Biological Forum – An International Journal **13(4): 908-912(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Organic Manures and Inorganic Fertilizer on the Fruit Quality of Banana

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(Received 27 September 2021, Accepted 17 November, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: There is a growing awareness about health and quality food in today's society. The Total soluble solid, sugar content, acidity determine the degree of acceptability. A field experiment was conducted during 2016-2017 at Instructional cum Experimental Farm, Biswanath College of Agriculture, AAU, Biswanath Chariali. The effects of organic manures and inorganic fertilizer was considered on the fruit quality parameters of banana cv. Amritsagar (AAA). The investigation consist of 5 treatments with 5 replication laid on RBD. The treatments were as follows T_1: FYM (Farm Yard Manure) + Microbial Consortia, T_2: Enriched Compost, T_3: Vermicompost, T_4: Microbial Consortia, T_0: RDF (FYM + NPK). The experiment revealed that qualitative characters such as TSS (Total soluble solid), titratable acidity, reducing sugar, non reducing sugar and total sugar were found highest in organic treatment than the inorganic treated plants. In the organics, T_1 recorded the highest TSS (25.72°Brix) and lowest in T_0 (22.55°Brix). Titratable acidity was found highest in T_2 (0.25). Reducing sugar, non reducing sugar and total sugar were found highest in T_1 with 11.23%, 12.11% and 23.30% respectively. Whereas, the self life of banana fruits were found better in inorganic treated plants as compared to organically produced fruits.

Keywords: Enriched Compost, Farm Yard Manure, Microbial Consortia, Total soluble solid, Titratable acidity, Total sugar, Vermicompost.

INTRODUCTION

Banana (*Musa* spp.) is one of the most important fruit crops of the world. Banana is believed to have originated in the hot, tropical regions of South East Asia (Spiden, 1926: Sauer, 1952). Banana is a quick growing plant which have an yield potential upto 100t/ha (Soares de melo *et al.*, 2014). Because of its high nutritious value, palatability and cheaper price the fruit is very popular among all class of people in India. In India 29.12 million tones of banana is produce from 0.85 million ha area with a productivity of 34.43 t/ha. (Anon., 2018). Banana is a heavy feeder of nutrient. The quality of fruits is influence by the genotype as well as the nutritional status of the soil. Thus optimum fertilizer and manure is required for growth, yield and quality banana. Continuous and indiscriminate use of inorganic fertilizer is degrading the agricultural lands which in return will reduce the yield and quality of fruit produce. This in future might lead to threat in the global food security. The organic fertilization can be substitute for supplying nutrient to banana production. Ramesh *et al.* (2010) reported that organic farming improves soil quality (physical, chemical and biological) subsequently enhancing the soil health and sustainability of crop production. Studies have revealed that organic manure support better quality and post harvest life of fruits when compared to the inorganic fertilizer (Patel *et. al.,* 2012). Fruit quality parameters like TSS, reducing sugar, non reducing sugar, total sugar were registered highest value in treated with organic amendments as compared to inorganic treatments (Vanilarasu and Balakrishnamurthy 2014). Ushakumari *et al*. (1997) observed the increase in sweetness of fruits; higher sugar-acid ratio and improved fruit quality when vermicompost was applied in banana as sole source of nutrients. An investigation carried out by Eman *et al.* (2003) in two seasons during 2000 to 2002 on the second and third rations of Williams banana revealed that the fruit quality properties were also improved by the application of bio-fertilizer. The treatment of bio-fertilizer plus 75 per cent NPK gave the highest values of fruit quality.

Thus the aim of the research was to realize the effect of organics and inorganic fertilizer on the fruit quality of banana and evaluate a suitable organic manure for banana production in Assam.

