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Prabhavathi K
Sri Konda Laxman Telangana
Horticultural University, Mulugu,
Siddipet, Telangana, India

Bhagwan A
Sri Konda Laxman Telangana
Horticultural University, Mulugu,
Siddipet, Telangana, India

Organic nutrient management practices for improving yield, quality and profitability in Mango cv. Banganpalli

Prabhavathi K and Bhagwan A

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Abstract

A field experiment was conducted at Fruit Research Station, Sangareddy, Telangana during 2011–12 to 2014–15 under AICRP (Fruits) to evaluate the effect of different organic nutrient management practices on yield, fruit quality and economics of mango (*Mangifera indica* L.) cv. Banganpalli. The experiment was laid out in Randomized Block Design (RBD) with seven treatments replicated thrice. Treatments consisted of FYM and vermicompost alone and in combination with biofertilizers (Azospirillum, Azotobacter and PSB) and vermiwash. The observations recorded included number of fruits per tree, average fruit weight, yield per tree, total soluble solids (TSS), shelf life, pulp stone ratio and benefit-cost ratio. The pooled results indicated significant differences among treatments for yield and quality attributes. Maximum number of fruits per tree (144.88) and highest yield (34.49 kg/tree) were recorded in T₅ (Vermicompost 50 kg/tree + Azospirillum + PSB @ 250 g/tree), which was found superior over other treatments. The highest pooled mean TSS (18.51 °B) was also recorded in T₅. The maximum average fruit weight (300.84 g) and the longest shelf life (13.83 days) were observed in T₇ (Vermicompost + Azospirillum + PSB + vermiwash). Economic analysis revealed that T₅ recorded higher and consistent benefit-cost ratio across the years. The study concluded that integration of vermicompost with biofertilizers, particularly Azospirillum and PSB, significantly improved yield, fruit quality and profitability in mango cv. Banganpalli and can be recommended for sustainable organic mango production.

Keywords: Mango cv. Banganpalli, vermicompost, FYM, Azospirillum, Azotobacter, PSB, vermiwash, organic farming

Introduction

Mango (*Mangifera indica* L.) is one of the most important fruit crops of India and is popularly known as the “King of fruits” due to its excellent taste, attractive flavour, high nutritive value and wide consumer acceptance. India is the leading producer of mango in the world, contributing a major share to global production. Among the commercial cultivars grown in South India, cv. Banganpalli occupies a prominent place because of its regular demand in domestic markets, attractive golden-yellow fruits, pleasant flavour, good keeping quality and suitability for long distance transport.

In recent years, the increasing cost of chemical fertilizers and growing awareness regarding health hazards, pesticide residues and environmental degradation have created strong demand for organic and eco-friendly mango production systems. Continuous use of inorganic fertilizers alone has been reported to adversely affect soil health by reducing soil organic carbon, microbial activity and nutrient availability, ultimately leading to decline in productivity. In contrast, organic manures such as farmyard manure (FYM) and vermicompost improve soil structure, water holding capacity, microbial population and provide slow and sustained nutrient release.

Further, integration of organic manures with beneficial microbial inoculants like Azospirillum, Azotobacter and phosphate solubilizing bacteria (PSB) has gained importance in sustainable horticulture. These biofertilizers enhance nutrient uptake by fixing atmospheric nitrogen, solubilizing unavailable phosphorus, producing plant growth promoting substances and improving root development. Such practices not only increase yield but also enhance fruit quality parameters like fruit weight, TSS, pulp content, shelf life and overall market value.

Corresponding Author:
Prabhavathi K
Sri Konda Laxman Telangana
Horticultural University, Mulugu,
Siddipet, Telangana, India

Hence, considering the need for sustainable mango cultivation, the present investigation was undertaken to study the effect of different organic nutrient management treatments involving FYM, vermicompost, biofertilizers and vermiwash on yield, fruit quality and economics of mango cv. Banganpalli, under field conditions.

Materials and Methods

An experiment was conducted during 2011–12 and 2014–15 at Fruit Research Station, Sangareddy, Telangana under AICRP (Fruits) on mango cultivar ‘Banganpalli’ which was uniform in vigor and size, planted at a spacing of 10 × 10 m and maintained under uniform cultural practices. The experiment comprised seven (07) treatments, each replicated thrice. The treatment details are T₁ – FYM (50kg/tree), T₂ – FYM (50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₃ – FYM (50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₄ – Vermicompost(50kg/ tree), T₅ – Vermicompost(50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₆ – Vermicompost(50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₇ – Vermicompost(50kg/ tree)+ *Azospirillum* culture @ 250 g/ tree + PSB@ 250 g/tree+ vermiwash.

