

## Ecofriendly Nutrient Management Practices for Yield and Quality of Banana

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**Key words:** Wellgro soil, Wellgro grains, fertilizers, Farm Yard Manure, Yield, Quality

### Abstract

Field investigations were carried out at Northern Block Farm of Agricultural Research Station, Bhavanisagar (TNAU) of Tamil Nadu, India during 2010-2012 to study the effect of nutrient management practices on productivity of banana. The results revealed that application of 100% recommended dose of fertilizer (RDF) along with 40% Wellgro soil recorded the maximum number of hands (10.2 and 10.3), number of fingers (136.3 and 145.2), bunch weight (23.9 and 25.3 kg/plant) and total yield (72.8 and 77.1 t/ha) during 2010-11 and 2011-12, respectively. Similarly, quality parameter was also influenced by integrated nutrient management practices during both years of study in banana. Nutrient management practices i.e. combined application of 40% Wellgro soil or Cow based Farm Yard Manure @ 10kg plant<sup>-1</sup> with recommended dose of fertilizers to banana has been found to be an ideal option to improve yield parameters and quality of banana under the soil and climatic conditions of Tamil Nadu, India.

### Introduction

Banana owing to its large size and rapid growth rate require relatively large amount of nutrients for higher yield and quality. Application of inorganic fertilizers though increases the yield substantially but could not able to sustain the fertility status of the soil. Considering the present situation of soil quality and environmental security, it is necessary to go for an integrated nutrient management (INM), involving various sources of organic manures. In today's cultivation many commercial organic manures are being used because of their application in lesser volume and also enriched with nutrients. One such commercial organic manure used in the study is Wellgro. Wellgro organic manure is a unique product with a blend of neem and non-timber forest produce and a rich source of nutrients. Hence, this study was under taken to find out the influence of ecofriendly nutrient management practices on yield and quality parameters of banana under irrigated conditions.

### Material and methods

The experiments were laid out in sandy loam soil at Northern Block Farm, Agricultural Research Station (Tamil Nadu Agricultural University), Bhavanisagar, Erode district of Tamil Nadu. The banana cv. Grand Naine (AAA) was used as a test crop during 2010-11 and 2011-12. The experiments consisted of thirteen treatments viz., Control (100% Recommended dose of fertilizer), four treatments consisted of Wellgro soil @ 20 and 40% in combination of 100 and 75% RDF, two treatments consisted of 2% Wellgro liquid organic manure spray on bunches with 100 and 75% RDF, four treatments consisted of Wellgro grains @ 20 and 40% combined with 100 and 75% RDF and the last two treatments comprised of Cow based Farm Yard Manure (FYM) @ 10kg plant<sup>-1</sup> with 100 and 75% RDF combinations. Randomized Complete Block Design was adopted for the experiments and it was replicated thrice. The net plot size for each treatment was 78 M<sup>2</sup>, which accommodated 24 numbers of banana trees spaced at 1.8 M X 1.8 M. Wellgro organic manures are a product of Indian Tobacco Company (ITC) and developed for soil application and foliar spray. These products are made from non-timber forest produce. They have appreciable quantities of nitrogen (1.6%) phosphorus (0.41%) and potash (2.10%) and also micronutrients such as zinc, boron, copper etc. Yield attributes such as bunch weight, number of hands bunch<sup>-1</sup>, total number of fingers bunch<sup>-1</sup>, finger weight and yield were recorded in both the seasons. Quality parameters such as Total Soluble Solids, acidity, ascorbic acid, reducing sugars, non reducing sugars and sugar acid ratio were also recorded in banana during both the years of study.