MATERIALS AND METHODS

The study was conducted in the Instructional cum Experimental Farm, Biswanath College of Agriculture, AAU, Biswanath Chariali during 2016-2017. Biswanath Chariali District falls in the subtropical climatic region having hot and humid summer, dry and cold winter seasons and receives an average annual rainfall of 1980.0 mm. The experiment was laid out in randomized block design (RDB) with the treatments T_1, T_2, T_3 T_4 and T_0 replicated five times. Treatment T_1, T_2, T_3 and T_4 were placed in an organic block. Sword suckers of banana were planted at a spacing of 2.1m × 2.1m. For the purpose of reference, the following notations were used to designate the different treatments.

T_1: FYM + Microbial Consortia
T_2: Enriched Compost
T_3: Vermicompost
T_4: Microbial Consortia
T_0: FYM + NPK (inorganic)

Details of the treatment:

T_1: At planting (May 2016) FYM @ 12 kg/plant + Microbial Consortia @ 30 g/plant was applied in pit and at 5 months after planting (October 2016) FYM @ 6 kg/plant + Microbial Consortia @ 15 g/plant was applied at 60 cm away from base of the plant.

T_2: Enriched Compost @ 5 kg/plant in each pit at planting and Enriched Compost @ 3 kg/plant was applied at 60 cm away from base of the plant at 5 month after planting

T_3: Vermicompost @ 5 kg/plant at planting Vermicompost @ 3 kg/plant at 5 months after planting

T_4: During planting 30g/plant Microbial Consortia as slurry At 5 month after planting 15 g/plant Microbial by mixing with 1 kg compost

T_0: FYM @ 12 kg/plant at the time of planting (May 2016) and the recommended doses of inorganic fertilizer for banana for Assam condition *i.e.* N:P:K @ 110 g: 33 g: 330 g per plant were applied at 3rd month (August, 2016) and at 5th month (October, 2016) after planting. At 3rd month, 120 g of urea, 210 g of SSP and 275 g of MOP per plant were applied at 30 cm away from the base of the banana psuedostem and at 5th month 120 g of urea and 275 g of MOP per plant were applied at 60 cm away from the base of the plant.

Quality analysis: For TSS, titratable acidity, reducing sugar, non reducing sugar and total sugar representative matured fingers were allowed for natual and uniform ripening. And those fruits were considered for analyzing the biochemical parameters. Titrable acidity, total sugars, reducing sugars and non-reducing sugars were estimated by adopting the standard method of A.O.A.C. (1975). After harvest of the bunch, the second hand was kept in room temperature to record the self-life of fruits.

TSS (Total soluble solid):

TSS of the fruit was determined by Pocket Refractometer PAL-1 and the result was expressed in °Brix.

Titratable acidity. Ten g of homogenised pulp was dissolved in 100 ml of distilled water and filtered. Ten ml of filtrate was titrated against 0.1 N NaOH using Phenolphthalein as indicator. Titratable acidity was expressed in percentage in terms of anhydrous malic acid.

$$\text{Titratable acidity (\%)} = \frac{\text{Titre value} \times \text{Normality of alkali} \times \text{Volume made up} \times \text{Eq wt. of malic acid}}{\text{Weight of the sample} \times \text{Aliquot} \times 1000} \times 100$$

Reducing sugar. Ten ml of saturated lead acetate and 5g of sodium oxalate were added to 25g pulp and the volume was made upto 250 ml with distilled water. The made up solution was titrated against 10ml boiling Fehling's solution mixture (5ml of Fehling's solution A + 5ml of Fehling's solution B) using methylene blue as indicator. Deep brick red colour of the solution indicated the end point and the value was expressed as percentage

$$\text{Reducing sugar (\%)} = \frac{\text{Factor (0.05)} \times \text{Volume made up}}{\text{Titre value} \times \text{Weight of the sample}} \times 100$$