Yield Parameters and Quality Assessment Methodology

The yield parameters recorded were the average number of fruits per tree, average yield per tree (kg), and average fruit weight (g). Yield was measured by weighing the fruits during each picking. For assessing various fruit quality parameters, fifty uniform and mature fruits were collected from each tree.

The total soluble solids (TSS) content of the fruit pulp was measured using a ERMA hand refractometer. Pulp stone ratio is measured by dividing the weight of pulp (g) extracted from the mature ripe fruit with the weight of the stone (g). The shelf-life of the fruits at room temperature was evaluated by placing ten mature fruits per treatment in three replicates, allowing them to ripen at room temperature. The shelf-life was recorded as the number of days the fruits remained consumable without deterioration. The data was statistically analysed by method of analysis of variance using R.B.D as described by Panse and Sukhatme (1985) [6].

Results and Discussion

Table 1: Effect of different Organic treatments on No. of fruits per tree of mango cv. Banganpalli

Treatments	2011-12	2012-13	2013-14	2014-15	Pooled mean
T ₁	30.00	61.60	112.00	144.70	87.08
T ₂	34.33	53.60	185.00	195.07	117.00
T ₃	89.33	72.00	115.00	180.00	114.08
T ₄	17.30	66.60	68.00	144.20	74.03
T ₅	115.00	85.00	173.00	206.50	144.88
T ₆	23.33	65.00	166.00	208.20	115.63
T ₇	22.00	65.00	195.00	162.70	111.18
SE+ <u>m</u>	1.42	2.26	3.97	5.25	3.23
CD at 5%	3.11	4.92	8.65	11.44	7.03

T₁ – FYM (50kg/tree), T₂ – FYM (50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₃ – FYM (50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₄ – Vermicompost(50kg/ tree), T₅ – Vermicompost(50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₆ – Vermicompost(50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₇ – Vermicompost(50kg/ tree)+ *Azospirillum* culture @ 250 g/ tree + PSB@ 250 g/tree+ vermiwash.

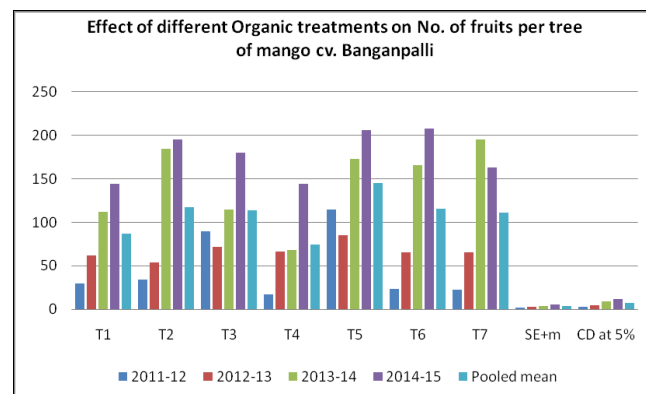


Table 2: Effect of different Organic treatments on Average fruit weight (g) of mango cv. Banganpalli

Treatments	2011-12	2012-13	2013-14	2014-15	Pooled mean
T ₁	295.13	291.70	263.67	247.5	274.50
T ₂	247.20	285.70	203.00	272.8	252.18
T ₃	310.37	303.40	251.67	285.0	287.61
T ₄	269.75	276.50	241.00	298.5	271.44
T ₅	304.27	291.40	226.00	304.1	281.44
T ₆	326.13	318.70	248.67	301.6	298.78
T ₇	325.67	300.20	290.00	287.5	300.84
SE+ <u>m</u>	8.21	7.77	7.79	9.43	8.42
CD at 5%	17.90	16.93	16.98	20.56	25.47

T₁ – FYM (50kg/tree), T₂ – FYM (50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₃ – FYM (50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₄ – Vermicompost(50kg/ tree), T₅ – Vermicompost(50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₆ – Vermicompost(50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₇ – Vermicompost(50kg/ tree)+ *Azospirillum* culture @ 250 g/ tree + PSB@ 250 g/tree+ vermiwash.