## Result

### Yield parameters

Results revealed that the yield and quality parameters were conspicuously higher in organic manure combinations as compared to fertilizers alone (control). However, application of 100% RDF along with either 40% Wellgro soil or FYM @ 10kg/plant recorded the maximum bunch weight, number of hands and fingers/bunch and total yield (Table 1). During 2010-11 and 2011-12, the highest bunch weight (23.9 and 25.3kg), number of hands (10.2 and 10.3) and fingers (136.3 and 145.2/bunch), finger weight (175.0 and 184.2 g) and maximum yield (72.8 and 77.1 t ha<sup>-1</sup>), respectively were obtained with application of 100% RDF along with 40% Wellgro soil. However, bunch weight was comparable with T<sub>12</sub> (23.77 kg), T<sub>9</sub> (23.3 kg) and T<sub>2</sub> (23.0 kg) during 2010-11 and with T<sub>12</sub> (25.3 kg) and T<sub>9</sub> (24.9 kg), T<sub>2</sub> (24.5 kg) and T<sub>8</sub> (23.7 kg) during 2011-12. Similarly, total yield was on par with T<sub>12</sub> (72.5 t ha<sup>-1</sup>), T<sub>9</sub> (71.0 t ha<sup>-1</sup>), T<sub>2</sub> (70.1 t ha<sup>-1</sup>) and T<sub>8</sub> (69.3 t ha<sup>-1</sup>) during first year and T<sub>12</sub> (77.1 t ha<sup>-1</sup>), T<sub>9</sub> (75.9 t ha<sup>-1</sup>), T<sub>2</sub> (74.7 t ha<sup>-1</sup>) and T<sub>8</sub> (72.1 t ha<sup>-1</sup>) during second year. The increment of yield due to the application of 100% RDF along with 40% Wellgro soil was 11.2 and 14.7% as compared to control. Similarly, application of 100% RDF with FYM @ 10kg/plant registered 10.8 and 14.6% higher yield over control during 2010-11 and 2011-12, respectively.

**Table 1. Effect of nutrient management practices on bunch characteristics of banana**

Treatments	2010-11					2011-12				
	Bunch weight (kg)	Number of hands/bunch	Total no. of fingers/bunch	Finger weight (g)	Yield (t/ha)	Bunch weight (kg)	Number of hands/bunch	Total no. of fingers/bunch	Finger weight (g)	Yield (t/ha)
T <sub>1</sub> - 100% RDF (Control)	21.2	8.6	125.2	167.3	64.6	21.6	9.6	131.3	173.3	65.8
T <sub>2</sub> - 100% RDF + 20% WS	23.0	9.5	132.0	172.7	70.0	24.5	10.3	139.0	182.3	74.7
T <sub>3</sub> - 100% RDF + 40% WS	23.9	10.2	136.3	175.0	72.8	25.3	10.3	145.2	184.2	77.1
T <sub>4</sub> - 75% RDF + 20% WS	21.0	8.6	123.3	169.3	64.0	21.6	9.5	124.1	178.0	65.7
T <sub>5</sub> - 75% RDF + 40% WS	22.5	9.2	126.4	171.0	68.5	22.5	10.0	128.7	180.3	68.6
T <sub>6</sub> - 100% RDF + WC spray	21.9	8.7	126.5	172.3	66.9	22.3	9.6	130.7	178.0	68.0
T <sub>7</sub> - 75% RDF + WC spray	20.5	8.5	118.6	170.0	62.5	21.0	9.1	124.0	176.3	64.1
T <sub>8</sub> - 100% RDF + 20% WG	22.5	9.8	130.7	173.7	69.3	23.7	10.0	136.1	181.0	72.1
T <sub>9</sub> - 100% RDF + 40% WG	23.3	9.5	133.4	178.7	71.0	24.9	10.2	139.8	184.7	75.9
T <sub>10</sub> - 75% RDF + 20% WG	21.2	8.9	122.2	172.8	64.6	21.8	10.0	127.3	179.0	66.5
T <sub>11</sub> - 75% RDF + 40% WG	21.4	9.3	123.1	171.7	65.2	21.7	9.9	129.0	178.3	66.1
T <sub>12</sub> - 100% RDF + FYM	23.8	10.0	135.4	174.3	72.5	25.3	10.4	141.5	186.3	77.1
T <sub>13</sub> - 75% RDF + FYM	21.3	9.7	126.3	170.4	65.0	21.9	9.6	130.9	179.0	66.9
S.Ed	0.6	0.5	3.1	5.3	2.1	0.8	0.5	3.4	5.4	2.4
CD(P=0.05)	1.2	1.0	6.3	10.1	4.2	1.6	1.1	7.0	11.2	5.0

