ns}	25.55^{*}	21.29^{*}
T_4-Vermicompost	15.15^{ns}	25.52^{*}	21.61^{*}
T_5-Composted coirpith	15.14^{ns}	25.80^{*}	21.05^{ns}
T_6-FYM + PGPRs	15.65^{ns}	23.11^{*}	21.51^{*}
T_7-Poultry manure + PGPRs	15.14^{ns}	27.29^{*}	21.53^{*}
T_8-Vermicompost + PGPRs	15.91^{ns}	30.53^{*}	23.57^{*}
T_9-Composted coirpith + PGPRs	15.36^{ns}	26.20^{*}	22.30^{*}
S. Em ±	0.26	0.50	0.67
C.D. @ 5%	0.79	1.49	2.02

*-significant @ 5%; ns- Non significant

TSS (°Brix)

Among the different treatments, T_8 (Vermicompost + PGPRs) recorded the maximum total soluble solids level (15.91 °Brix) and the minimum level of TSS (14.80 °Brix) was recorded in control T_1.

The effect of organic manure and biofertilizer on increasing TSS could be due to their beneficial effect on the total leaf area of the plant, which is reflected in the production of more carbohydrates through photosynthesis. These results are agreed with those obtained by Patil and Asery (2009) in sweet orange, Singh *et al.* (2010) in strawberry.

The enhancement in the TSS content of the fruits can likely be attributed to the significant role played by plant growth-promoting microbial agents in increasing nutrient uptake, which in turn stimulates the catalytic activity of various enzymes involved in physiological processes, resulting in higher production of sugars and amino acids within the fruits (Dutta and Kundu, 2012). Pirlak and Kose (2009) also reported that root inoculation with bacterial strains significantly increased total soluble solids (8.15 %) in the strawberry cultivar Selva.

The increase in TSS content may be due to the hydrolysis of starch and other insoluble carbohydrates by hydrolytic enzymes into soluble sugars during ripening.

Sugar-acid ratio

Organic manure and PGPRs application significantly varied the sugar-acid ratio. The maximum sugar-acid ratio (30.53) was found in T_8 (Vermicompost + PGPRs) however, the minimum sugar-acid ratio was recorded in T_1 -control (20.61).

The application of organic manure improved nutrient absorption, enhanced photosynthesis, and balanced fruit ripening. All of these factors contribute to an increase in the sugar-acid ratio of the fruit.

Sugar: Acid ratio during development stages: Sugars remain low and acidity content remains high, but as the fruits mature, the sugars increase and the acid level decreases, thus increasing the ratio. The results of the present study agree with those reported by Priyanka *et al.* (2021).

Total anthocyanin content (mg/ 100g)

Application of organic manure and PGPRs had a marked influence on the total anthocyanin content. The maximum total anthocyanin content (23.57 mg/100 g) was observed in T_8 (Vermicompost + PGPRs). The lowest total anthocyanin content was observed in the T_1 control (18.13 mg/100 g).

The high percentage of humic acids in vermicompost benefits plant health by promoting the synthesis of phenolic compounds such as anthocyanins (Theunissen *et al.,* 2010). Similar results were reported in strawberry plants treated with bacterial strains, which consistently produced higher total anthocyanins than the untreated control.

Total phenolic content (mg GAE/ 100g)

The total phenolic content differed significantly among the treatments. The maximum total phenolic content (249.21 mg GAE/ 100g) was observed in T_7 (Poultry manure + PGPRs) and the minimum total phenolic content (192.78 mg GAE/ 100g) was recorded in control T_1.

Significant enhancements in total phenolics confirmed the potential of biofertilizers and organic manure to enhance the nutritive qualities of the crop. The present study results get support from Rahman *et al. (*2018), reported that treatments of strawberry plants with bacterial strains consistently produced higher phenolics as compared to non-treated control.

100 aril weight per fruit(g)

Vermicompost + PGPRs exhibited the most promising results by greatly increasing the 100 aril weight per fruit 44.70 g, whereas the minimum results 36.00 g were recorded in control T_1. The application of vermicompost and PGPRs showed a significant increase in number of arils per fruit and weight.

The nutrients supplemented with Organic manure along with biofertilizers increased aril weight. It might be due to optimum supply of proper plant nutrients through building of organic matter in soil resulted in enriching soil fertility and ultimately production of more photosynthates that accelerates the metabolic activities of the plants. These results are in conformity with the findings of Vessey *et al.* (2003) Mohamed *et al.* (2018) and Jat *et al.* (2023) in pomegranate.