Total sugars. From the solution of 250 ml made up for reducing sugar estimation. 50ml of the solution was taken and 5ml of concentrated HCl was added to it and kept overnight. The solution was then neutralized with 1 N NaOH and volume was made up to 100ml with distilled water and titrated against 10ml boiling Fehling's solution mixture using methylene blue as indicator. From the titre value, percentage of total sugar was calculated as follows:

$$\text{Total sugar} = \text{Sucrose\%} + \text{Reducing sugar \%}$$

$$\text{Sucrose\%} = (\text{Total invert sugar\%} - \text{Reducing sugar\% originally present}) \times 0.95$$

$$\text{Total invert sugar (\%)} = \frac{\text{Factor(0.05)} \times \text{Volume made up} \times \text{Volume of stock solution}}{\text{Titre value} \times \text{Weight of the sample taken} \times \text{Aliquot}} \times 100$$

Non-reducing sugars. Non-reducing sugar was obtained as the difference between total sugars and reducing sugars and expressed in percentage.

Physiological loss in weight. The physiological loss in weight of the hand was computed on the basis of the initial weight of the hand and weight at subsequent intervals of time and weight loss was expressed as percentage (Kumar *et al*., 2013).

$$\text{PLW (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Final weight}} \times 100$$

Self-life of fruits after harvest: Number of days was counted from the day of harvesting to the day till the fruits remained in edible condition as evident by over softening and onset of decay (Vanilarasu and Balakrishnamurthy 2014).

RESULTS AND DISCUSSION

A. Effect on biochemical properties of fruits

Total soluble solids, titratable acidity, sugar contents determine the quality of fruits. The biochemical characters TSS, acidity, sugar content was found better in organic as compared to inorganic. The finding are in accordance with the results of Athani and Hulamani (2000) in banana and Anon., (2001) in custard Apple. The data of qualitative parameters of fingers presented in Table 1 revealed that in TSS there is no significant difference among the organic treatments. Highest TSS content (25.72°Brix) was recorded in T_1. And lowest TSS content (24.46°Brix) was recorded in T_2. And TSS of organics means *i.e.* 25.08°Brix was found superior than the mean of RDF *i.e.* 24.46°Brix. Higher content of TSS in banana fruits might be due to the accumulation of sugars and other soluble components from hydrolysis of protein and oxidation of ascorbic acid (Marriot *et al*., 1981). Due to high moisture content there was high ion concentration in the cell which increased the osmotic pressure at the cell solute and consequently opening of the stomata, and further changed in proportion of starch to sugar might have increased considerably in the treatments. The high moisture content was attributed to better moisture conservation which has increased in fruit quality of FYM + Microbial Consortia (T_1) treated plants. Helkiah *et al.*, (1981); Tandon, (1994); Tisdale *et al.*, (1995) revealed that application of FYM not only increased the crop productivity but also improved soil structure, water holding capacity and support to growth of microorganism by supplying essential micronutrients. The humic substance formed during decomposition of FYM might have improved the water holding capacity of the soil. An increase in microbial population due to addition of Microbial Consortia along with FYM have made the nutrients available required by the crop in steady rate. The TSS has been reported associated with regular and sustained of Nitrogen from soil as reported by Chattopadhyay *et al.*, (1980); Bellie (1987). Bakheit and Elsadig (2015) also observed higher TSS of Dwarf Cavendish at green and ripe stage in plants treated with organic fertilizers (Manures and Compost) than inorganic fertilizers (Urea and NPK).

Post harvest assessment of acidity is important in the evaluation of the taste of the fruits. In the present study, the titratable acidity did not differ significantly among all the treatments. The acidity of banana fruits was lowest in T_0 (0.19%) as compared to organic means (0.22%). The lower content of titratable acidity in the fruits of banana could be attributed to the dilution effect because of fruit size and conversion of acid into sugars and salts. According to Marriot (1980), the major organic acids present in the banana pulp are malic, citric, and oxalic acids. The variations in the composition of these acids during ripening might have influenced the titratable acidity of the fruit pulp.

