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# EFFECT OF FOLIAR APPLICATION OF LIQUID ORGANIC MANURES ON QUALITY OF GRAPES CV. MANJRI NAVEEN

**Priya James[1*], Sateesh V. Pattepur[2], S. N. Patil[1], Sanjeevraddi G. Reddi[3] and Mallikarjun Awati[4]**

[1]Department of Fruit Science, College of Horticulture, Bagalkot - 587104, Karnataka, India

[2]Department of Fruit Science, Kittur Rani Channamma College of Horticulture, Arabhavi – 591218, Karnataka, India

[3]Department of Agronomy, Officer to the Vice Chancellor, College of Horticulture, Bagalkot - 587104, Karnataka, India

[4]Department of Biotechnology and Crop Improvement, College of Horticulture, Bagalkot - 587104, Karnataka, India

*Corresponding author E-mail: *priyajm99@gmail.com*

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**ABSTRACT**

A field experiment was conducted during the year of 2023-24 at Main Horticulture Research and Extension Centre (MHREC) under the University of Horticultural Sciences, Bagalkot inorder to evaluate the effect of various organic liquid manures on quality of grapes cv. Manjri Naveen. The experiment was laid out in a randomized block design with three replications and twelve treatments. The results revealed that, $T_{11}$ treatment [panchagavya (3%) + jeevamrutha (3%) + vermiwash (1.5%) + humic acid (0.3%)] recorded the highest TSS (19.77 °Brix), TSS to acid ratio (36.65), berry firmness (3.92 N), juice content (68.11 %), organoleptic evaluation of texture (8.11), taste (8.28), flavour (8.38), overall acceptability (8.52) and lowest acidity (0.54%) and shattering percentage (6.64 %).

***Keywords*: **Grapes, foliar application, total soluble solids, jeevamrutha, quality

## Introduction

Grapes are one of the most significant commercial fruit crops, originally native to Armenia, near the Caspian Sea, and introduced to India by Persian invaders around 1300 A.D. Botanically classified as a berry, grapes are non-climacteric fruits belonging to the genus Vitis, growing on deciduous and perennial woody vines. This fruit is known for its pleasant taste and is rich in sugars, acids, vitamins, and minerals (Pezzuto, 2018). In India, grapevines thrive across various soil types and climates, including hot and mild tropical regions. The country produces approximately 3,490 thousand metric tons of grapes annually on 175.93 thousand hectares (NHB 2021-22), with Maharashtra being the largest producer, contributing 78.3% of the national grape output (Kurubar *et al.*,, 2023).

The pressure on agriculture to deliver high-quality yields is increasing as the population continues to grow rapidly. Although chemical fertilizers are a key part of modern agricultural systems, they negatively impact soil health, crops grown in these soils, beneficial microbial populations, humans, wildlife and water ecosystems. Additionally, the rising costs of inorganic fertilizers have made them unaffordable for small and marginal farmers (Gore and Sreenivasa, 2011). At the same time, growing consumer awareness of the benefits of organic food has driven demand for organic inputs among farmers, aiming to produce safe, cost-effective organic agricultural products. Liquid organic manures are natural preparations that can sustainably address this issue by improving the general health, vitality, growth of plants and protect them against infections. Liquid organic manures are obtained by active fermentation of animal products and plant residues over specific duration. The liquid organic solutions include helpful bacteria, growth-promoting hormones such indole acetic acid and gibberellic acid, vital micronutrients, several vitamins and necessary amino acids (Vala and Chauda, 2021).

Panchagavya, a multicomponent ayurvedic formulation made from cow dung, urine, milk, curd, and ghee (Naresh *et al.,,* 2018), undergoes proper mixing and incubation to create a fermented solution with remarkable effects on crops (Chandra *et al.,,* 2019). Rich in macronutrients, micronutrients, vitamins, essential amino acids, growth-promoting factors like auxins and gibberellins and beneficial microbes, panchagavya acts as a tonic to enrich the soil and enhance plant vigour, leading to high-quality production (Pathak and Ram, 2013). Jeevamrutha is a fermented microbial culture that not only provides nutrients but also acts as a catalyst, enhancing soil microbial activity and increasing the population of native earthworms (Jhade *et al.,,* 2020).