Fruit colour and aril colour

Among different treatments, Treatment T_8 (Vermicompost + PGPRs) showed the maximum *a** (50.24) and the minimum *L** and *b** coordinates in Fruit colour (31.10 and 22.72 respectively). The same treatment showed increased *a** (15.82) and decreased *L** and *b** values (15.60 and 1.10) in aril colour.

Organic manures provide a balanced and sustained supply of nutrients such as potassium, which is essential for colour development in the outer skin of the fruit. Adequate potassium levels can enhance the intensity and uniformity of the outer colour of the fruit. The colour in pomegranate arils is primarily due to anthocyanins. Organic manure enhances the availability of nutrients that are directly involved in the biosynthesis of anthocyanins, leading to deeper and more intense aril coloration.

The colour of pomegranates is an important factor that clearly affects market acceptance and consumer preference. During ripening, *L** and *b** value decreased while *a** value increased. The same behaviour was reported by Manera *et al.* (2012) in pomegranates. As the value of *a** increases and the value of *L** decreases steadily, the green colour of pomegranate rind is replaced by the red colour (Nuncio *et al.,* 2013).

The increase in the *a**coordinate in arils, is due to the increased biosynthesis and accumulation of anthocyanin pigments, which are responsible for the intense red colour of ripe pomegranate fruits. Hernandez *et al.* (1999) reported that the anthocyanin profile changed during fruit ripening delphinidin-3, 5-diglucoside was the main pigment in the early fruit ripening stage, followed by cyaniding-3, 5-diglucoside. However, in the later stages, the monoglucoside derivatives cyaniding-3-glucoside and delphinidin-3-glucoside increased considerably (Nuncio *et al.,* 2013).

Table 3 : The effect of organic manure and PGPRs on the quality characteristics of pomegranate cv. Bhagwa.

Treatments	Total phenolic content (mg GAE/100g)	100 aril weights (g)
T_1- Control	203.25	36.00
T_2- FYM	222.48*	39.91*
T_3- Poultry manure	207.48*	39.85*
T_4- Vermicompost	218.16*	39.37*
T_5- Composted coirpith	227.89*	39.86*
T_6- FYM + PGPRs	223.30*	41.54*
T_7- Poultry manure + PGPRs	249.21*	41.18*
T_8- Vermicompost + PGPRs	224.29*	44.70*
T_9- Composted coirpith + PGPRs	233.79*	41.11*
S. Em ±	3.42	0.51
C.D.@ 5%	10.25	1.52

*-significant @ 5%; ns- Non significant

Table 4 : Effect of Organic manures and PGPRs on fruit and aril colour of pomegranate cv. Bhagwa.

Treatments	Fruit peel colour			Aril colour		
	*L**	*a**	*b**	*L**	*a**	*b**
T_1- Control	46.08	39.06	30.47	24.30	8.65	2.33
T_2- FYM	37.80^{ns}	45.53*	23.43*	18.36*	12.98*	1.46*
T_3- Poultry manure	38.16^{ns}	47.35*	26.16*	17.51*	14.36*	1.42*
T_4- Vermicompost	38.61^{ns}	44.41*	28.34*	18.39*	15.34*	2.24^{ns}
T_5- Composted coirpith	34.39*	43.51*	26.37*	18.41*	13.49*	1.36*
T_6- FYM + PGPRs	37.48*	47.44*	24.55*	16.42*	15.39*	1.27*
T_7- Poultry manure + PGPRs	38.36^{ns}	49.56*	25.46*	17.46*	12.63*	1.38*
T_8- Vermicompost + PGPRs	31.10*	50.24*	22.72*	15.60*	15.82*	1.10*
T_9- Composted coirpith + PGPRs	39.21^{ns}	43.05*	26.30*	19.26*	12.36*	1.75*
S. Em ±	2.03	0.19	0.10	0.09	0.18	0.08
C.D.@ 5%	6.08	0.58	0.31	0.27	0.53	0.25

*-significant @ 5%; ns- Non significant

Conclusion

Based on the above results, it can be concluded that Vermicompost + PGPRs recorded maximum Juice per cent, reducing sugars, total sugars, TSS, sugar - acid ratio, Total anthocyanin, Total phenolic content. However, Poultry manure + PGPRs showed *on par* results with Vermicompost + PGPRs on quality parameters in pomegranate cv. Bhagwa under central dry zone of Karnataka.

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