Table 3: Effect of different Organic treatments on Yield (kg/tree) of mango cv. Banganpalli

Treatments	2011-12	2012-13	2013-14	2014-15	Pooled mean
T ₁	8.67	17.89	30.33	23.89	20.20
T ₂	8.37	15.55	37.27	35.50	24.17
T ₃	26.22	22.42	27.45	33.84	27.48
T ₄	4.55	18.25	16.16	28.89	16.96
T ₅	32.13	23.55	40.56	41.70	34.49
T ₆	7.62	21.06	42.87	42.08	28.41
T ₇	6.99	19.33	56.77	31.19	28.57
SE+ <u>m</u>	1.90	7.32	33.05	2.78	11.26
CD at 5%	5.84	NS	NS	8.57	31.19

T₁ – FYM (50kg/tree), T₂ – FYM (50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₃ – FYM (50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₄ – Vermicompost(50kg/ tree), T₅ – Vermicompost(50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₆ – Vermicompost(50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₇ – Vermicompost(50kg/ tree)+ *Azospirillum* culture @ 250 g/ tree + PSB@ 250 g/tree+ vermiwash.

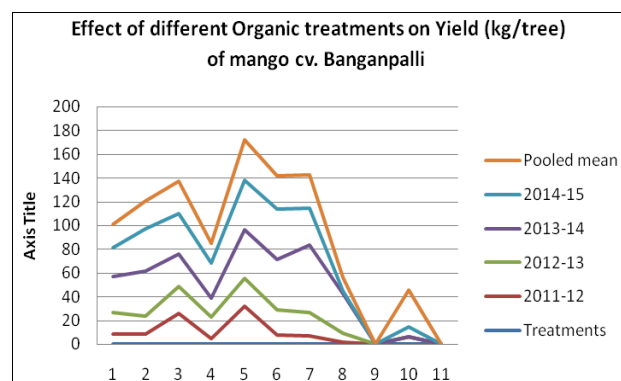


Table 4: Effect of different Organic treatments on TSS (°B) of mango cv. Banganpalli

Treatments	2011-12	2012-13	2013-14	2014-15	Pooled mean
T ₁	17.20	18.00	15.50	18.30	17.25
T ₂	19.43	18.80	13.83	18.50	17.64
T ₃	18.40	18.10	17.00	18.00	17.88
T ₄	20.00	20.00	15.50	17.60	18.28
T ₅	20.03	20.00	16.50	17.50	18.51
T ₆	20.67	18.50	14.50	18.30	17.99
T ₇	19.00	18.30	17.17	19.00	18.37
SE+ <u>m</u>	0.45	0.50	0.57	0.57	0.52
CD at 5%	0.99	1.10	1.26	1.25	1.15

T₁ – FYM (50kg/tree), T₂ – FYM (50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₃ – FYM (50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₄ – Vermicompost(50kg/ tree), T₅ – Vermicompost(50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₆ – Vermicompost(50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₇ – Vermicompost(50kg/ tree)+ *Azospirillum* culture @ 250 g/ tree + PSB@ 250 g/tree+ vermiwash.

Table 5: Effect of different Organic treatments on Shelf life (days) and pulp stone ratio of mango cv. Banganpalli

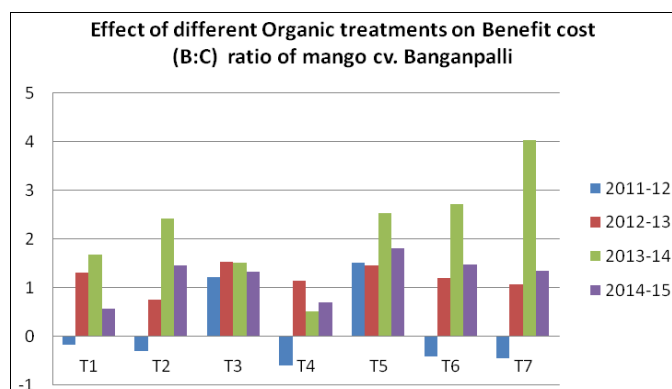
Treatments	Shelf life (days)			pulp stone ratio		
	2011-12	2012-13	Pooled mean	2013-14	2014-15	Pooled mean
T ₁	11.33	11.44	11.39	5.07	5.51	5.29
T ₂	11.67	11.55	11.61	4.84	4.81	4.83
T ₃	13.33	13.11	13.22	4.71	4.07	4.39
T ₄	13.33	12.44	12.89	5.09	5.12	5.11
T ₅	11.33	11.11	11.22	4.82	4.51	4.67
T ₆	13.00	13.00	13.00	6.18	6.17	6.18
T ₇	14.00	13.66	13.83	5.59	4.34	4.97
SE+ <u>m</u>	0.30	0.27	0.29	0.11	0.16	0.14
CD at 5%	0.66	0.60	0.63	0.24	0.35	0.30

T₁ – FYM (50kg/tree), T₂ – FYM (50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₃ – FYM (50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₄ – Vermicompost(50kg/ tree), T₅ – Vermicompost(50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₆ – Vermicompost(50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₇ – Vermicompost(50kg/ tree)+ *Azospirillum* culture @ 250 g/ tree + PSB@ 250 g/tree+ vermiwash.