Vermiwash, is a liquid biofertilizer collected after the passage of water through a column of worm activation (Gulsar and Iyer, 2006). The nutrients present in vermiwash are in water soluble form and intermediate requirement of a number of components can be met from a single source. Numerous helpful bacteria found in fresh vermiwash aid in plant growth and shield it from various pests (Sundararasu, 2016). Humic acids (HAs) are macromolecules that comprise humic substances (HS), which are organic matter distributed in terrestrial soil, natural water and sediments resulting from the decay of vegetable and natural residues (De melo *et al.,*, 2016). The phenol , carboxylic acid and quinone functional groups of HAs play a major role in their antioxidant, antimutagenic, fungicidal and bactericidal properties within the HA's structure (Siddiqui *et al.,*, 2009). Considering the efficiency of these organic liquid manures at different growth stages on quality parameters, the present experiment on effect of foliar application of various liquid organic manures on quality of grapes cv. Manjri Naveen was taken up.

## Material and Methods

The present investigation was conducted during the year of 2023-24 at Main Horticulture Research and Extension Centre (MHREC) under the University of Horticultural Sciences, Bagalkot. The site was geographically situated at 16$^{o}$ 10' North latitude, 75$^{o}$ 42' East longitude and an altitude of 542 m above mean sea level. The experiment site soil texture is red sandy loam soil with good physical qualities and drainage with a pH of 8.05 and an EC of 0.15 dS/m. The study location experienced a minimum and maximum temperatures were 17.07 $^{0}$C and 38.33 $^{0}$C respectively, with an average annual rainfall of 255.6 mm.

To conduct the field experiment, 12-year-old grapevines of cv. Manjri Naveen which were planted at a spacing of 3 m x 1.5 m and trained on a Y trellis system were selected. A total of 180 plants were chosen using a randomized block design. The selected plants for the experiment were pruned uniformly during the third week of October 2023, as part of the October pruning.

**Treatment details**

$T_1$ – Panchagavya (3%)

$T_2$ – Jeevamrutha (3%)

$T_3$ – Vermiwash (1.5%)

$T_4$ – Humic acid (0.3%)

$T_5$ – Panchagavya (3%) + Jeevamrutha (3%)

$T_6$ – Panchagavya (3%) + Vermiwash (1.5%)

$T_7$ – Panchagavya (3%) + Humic acid (0.3 %)

$T_8$ – Jeevamrutha (3%) + Vermiwash (1.5%)

$T_9$ – Jeevamrutha (3%) + Humic acid (0.3 %)

$T_{10}$ – Vermiwash (1.5%) + Humic acid (0.3 %)

$T_{11}$ – Panchagavya (3%) + Jeevamrutha (3%) + Vermiwash (1.5%) + Humic acid (0.3 %)

$T_{12}$ – Control

The imposition of the treatments was during 15 – 20 days, 25-30 days and 45-50 days after October pruning by foliar application method.

Panchagavya was prepared by mixing desi cow dung of 2.5 kgs, 450 g desi cow ghee, 3.5 litres of desi cow urine, 3.5 litres of water, 1 litre of desi cow milk, 750 ml of desi cow curd, 1 kg of jaggery, tender coconut water of 1 litre, 4 ripened cavendish bananas and allowed for fermentation. By 30$^{th}$ day, panchagavya was ready for spraying to the plants. Jeevamrutha preparation also involved the mixing of 2.5 kgs cow dung, 2.5 litres of cow urine, 25 litres of water, 500 g pulse flour, 500 g jaggery and was ready for use by 7 days. Both panchagavya and jeevamrutha was mixed properly twice a day as well as the barrel was placed in a shaded area and covered with a cotton cloth to keep houseflies away and prevent the development of maggots in the solution during the preparation and storage. For the preparation of vermiwash, adult earthworms of 500 gram were collected from vermicompost pit and were dropped into 1250 ml of lukewarm (37°- 40°C) distilled water, agitated for 2 minutes. Earthworms were removed and given a second washing in 100 ml of water that was at room temperature (+30°C). The earthworms were agitated in the warm water, which caused them to discharge enough mucus and body fluid to create the vermiwash. Further the solution was filtered and used for applications (Jandaik *et al.,* 2015). For humic acid treatment, a commercially available solution named Super Humic 15% having a composition of 10% humic acid and 5% fulvic acid was used for spraying.