The data on reducing sugar of fruits (Table 1) revealed high significant differences among the organic treatments. T_1 recorded the highest reducing sugar among all with 11.23 %. The treatments T_1 and T_4 (10.74 %) and T_3 (10.36 %) were at par with each which were followed by T_2 (9.12 %). The non-reducing sugar also varied significantly among the organic treatments. The highest non-reducing sugar was recorded in T_1 (12.11 %) which was found optimum and at par with T_4 (11.57 %). They were followed by T_3 (10.92 %) and T_2 (10.68%). Non-reducing sugar was found to be higher in the plants treated with organics than the plants treated with RDF *i.e.* 9.34 %. The total sugar was recorded maximum at T_1 (23.30 %) followed by T_4 (22.50 %) and T_3 (21.25 %). The lowest was recorded in T_2 (19.83 %). On an average, higher reducing sugar (10.36%), non reducing sugar (11.32%) and total sugar (21.72%) was estimated in fruits produced by using organics The inorganic (T_0) treated plants recorded lower reducing sugar (7.72%), non reducing sugar (9.34%) and total sugar (17.06%). The humic substances in FYM and more microbial activity in soil due to microbial consortia have made both micro and macro nutrient available in the soil which plays better role in carbohydrates synthesis and promote the accumulation of reducing and non reducing sugar. FYM contains all essential plant nutrients like C, N, P, K, Ca, Mg, Cu, Fe, Mn, Na, Zn etc. as claimed by Baghel and Gupta (2003). Tiwary *et al.,* (1998) recorded higher TSS and reducing sugar contents in banana fruits cv. Gaint produced by inoculating with *Azotobacter*. The continous supply of nutrient specially nitrogen might have increased the leaf area with higher synthesis of assimilates due to higher rate of photosynthesis. And this might have increased the translocation of photosynthetic products from leaves to the developing fruits and as a result increase the total sugar content.

Table 1: Qualitative parameters of fingers.

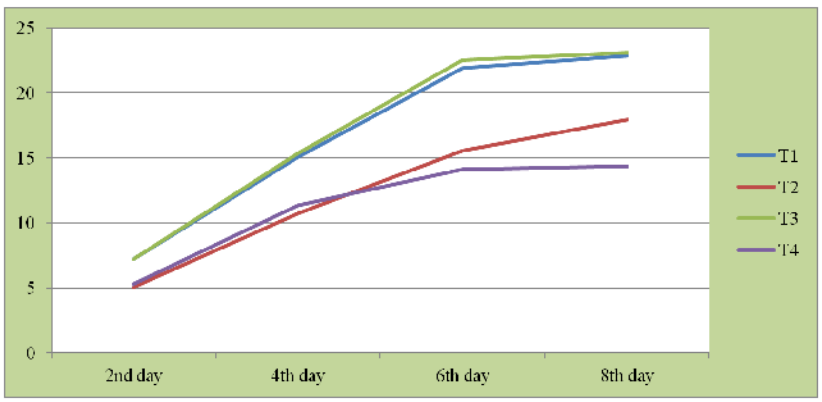
Treatments	TSS (°Brix)	Titratable acidity (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
T_1: FYM+ Microbial consortia	25.72	0.23	11.23	12.11	23.30
T_2: Enriched compost	24.46	0.25	9.12	10.68	19.83
T_3 : Vermicompost	25.15	0.22	10.36	10.92	21.25
T_4: Microbial consortia	25.02	0.19	10.74	11.57	22.50
SEd±	0.76	0.04	0.91	0.66	1.50
CD (P=0.05)	**NS**	**NS**	**1.51**	**1.16**	**2.62**
Organics (Mean)	25.08	0.22	10.36	11.32	21.72
RDF (Mean)	22.55	0.19	7.72	9.34	17.06