Table 6: Effect of different Organic treatments on Benefit cost (B:C) ratio of mango cv. Banganpalli

Treatments	2011-12	2012-13	2013-14	2014-15
T ₁	-0.16	1.32	1.68	0.58
T ₂	-0.29	0.76	2.42	1.46
T ₃	1.23	1.54	1.52	1.33
T ₄	-0.60	1.15	0.52	0.70
T ₅	1.52	1.46	2.53	1.82
T ₆	-0.40	1.20	2.73	1.49
T ₇	-0.44	1.08	4.04	1.35

T₁ – FYM (50kg/tree), T₂ – FYM (50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₃ – FYM (50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₄ – Vermicompost(50kg/ tree), T₅ – Vermicompost(50kg/ tree)+ *Azospirillum* culture+ PSB (@ 250 g/ tree), T₆ – Vermicompost(50kg/ tree)+ *Azotobacter*+ PSB (@ 250 g/ tree), T₇ – Vermicompost(50kg/ tree)+ *Azospirillum* culture @ 250 g/ tree + PSB@ 250 g/tree+ vermiwash.



The results clearly indicated that application of organic manures along with biofertilizers significantly influenced fruit number, fruit weight, yield and quality attributes of mango cv. Banganpalli during all the years of experimentation. Overall, treatments involving vermicompost in combination with biofertilizers performed better than FYM alone and FYM-based combinations, indicating the superiority of enriched organic nutrient management in improving productivity and fruit quality.

Effect of different organic treatments on no. of fruits of Mango

The data on number of fruits per tree (Table 1) showed significant differences among treatments during all years. Among the treatments, T₅ (Vermicompost 50 kg/tree + *Azospirillum* + PSB @ 250 g/tree) recorded the maximum number of fruits per tree with pooled mean of 144.88 fruits/tree, which was significantly superior over all other treatments. This

was followed by T₂ (FYM + *Azospirillum* + PSB) with pooled mean of 117.00 fruits/tree and T₆ (Vermicompost + *Azotobacter* + PSB) with 115.63 fruits/tree. Similar findings were reported by Sharma and Singh (2009) ^[9] and Kumar *et al.* (2010) ^[4] in mango, where vermicompost and biofertilizer integration improved fruiting behaviour. Singh *et al.* (2012) ^[10] also reviewed that combined use of organic manures and biofertilizers promotes better reproductive growth in mango. The lowest pooled mean fruit number was observed in T₄ (Vermicompost alone) with 74.03 fruits/tree, followed by T₁ (FYM alone) with 87.08 fruits/tree.

The higher fruit number under vermicompost + biofertilizer treatments might be due to improved nutrient availability and better microbial activity in the rhizosphere, leading to enhanced flowering, fruit set and reduced fruit drop. Biofertilizers such as *Azospirillum* and *Azotobacter* are known to fix atmospheric nitrogen and produce growth promoting substances, while PSB solubilizes native phosphorus, resulting in improved nutrient uptake and reproductive growth.

Effect of different organic treatments on average fruit weight (g) of Mango

Average fruit weight differed significantly among the treatments (Table 2). The pooled mean fruit weight was highest in T₇ (Vermicompost + *Azospirillum* + PSB + Vermiwash) with 300.84 g, which was statistically on par with T₆ (Vermicompost + *Azotobacter* + PSB) having 298.78 g.

The increase in fruit weight under vermicompost-based enriched treatments may be attributed to continuous supply of nutrients, better soil structure, improved moisture retention and enhanced

microbial activity. Vermiwash application might have contributed additional enzymes, hormones and micronutrients, which promoted cell division and enlargement, resulting in heavier fruits. Foliar spraying of vermiwash (50 per cent) is helpful for better growth, flowering and fruiting (Ram, 2021) [7].

Effect of different organic treatments on fruit yield (kg/tree) of Mango

Yield data (Table 3) revealed that, mango yield increased considerably due to application of vermicompost and biofertilizers. The pooled mean yield was highest in T₅ (Vermicompost + Azospirillum + PSB) with 34.49 kg/tree, which was distinctly superior over all other treatments. This was followed by T₇ (Vermicompost + Azospirillum + PSB + Vermiwash) with 28.57 kg/tree and T₆ (Vermicompost + Azotobacter + PSB) with 28.41 kg/tree. Similar enhancement in mango yield under integrated organic nutrient management was also reported by Yadav *et al.* (2011) [11] and Hazarika and Ansari (2007) [3]. The beneficial effect of organic manures in improving productivity through better soil biological properties was also supported by Bopaiah and Shetty (1991) [2]. Sable *et al.*, 2023 [8] also reported that application of Azotobacter (5 ml) and phosphorus solubilising bacteria (PSB) (5 ml) dissolved in 1 L of water and mixing with well decomposed organic manure per plant at the time of onset of monsoon and at the time of flowering stage gives more fruit yield and saves 15 per cent of recommended dose of nitrogen and phosphorus fertilizers.