Quality parameters analysis were conducted after the harvest of the bunches in February 2024.

### Total soluble solids (TSS)

The total soluble solid (TSS) content was measured using a digital hand refractometer.

### Titratable acidity (%)

Titratable acidity was assessed by titration method using Phenolphthalein as indicator.

### TSS: acid ratio

TSS to acid ratio was calculated by dividing TSS (°Brix) to titratable acidity (%) of fruits.

### Berry firmness

Berry firmness was evaluated using the TAXT plus texture analyzer, which punctured the berry with a 2 mm cylinder probe. The peak force value displayed on the graph was utilized to determine the texture value, measured in Newton force (N).

### Shattering (%)

The shattering percentage was recorded by shaking the bunch after harvest, counting the dropped berries in comparison to total number of berries in the bunch.

### Juice content (%)

The berry juice content was calculated by weighing 50 g of berries and extracting juice from it. The juice content was determined as volume of juice to weight of berry pulp.

$$\text{Juice content per cent (v/w)} = \frac{\text{Volume of juice (ml)}}{\text{Weight of berry pulp (g)}} \times 100$$

### Organoleptic evaluation

Organoleptic evaluation was carried out by a group of 10 semi-trained judges who assessed the grape berries using a nine-point hedonic scale for colour, taste, flavour, texture/consistency and overall acceptability.

All of the data for the aforementioned parameters were tabulated and statistical analysis (ANOVA) was carried out using a randomized block design. The results were tested at a 5% level of significance using Cochran and Cox's (1957) method of analysis of variance. The critical difference of 5 % was established when the 'F' test for comparing treatment means was demonstrated to be significant.

## Results and Discussion

The treatment $T_{11}$ which is a combined application of panchagavya (3%), jeevamrutha (3%), vermiwash (1.5 %) and humic acid (0.3 %) resulted in the highest TSS (19.77 °Brix), least titratable acidity (0.54 %) and highest TSS:acid ratio (36.65) and the lowest TSS (16.56 °Brix), highest titratable acidity (0.79 %) and lowest TSS:acid ratio (20.88) was recorded in control ($T_{12}$). Cytokinins present in panchagavya stimulate carbohydrate metabolism and establish new source-sink connections, thereby increasing TSS concentration in fruits (ShM *et al.,* 2017). The application of jeevamrutha likely accelerated the metabolic conversion of starch and pectin into soluble compounds and facilitated the rapid translocation of sugars from leaves to developing fruits (Sahana *et al.,* 2020). Vermiwash contributed to the increased transfer of photosynthetic byproducts from leaves to developing fruits, leading to a rise in total sugars (Rajkumar *et al.,* 2019). The enhancement in sugar content could also be due to application of humic acid, which play a crucial role in carbohydrate synthesis and breakdown, translocation, protein synthesis, nutrient availability and the stimulation of pigment accumulation leading to greener leaves with enhanced photosynthetic efficiency. This improved efficiency results in the production of more assimilates, which are reflected in higher total soluble solids (Maha and Abdel salam, 2016).

The decrease in titratable acidity of berries with the application of panchagavya and jeevamrutha treatments may be due to the beneficial effects of boron and zinc, which facilitate the conversion of acids into sugars and their derivatives through glycolytic pathways or their utilization in respiration (Jhade *et al.,* 2020). Khachi *et al.* (2015) reported that, the easily assimilated nutrients in vermiwash decrease acidity and improve fruit quality. Typically, as total soluble solids increase and acidity decreases, the TSS to acidity ratio also rises.

In case of juice content, the treatment $T_{11}$ recorded the maximum value (68.11 %) and the minimum (54.31 %) was exhibited in control treatment. Panchagavya, jeevamrutha, and vermiwash serve as powerful plant growth stimulants. They enhance the biological efficiency of crops, stimulate a surge in soil biological activity, make nutrients more accessible to plants and improve the berry characteristics (Devi and Singh, 2023). The increase in pulp weight could be attributed to humic acid's stimulation of photosynthetic pigments which enhances the photosynthesis rate. This, in turn, leads to the production of a higher amount of carbohydrates within the fruit tissues. Thus, the improved berry length, diameter and the enhanced pulp content have led to the highest juice content.

