

Effect of Biofertilizers on Yield and Quality Attributes of Grape cv. Muscat Hamburg

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(Received 26 September 2022, Accepted 09 November, 2022)

(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: An experiment was carried out at farmer's field, to study the effect of biofertilizers on the yield and quality of grape cv. Muscat Hamburg. The biofertilizers viz., *Azotobacter*, phosphate solubilising bacteria and potash releasing bacteria were applied at the rate of 100 g, 200 g and 300 g each along with 75% and 100% recommended dose of fertilizers and control. Among the treatments, the application of 300 g each of *Azotobacter*, phosphate solubilising bacteria, potash releasing bacteria along with 100% recommended dose of fertilizers exhibited profound effect on yield and yield attributing traits, reflected by higher number of bunches (32.05 per vine), maximum bunch weight (275.81 g) and maximum yield (8.84 kg/vine). The same treatment also positively influenced the quality attributes viz., TSS, TSS: acid ratio and total sugars. Application of biofertilizers along with 100% recommended dose of fertilizers have better impact on yield and quality attributes of grape cv. Muscat Hamburg.

Keywords: *Azotobacter*, phosphate solubilising bacteria, potash releasing bacteria, yield, quality.

INTRODUCTION

Grapes is one of the commercially grown fruit crops of the world as well as in India and serves as a good source of minerals (calcium, iron, phosphorus) and vitamins (B₁ and B₂). It originated from Armenia near the Caspian Sea of Russia, from where it spread westward to Europe and eastward to Iran and Afghanistan. Grape is a versatile crop and though it originated in temperate region, it is amenable for cultivation in tropical and subtropical climatic conditions. In North India, where the winter temperatures rarely reach the freezing point, the vines undergo dormancy whereas in South India, the winter is mild and the vines do not undergo dormancy and remain evergreen throughout the year. The cultivation of grape under Tamil Nadu condition is very unique as the pruning for production is done twice at an interval of five months enabling five crops in two years unlike a single crop in a year for yield under North Indian condition. Muscat Hamburg is an important seeded variety grown commercially in the state of Tamil Nadu for table purpose. The variety is pruned to short canes (5-6 buds), bunch medium to large, shouldered compact, berry small to medium, spherical, pink to blackish purple, opaque, strongly adherent with pedicel, pulp light green, soft, sweet, juicy, mildly scented, good

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eating quality with characteristic muscat flavour. Grapes vine demands good amount of nutrients and the response of growth, productivity and quality are mainly based on the amount of nutrients made available to the grapevine. Grapes have been highly exploited by the application of inorganic fertilizers. However, the excess usage of inorganic fertilizers leads to deterioration of soil and environment (Ayoub, 1999). Bio-fertilizers help to enhance overall soil fertility by modifying soil texture, soil structure integrity, aeration, increased nutrient availability, thereby greatly influencing plant growth and yield. Bio-fertilizers (*Azotobacter*, Phosphate solubilizing bacteria (PSB), Potash releasing bacteria (KRB) combined with organic manure influence the plant growth by enhancing root biomass and total root surface, which in turn facilitates higher absorption of nutrients and increases yield in wheat (Game et al., 2020). *Azotobacter chroococcum* is one of the free living N₂ fixing, non-symbiotic and heterotrophic bacteria ascribed to fix nitrogen from the atmosphere. It is also associated with the production of growth promoting substances, phytohormones and antifungal substances (Singh and Varu 2013). It also increases the uptake of nutrients and helps in synthesis of amino acids and proteins. *Bacillus megaterium var. phosphaticus* is one of the phosphate solubilising

bacteria, which helps in transformation of unavailable form of phosphorous to available form (Džami and Stevanovi 2000). *Bacillus mucilaginosus* is one of the soil bacteria and is commonly used as a bio fertilizer to release potassium from the soil minerals (Yang *et al.*, 2016). Hence, this study was carried out to evaluate the effect of biofertilizers on yield and quality of grape cv. Muscat Hamburg.