B. Effect on physiological loss in weight and self life

Data pertaining to physiological loss in weight are presented graphically Fig. 1 and 2. The banana fruits showed a gradual increase in the physiological loss in weight (PLW) throughout the storage period irrespective of the treatments. Among the organic treatments, the highest PLW was recorded in T_3 and lowest in T_4. However, fruits obtained from RDF showed lower PLW as compared to the organic treatments. The shelf-life of fingers after harvest was found to have significant difference among all the organic treatments and the maximum value was achieved at T_4 (9.70 days) (Table 2). But the fruits obtain from inorganic fertilization (T_0) had more self life *i.e* 9.90 days than organically produce fruits (9.03 days). The extend of self life might be the contribution of reduce weight loss, reduce respiration and transpiration. Subramaniam *et al.*, (2019) also found that highest self life of banana when treated with 100% recommended NPK through foliar spraying of soluble fertilizer and lowest when treated with Vermicompost 6 kg/plant.

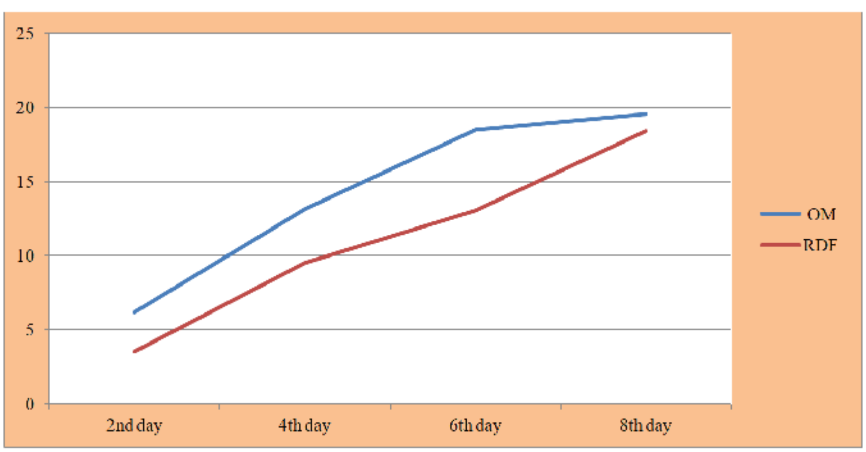
Table 2: Shelf-life of fruits after harvest.

Treatments	Self life (days)
T_1: FYM + Microbial consortia	9.10
T_2: Enriched compost	9.33
T_3 : Vermicompost	8.00
T_4: Microbial consortia	9.70
SEd±	0.75
CD (P=0.05)	**1.31**
Organics (Mean)	9.03
RDF (Mean)	9.90



T_1 FYM + Microbial consortia
T_2 Enriched Compost
T_3 Vermicompost
T_4 Microbial Consortia

Fig. 1. Physiological loss in weight (%) of hands under different organic treatments.



OM = Organics mean RDF = Recommended dose of fertilizer

Fig. 2. Comparison between the physiological loss in weight (%) of organics and RDF.

CONCLUSION

From the study it can be conclude that organic treatment enhance the fruit quality in contrast to inorganic treatment. By evaluating various organic combination for producing quality fruits organic treatment (FYM + Microbial Consortia) was found to be best and can be recommended for organic cultivation.

Acknowledgement. The author takes the privilege to express his deep sense of gratitude and indebtedness to his Major Advisor Dr. D.N. Hazarika, Professor, Department of Horticulture, BNCA for his keen interest, innovative suggestion, valuable guidance and constant encouragement during the entire period of investigation and preparation of this manuscript. It was his zeal and enthusiasm which made it possible for the author to complete the work. The author feels fortunate to have a friendly guide like him.

Conflict of Interest. None.

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How to cite this article: Rahman, J. I.; Hazarika, D.N.; Borah, B. and Bhattacharjee, D. (2021). Effect of Organic Manures and Inorganic Fertilizer on the Fruit Quality of Banana. *Biological Forum – An International Journal, 13*(4): 908-912.