The highest berry firmness (3.92 N) was noted in $T_{11}$ treatment and the lowest firmness (2.89 N) was observed in control. The use of liquid organic manures, which are rich in potassium, plays a major role in regulating plant water status, controlling stomatal activity, and enhancing photosynthesis (Yadav *et al.,* 2011). Additionally, panchagavya is known to enhance calcium uptake, a vital nutrient for cell wall stability, thereby contributing to a firmer fruit texture (Sau *et al.,* 2017). Jeevamrutha further stimulate the production of secondary metabolites such as phenolics and lignin which strengthen cell walls and improve fruit firmness. Vermiwash, rich in nutrients including calcium, when applied to grapevines, can boost plant health and vigour. Enhanced nutrient uptake improves berry development and results in firmer fruit. Application of humic acid to creating favourable conditions to facilitate nutrient uptake by roots and cause increase in calcium and fruit firmness (El-Razek *et al.,* 2012).

The present study revealed a significant difference in shattering (%) among the various treatment combinations. Treatment $T_{11}$ resulted in the lowest shattering at 6.64%, while the highest shattering (9.22 %) was observed in control treatment. Panchagavya and jeevamrutha contain plant hormones like auxins, gibberellins and cytokinins, which are essential for fruit development and retention. These hormones can influence fruit set and shedding. Additionally, these substances are known to have antioxidant properties, which may help protect grapevines from oxidative stress and enhance fruit retention as noted by Sugha (2005). The beneficial compounds and microorganisms in vermiwash may assist grapevines in managing stressors like water stress or disease pressure, potentially reducing premature berry drop, as suggested by Rajkumar *et al.* (2019). Humic acid improves the uptake and availability of essential nutrients like calcium and magnesium, which are vital for strengthening cell walls and enhancing fruit set and attachment. Additionally, it boosts the plant's resilience to environmental stressors, thereby reducing fruit drop and improving berry attachment.

The data on berry texture, taste, flavour and overall acceptability exhibited significant variations across different treatments. Treatment $T_{11}$ yielded the highest scores for texture (7.86), taste (8.07), flavour (7.73) and overall acceptability (8.08). Smith *et al.* (2002) reviewed several studies and found that organic fruits and vegetables are often reported to be fresher and better tasting. For instance, Michael (2010) conducted a study on red lettuce and found that applying organic fertilizers in the field resulted in lettuce with improved taste and appearance. Similarly, increased potassium levels have been shown to enhance the sweetness of peaches, as demonstrated by Javana *et al.* (2012). This increase in sweetness is likely due to potassium's role in the biosynthesis and transfer of sugars as concluded by Karam *et al.* (2003).

## Conclusion

The present study reveals that application of liquid organic manures has enhanced the quality parameters. Among the treatment combinations, combined application of panchagavya (3 %), jeevamrutha (3 %), vermiwash (1.5 %) and humic acid (0.3 %) improved the TSS, TSS:acid ratio, juice content, berry firmness as well as reducing the acidity and shattering percentage. These liquid organic manures can be a partial alternative for the use of inorganic inputs to maintain soil and plant health for sustainable development.

**Table 1 :** Total soluble solids, titratable acidity, TSS to acid ratio, juice content, berry firmness and shattering percentage of grapes cv. Manjri Naveen as influenced by foliar application of liquid organic manures

| Treatment | Total Soluble Solids ($^0$ Brix) | Titratable acidity (%) | TSS to acid ratio | Juice content (%) | Berry firmness (N) | Shattering (%) |
|---|---|---|---|---|---|---|
| $T_1$ | 17.67 | 0.69 | 25.60 | 56.43 | 3.38 | 8.32 |
| $T_2$ | 17.20 | 0.73 | 23.68 | 56.24 | 3.21 | 8.60 |
| $T_3$ | 16.94 | 0.75 | 22.50 | 55.91 | 3.10 | 8.82 |
| $T_4$ | 17.77 | 0.66 | 26.92 | 56.85 | 3.44 | 8.14 |
| $T_5$ | 18.32 | 0.62 | 29.71 | 61.83 | 3.62 | 7.27 |
| $T_6$ | 18.13 | 0.65 | 28.05 | 59.32 | 3.57 | 7.59 |
| $T_7$ | 19.46 | 0.56 | 35.89 | 67.23 | 3.83 | 6.83 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **$T_8$** | 17.89 | 0.66 | 27.10 | 57.16 | 3.49 | 7.75 |
| **$T_9$** | 19.11 | 0.57 | 35.66 | 66.71 | 3.76 | 7.04 |
| **$T_{10}$** | 18.51 | 0.60 | 32.70 | 64.43 | 3.67 | 7.21 |
| **$T_{11}$** | 19.77 | 0.54 | 36.65 | 68.11 | 3.92 | 6.64 |
| **$T_{12}$** | 16.56 | 0.79 | 20.88 | 54.31 | 2.89 | 9.22 |
| **S.Em ±** | **0.25** | **0.01** | **0.41** | **0.95** | **0.03** | **0.10** |
| **CD at 5%** | **0.80** | **0.03** | **1.25** | **2.91** | **0.09** | **0.36** |