MATERIALS AND METHODS

The experiment was taken up in the farmer's field, on eight years old grapevines cv. Muscat Hamburg grafted on Dog Ridge rootstock. The vines were trained on bower system and maintained at a spacing of 4 m × 2 m. Soil type of the experimental plot was sandy loam with pH, EC, available N, P and K of 7.67, 0.08 dS/m, 224 kg/ha, 38 kg/ha and 199.5 kg/ha respectively. The grapevines of mean girth 12±0.9 cm were chosen for the study and the experiment was laid out in a Randomized Block Design consisting of seven treatments with three replications as detailed below:

T ₁ : 100% RDF (200: 160:600 g NPK/vine) (control)
T ₂ : 100% RDF +100 g <i>Azotobacter</i> +100 g PSB+ 100 g KRB/ vine
T ₃ : 100% RDF + 200 g <i>Azotobacter</i> + 200 g PSB+200 g KRB/vine
T ₄ : 100% RDF + 300 g <i>Azotobacter</i> + 300 g PSB +300 g KRB/vine
T ₅ : 75% RDF + 100 g <i>Azotobacter</i> + 100 g PSB +100 g KRB/ vine
T ₆ : 75% RDF + 200 g <i>Azotobacter</i> + 200 g PSB +200 g KRB/vine
T ₇ : 75% RDF + 300 g <i>Azotobacter</i> + 300 g PSB +300 g KRB/vine

The biofertilizers *viz.*, *Azotobacter*, phosphate solubilizing bacteria (PSB) and potash releasing bacteria (KRB) obtained from the Department of Agricultural Microbiology, TNAU, Coimbatore were used for the present study. The recommended dose of fertilizers (RDF) for grapevine cv. Muscat Hamburg is 200: 160:600 g NPK/vine. Immediately after pruning of the grapevines, the biofertilizers were applied as per the treatments along with well decomposed farmyard manure. The inorganic fertilizers corresponding to full dose of nitrogen and phosphorus and half the dose of potassium were applied two weeks after pruning. The remaining half dose of potassium was applied 60 days after pruning as top dressing.

Observations on yield and quality parameters *viz.*, number of bunches per vine, bunch weight, yield per vine, TSS, TSS: acid ratio and total sugars were recorded. The number of bunches per vine was calculated by taking count on number of bunches appeared on each vine. The harvested bunches from vines were weighed and computed for mean bunch weight (g). The total bunch yield per vine was computed by multiplying number of bunches with mean bunch weight. The TSS content in the pulp was determined by using the juice squeezed from the pulp and the reading was noted by using "ERMA" hand refractometer. Acidity was estimated by titrating the fresh juice extracted from pulp against 0.1 N NaOH added with phenolphthalein indicator by Ranganna

(1986) and the value expressed as percent tartaric acid equivalents. TSS: Acid ratio was calculated by dividing TSS (⁰ Brix) by acidity (%). The total sugars, reducing sugars and non-reducing sugars were estimated by the method suggested by Somogyi (1952). The sugar acid ratio was calculated by dividing total sugar percentage in pulp with percent acidity. The data recorded on the above mentioned attributes were analysed statistically (Panse and Sukhatme 1985).

RESULTS AND DISCUSSION

In the present study, the application of biofertilizers along with normal and reduced levels of RDF was found to exhibit significant influence on yield and quality attributes of grape cv. Muscat Hamburg (Table 1). The vines treated with 300 g *Azotobacter* + 300 g PSB + 300 g KRB/vine along with 100% RDF (T₄) performed significantly superior for the yield parameters *viz.*, number of bunches (32.05), bunch weight (275.81g) and yield per vine (8.84 kg) (Table 1). The application of biofertilizers along with organic manures improved the availability of nutrients in the soil which in turn increases the capability of the plants to uptake the solutes from the rhizosphere (Liaquat *et al.* 2018; Thavaprakash *et al.*, 2005). The nitrogen fixers are responsible for better production and transport of plant growth promoting substances (Athani *et al.*, 2007). The maximum bunch weight in T₄ might be due to improved internal nutrient content of the plant leading to increased growth and vigour associated with photosynthesis and finally translocation of assimilates into the fruits (Hansen, 1969). Likewise El-Naggar, 2004 observed that *Azotobacter* was found in improving nutritional status of vine, yield, physical and chemical qualities of grapevines. The increased bunch weight might have contributed for the increased yield per vine in the treatment T₄. The increase in yield by the application of biofertilizers with organic manures as recorded in the present study might also be attributed to the availability of rich source of macronutrients, micronutrients, vital plant promoting substances, which are known to increase the vigour and yield of plants. Earlier similar results was also reported by Kanitkar *et al.* (2019) in grapes.