### Fruit quality

The various INM practices ushered in variation on TSS content of banana during the course of investigation. All the INM treated plots significantly influenced the TSS content over inorganic fertilizers alone (T<sub>1</sub>). Among the treatments, 75% RDF + 2% liquid organic manure spray on bunches (T<sub>7</sub>) recorded the maximum TSS (21.38°B) during 2010-11 whereas 100% RDF + 2% liquid organic manure spray (T<sub>6</sub>) had more pronounced effect on TSS (21.86°B) during 2011-12. The highest acidity percentage (0.33) was recorded with application of 100% RDF alone (T<sub>1</sub>) during 2010-11, but it was on par with T<sub>6</sub>, T<sub>3</sub>, T<sub>12</sub>, T<sub>5</sub>, T<sub>9</sub>, T<sub>8</sub>, T<sub>4</sub> and T<sub>7</sub> whereas, the minimum percentage of acidity (0.22) was recorded in T<sub>10</sub> and T<sub>11</sub>. Similar results were obtained during 2011-12 also. Application of 75% RDF along with 40% *Wellgro* soil (T<sub>5</sub>) recorded superior

values of ascorbic acid (16.35 and 15.91 mg 100g<sup>-1</sup>) than T<sub>1</sub> *i.e.* 100% RDF alone (12.60 and 11.61 mg 100g<sup>-1</sup>) during 2010-11 and 2011-12 respectively. The INM practices did not have any marked influence on the total sugar contents during both the years of study. However, numerically the highest value of total sugar content (14.13%) was noted in T<sub>5</sub> (75% RDF + 40% WG organic soil) during 2010-11 and in T<sub>7</sub> (15.35%) during 2011-12. The sugar acid ratio of fruits showed highly significant differences due to adoption of various INM treatments during both the years. During 2010-11, the treatment T<sub>10</sub> (75% RDF + 20% Wellgro grains) recorded the maximum sugar: acid ratio of 66.33 and was statistically on par with T<sub>11</sub> (55.24). During the second year, application of 75% RDF + 2% liquid organic manure spray on bunches (T<sub>7</sub>) registered the maximum sugar acid ratio (109.64) and it was comparable with T<sub>13</sub>.

**Table 2. Effect of nutrient management practices on fruit quality parameters during 2010-11**

Treatments	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100g)	Reducing sugars (%)	Non reducing sugars (%)	Sugar: acid ratio
T <sub>1</sub> - 100% RDF (Control)	18.57	0.33	12.60	10.28	1.55	36.18
T <sub>2</sub> - 100% RDF + 20% WS	20.13	0.26	14.27	11.63	1.43	50.99
T <sub>3</sub> - 100% RDF + 40% WS	20.36	0.31	14.29	11.58	1.25	42.36
T <sub>4</sub> - 75% RDF + 20% WS	20.56	0.28	15.61	10.66	1.48	42.99
T <sub>5</sub> - 75% RDF + 40% WS	21.09	0.29	16.35	11.82	2.32	48.73
T <sub>6</sub> - 100% RDF + WC spray	21.25	0.31	12.70	11.81	1.55	43.36
T <sub>7</sub> - 75% RDF + WC spray	21.38	0.27	12.57	11.13	2.09	48.85
T <sub>8</sub> - 100% RDF + 20% WG	20.33	0.28	14.16	10.40	1.82	44.83
T <sub>9</sub> - 100% RDF + 40% WG	20.48	0.28	14.23	10.04	2.13	43.91
T <sub>10</sub> - 75% RDF + 20% WG	20.52	0.22	15.32	12.42	2.31	66.63
T <sub>11</sub> - 75% RDF + 40% WG	19.95	0.22	14.02	10.41	1.67	55.24
T <sub>12</sub> - 100% RDF + FYM	20.93	0.30	12.63	9.25	2.30	39.67
T <sub>13</sub> - 75% RDF + FYM	21.22	0.26	12.49	10.58	1.49	45.87
S.Ed	0.64	0.03	1.18	1.14	1.15	6.10
CD(P=0.05)	1.32	0.06	2.43	NS	0.35	12.59