**$T_1$**: Panchagavya (3%)
**$T_2$**: Jeevamrutha (3%)
**$T_3$**: Vermiwash (1.5%)
**$T_4$**: Humic acid (0.3 %)
**$T_5$**: Panchagavya (3%) + Jeevamrutha (3%)
**$T_6$**: Panchagavya (3%) + Vermiwash (1.5%)
**$T_7$**: Panchagavya (3%) + Humic acid (0.3 %)
**$T_8$**: Jeevamrutha (3%) + Vermiwash (1.5%)
**$T_9$**: Jeevamrutha (3%) + Humic acid (0.3 %)
**$T_{10}$**: Vermiwash (1.5%) + Humic acid (0.3 %)
**$T_{11}$**: Panchagavya (3%) + Jeevamrutha(3%) + Vermiwash (1.5%) +Humic acid(0.3 %)
**$T_{12}$**: Control

**Table 2 :** Organoleptic evaluation of grapes cv. Manjri Naveen as influenced by foliar application of liquid organic manures

| Treatment | Colour | Texture | Taste | Flavour | Overall acceptability |
|---|---|---|---|---|---|
| **$T_1$** | 7.09 | 7.33 | 7.41 | 7.55 | 7.38 |
| **$T_2$** | 7.05 | 7.28 | 7.33 | 7.50 | 7.25 |
| **$T_3$** | 6.88 | 7.27 | 7.29 | 7.41 | 7.18 |
| **$T_4$** | 7.14 | 7.38 | 7.41 | 7.59 | 7.46 |
| **$T_5$** | 7.40 | 7.46 | 7.67 | 7.66 | 7.68 |
| **$T_6$** | 7.37 | 7.40 | 7.62 | 7.65 | 7.62 |
| **$T_7$** | 7.79 | 7.86 | 8.15 | 8.24 | 8.12 |
| **$T_8$** | 7.30 | 7.38 | 7.53 | 7.58 | 7.50 |
| **$T_9$** | 7.75 | 7.76 | 8.11 | 7.90 | 8.00 |
| **$T_{10}$** | 7.67 | 7.51 | 7.85 | 7.72 | 7.75 |
| **$T_{11}$** | 7.89 | 8.11 | 8.28 | 8.38 | 8.52 |
| **$T_{12}$** | 6.76 | 6.72 | 6.86 | 6.92 | 6.82 |
| **S.Em ±** | **0.81** | **0.13** | **0.11** | **0.14** | **0.14** |
| **CD at 5%** | **NS** | **0.42** | **0.37** | **0.43** | **0.44** |

**$T_1$**: Panchagavya (3%)
**$T_2$**: Jeevamrutha (3%)
**$T_3$**: Vermiwash (1.5%)
**$T_4$**: Humic acid (0.3 %)
**$T_5$**: Panchagavya (3%) + Jeevamrutha (3%)
**$T_6$**: Panchagavya (3%) + Vermiwash (1.5%)
**$T_7$**: Panchagavya (3%) + Humic acid (0.3 %)
**$T_8$**: Jeevamrutha (3%) + Vermiwash (1.5%)
**$T_9$**: Jeevamrutha (3%) + Humic acid (0.3 %)
**$T_{10}$**: Vermiwash (1.5%) + Humic acid (0.3 %)
**$T_{11}$**: Panchagavya (3%) + Jeevamrutha(3%) + Vermiwash (1.5%)+Humic acid(0.3 %)
**$T_{12}$**: Control

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