The fruit quality in grapes is mainly assessed by biochemical components like total soluble solids, sugar acid ratio and acidity. Fruit quality parameters were superior in berries from the treatment T₄. T₄ recorded the maximum TSS (18.33⁰brix), minimum acidity (0.21 per cent), maximum TSS: Acid ratio (87.28), total sugars content (15.33 per cent), reducing sugars (14.06 per cent), highest sugar : acid ratio (73.00) (Table 2). The application of normal and reduced dosage of inorganic fertilizers along with biofertilizers such as *Azotobacter*, Phosphate Solubilising Bacteria (PSB) and Potash Releasing Bacteria (KRB) revealed a regulatory on absorption and translocation of various metabolites. This leads to increase in TSS, reduced acidity and

production of good quality fruits (Abou-El-Hamd *et al.*, 2006; Ram *et al.*, 2007). An increase in total sugars was observed in the treatment T₄ supplied with biofertilizers, organic manures and chemical fertilizers. This might be due to quick metabolic transformation of compounds which is soluble and lead to enhanced

conversion of organic acids into sugar (polysaccharide degraded to monosaccharide) (Hazarika *et al.*, 2015). Enhanced N and K concentrations in petioles might have improved TSS, TSS Acid ratio but decreased acidity (El-Razek *et al.*, 2011) in grape cv. 'Crimson Seedless'.

Table 1: Effect of biofertilizers on yield and yield attributing traits in grape cv. Muscat Hamburg.

Treatments	Bunch weight (g)	Number of bunches per vine	Yield per vine (kg/vine)
T ₁ - 100% RDF (control)	259.40	22.90	5.94
T ₂ - 100% RDF + 100 g <i>Azotobacter</i> + 100g PSB + 100 g KRB/ vine	250.54	25.50	6.39
T ₃ - 100% RDF + 200 g <i>Azotobacter</i> + 200 g PSB + 200g KRB/vine	264.64	29.46	7.80
T ₄ - 100% RDF + 300 g <i>Azotobacter</i> + 300 g PSB + 300g KRB/vine	275.81	32.05	8.84
T ₅ - 75% RDF + 100 g <i>Azotobacter</i> + 100 g PSB + 100 g KRB/ vine	240.11	23.76	5.71
T ₆ - 75% RDF + 200 g <i>Azotobacter</i> + 200 g PSB + 200g KRB/vine	245.17	24.68	6.05
T ₇ -75% RDF + 300 g <i>Azotobacter</i> + 300 g PSB + 300g KRB/vine	260.96	26.92	7.03
SE d	5.12	1.27	0.21
CD (p=0.05)	11.16*	2.76*	0.45*

*Significance at 5 percent level

Table 2: Effect of biofertilizers on quality attributes in grape cv. Muscat Hamburg.

Treatments	TSS (°Brix)	Titrate acidity (%)	TSS : Acid ratio	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Sugar acid ratio
T ₁ - 100% RDF (control)	17.13	0.32	53.53	14.37	13.38	1.06	45.18
T ₂ - 100% RDF + 100 g <i>Azotobacter</i> + 100g PSB + 100 g KRB/ vine	16.80	0.33	50.90	14.35	13.16	0.98	43.51
T ₃ - 100% RDF + 200 g <i>Azotobacter</i> + 200 g PSB + 200g KRB/vine	17.58	0.24	73.25	14.63	13.48	1.19	60.97
T ₄ - 100% RDF + 300 g <i>Azotobacter</i> + 300 g PSB + 300g KRB/vine	18.33	0.21	87.28	15.33	14.06	1.27	73.00
T ₅ - 75% RDF + 100 g <i>Azotobacter</i> + 100 g PSB + 100 g KRB/ vine	16.27	0.35	46.48	13.61	12.81	0.80	39.47
T ₆ - 75% RDF + 200 g <i>Azotobacter</i> + 200 g PSB + 200g KRB/vine	17.09	0.33	51.78	14.35	13.37	0.99	44.08
T ₇ -75% RDF + 300 g <i>Azotobacter</i> + 300 g PSB + 300g KRB/vine	17.50	0.30	58.33	14.54	13.48	1.15	47.85
SE d	0.23	0.01	1.24	0.40	0.19	0.35	1.44
CD (p=0.05)	0.50*	0.01*	2.70*	0.87*	0.41*	NS	3.14*

NS - Non significant *Significance at 5 percent level

CONCLUSION

Based on the present investigation, it is concluded that application of biofertilizers *viz.*, 300 g *Azotobacter*, 300 g Phosphate solubilising bacteria and 300 g Potassium releasing bacteria/vine along with 100% RDF in grapes cv. Muscat Hamburg is found to improve the yield and quality attributes.

FUTURE SCOPE

Application of biofertilizers in grape may be recommended for grape cultivation for obtaining improved yield with good quality fruits.

Acknowledgement. The authors acknowledge the analytical facilities availed from the Department of Fruit Science, TNAU, Coimbatore.

Conflict of Interest. None.

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How to cite this article: Vijayalakshmi T., C. Kavitha, K.A. Shanmugasundaram and I. Muthuvel (2022). Effect of Biofertilizers on Yield and Quality Attributes of Grape cv. Muscat Hamburg. *Biological Forum – An International Journal*, 14(4a): 238-241.