The lowest pooled mean yield was observed in T₄ (Vermicompost alone) with 16.96 kg/tree, followed by FYM alone (T₁) with 20.20 kg/tree.

The significantly higher yield under T₅ might be due to combined effect of vermicompost and biofertilizers ensuring balanced nutrient supply, improved nutrient use efficiency, better vegetative growth and higher fruit retention. Vermicompost provides readily available nutrients, humic substances and beneficial microbes, while Azospirillum contributes nitrogen fixation and root stimulation. PSB enhances phosphorus availability which is critical for flowering and fruit development.

Effect of different organic treatments on TSS (°B) of Mango

The quality parameter TSS showed significant variation among treatments. The pooled mean TSS was highest in T₅ - Vermicompost + Azospirillum + PSB (18.51 °B) followed by T₇ - Vermicompost + Azospirillum + PSB + Vermiwash (18.37 °B) (Table 4).

Higher TSS values under vermicompost and biofertilizer treatments may be due to better carbohydrate synthesis and translocation to fruits because of balanced nutrient availability, particularly potassium and phosphorus, along with improved physiological activity. Organic manures also improve photosynthetic efficiency and accumulation of sugars, thereby enhancing fruit sweetness.

Effect of different organic treatments on shelf life (days) and pulp stone ratio of Mango

Shelf life was significantly influenced by organic treatments. The pooled mean shelf life was maximum in T₇ - Vermicompost + Azospirillum + PSB + Vermiwash (13.83 days), which was significantly superior over all other treatments. The improvement in shelf life might be due to vermiwash and vermicompost supplying calcium, micronutrients and plant growth substances that strengthen fruit tissue and reduce physiological weight loss delaying the fruit ripening. Improved

nutrient balance enhances post-harvest quality.

Pulp stone ratio was maximum in T₆- Vermicompost (50 kg/tree)+ Azotobacter+ PSB (@ 250 g/ tree) (6.18), which was significantly superior to all other treatments. This was followed by T₇- Vermicompost + Azospirillum + PSB + Vermiwash (4.97). The higher pulp stone ratio indicates better edible portion and fruit development, possibly due to increased nutrient uptake and enhanced fruit growth. Azotobacter and PSB together might have improved nitrogen and phosphorus availability leading to increased pulp formation.

Effect of different organic treatments on Benefit cost ratio of Mango

Economic analysis (Table 6) revealed that the profitability of mango production was influenced by the treatments. T₅ consistently maintained higher Benefit Cost ratio across years (1.52, 1.46, 2.53 and 1.82) indicating stable profitability. Similar observations on profitability of integrated organic nutrient management were reported by Nath and Singh (2011) [5] and Bhattacharyya and Chakraborty (2005) [1], who highlighted that organic production improves market acceptability and economic returns.

Negative B:C in 2011-12 for several treatments indicates poor yield returns in that year, possibly due to initial adjustment period of trees to organic nutrient management. However, in later years, enriched organic treatments resulted in higher yields and better economic returns. The higher profitability under vermicompost + biofertilizer treatments was due to increased fruit yield and improved fruit quality fetching better market value, even though input costs were comparatively higher than FYM alone.

Summary and Conclusion

From pooled analysis of yield and quality attributes, it is evident that T₅ (Vermicompost 50 kg/tree + Azospirillum + PSB @ 250 g/tree) was the best treatment for maximizing fruit number, yield and TSS. However, T₇ (Vermicompost + Azospirillum + PSB + Vermiwash) was superior for improving shelf life and maintained high yield performance.

The study concluded that, application of Vermicompost (50 kg/tree) + Azospirillum + PSB @ 250 g/tree (T₅) is the most promising treatment for achieving higher fruit yield (34.49 kg/tree), maximum fruit number (144.88 fruits/tree) and improved TSS (18.51 °B). For better shelf life, T₇ (vermicompost + biofertilizers + vermiwash) was found superior. Therefore, vermicompost enriched with biofertilizers can be recommended as an effective organic nutrient management practice for improving yield, fruit quality and economic returns in mango cv. Banganpalli.

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