**Table 3. Effect of nutrient management practices on fruit quality parameters during 2011-12**

Treatments	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100g)	Reducing sugars (%)	Non reducing sugars (%)	Total sugars (%)	Sugar: acid ratio
T <sub>1</sub> - 100% RDF (Control)	19.05	0.22	11.61	12.12	1.34	13.46	61.18
T <sub>2</sub> - 100% RDF + 20% WS	19.15	0.17	14.85	12.19	1.67	13.86	81.53
T <sub>3</sub> - 100% RDF + 40% WS	18.79	0.18	14.05	10.82	1.58	12.40	68.89
T <sub>4</sub> - 75% RDF + 20% WS	21.03	0.16	15.23	12.66	1.45	14.11	88.19
T <sub>5</sub> - 75% RDF + 40% WS	21.52	0.17	15.91	13.50	1.83	15.33	90.18
T <sub>6</sub> - 100% RDF + WC spray	21.86	0.21	14.36	13.48	1.70	15.18	72.29
T <sub>7</sub> - 75% RDF + WC spray	21.59	0.14	14.85	13.54	1.81	15.35	109.64
T <sub>8</sub> - 100% RDF + 20% WG	19.84	0.21	14.77	13.35	1.58	14.93	71.10
T <sub>9</sub> - 100% RDF + 40% WG	18.18	0.19	14.25	12.08	1.66	13.74	72.32
T <sub>10</sub> - 75% RDF + 20% WG	20.86	0.16	15.02	12.74	1.55	14.29	89.31
T <sub>11</sub> - 75% RDF + 40% WG	21.12	0.18	13.65	13.27	1.76	15.03	83.50
T <sub>12</sub> - 100% RDF + FYM	18.26	0.18	13.30	12.50	1.51	14.01	77.83
T <sub>13</sub> - 75% RDF + FYM	21.29	0.14	14.21	12.83	1.43	14.26	101.86
S.Ed	0.99	0.02	1.67	0.61	0.18	0.98	8.84
CD(P=0.05)	2.05	0.03	3.46	1.26	NS	NS	18.24

## Discussion

### Effect of INM on yield of banana

Higher yield response owing to application of organics ascribed to improved physical, chemical and biological properties of soil resulting in better supply of plant nutrients, which in turn led to good crop growth and yield. Humus substance present in organic product could have mobilized the reserve food materials to the sink through increased activity of hydrolyzing and oxidizing enzymes. These products would help the better availability and utilization of nutrients. All these positive effect might have facilitated quick mobilization and availability of nutrients that would aid in increased plant height, number of leaves, leaf area, leaf area index and photosynthetic rate. This in turn would have assisted for the increased yield of banana. This is in confirmation with the findings of Patel *et al.* (2010) and Aba *et al.* (2011).

### **Effect of INM on quality of fruits**

The fruit quality in banana is mainly assessed by the parameters like TSS, starch, total sugar, ascorbic acid and acidity in the pulp. Fruit quality was superior in plants treated with organic and inorganic manures as compared to inorganic alone. It might be due to application of adequate amount of nutrients through organic and inorganic fertilizers. A high total soluble solid was recorded either with 100 or 75% RDF along with 2% liquid organic manure spray on bunches. This might be due to rapid transformation of complex carbohydrates into soluble sugars and also quick mobilization of metabolites from source to sink under the influence of growth substances contained in the liquid organic manure. Athani and Hulamani (2000) also reported that the increased fruit quality parameters were due to the addition of different organic manures to the soil and in turn to plants, which enhanced the biosynthesis and translocation of carbohydrates to fruits. Further, the availability of macro and micronutrients from different organic manures might have increased the leaf area with higher synthesis of assimilates, which is due to translocation of photosynthetic products from leaves to developing fruits and thereby increasing total sugars. These results are in agreement with those obtained by Naby (2000).

### **Suggestions to tackle with the future challenges of organic banana production**

From the two years of experiments, it can be concluded that combined application of either 40% Wellgro soil or Cow based Farm Yard Manure @ 10kg plant<sup>-1</sup> along with recommended dose of fertilisers is found to be an ideal option to improve yield and quality parameters of banana under the soil and climatic conditions of Western zone of Tamil Nadu, India.

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