

Original Research Article

EFFECT OF ORGANIC MANURES AND INORGANIC FERTILIZER ON THE LEAF CHARACTERS OF BANANA

ABSTRACT

A field experiment was carried out at Instructional cum Experimental Farm, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali to study the effects of organic manures and inorganic fertilizer on leaf characters of banana cv. Amritsagar (AAA) during 2016-2017. The investigation was carried out with the treatments as follows T₁: FYM (Farm Yard Manure) + Microbial Consortia, T₂: Enriched Compost, T₃: Vermicompost, T₄: Microbial Consortia, T₀: RDF (FYM + NPK). The treatments T₁, T₂, T₃ and T₄ were placed in certified organic block with five replications laid in RDB while the treatment T₀ was laid out outside the organic block with five replications.

In the organics, T₁ recorded the highest number of functional leaves (7.97, 12.46 and 5.37) in vegetative stage, shooting stage and harvesting stage respectively. Highest leaf area of 2.69 m² at vegetative stage and 11.17 m² at shooting stage were recorded in T₁ while lowest leaf area of 2.41 m² at vegetative stage and 8.89 m² at shooting stage were recorded in T₄. Leaf area index was highest in T₁. Chlorophyll content index in both vegetative stage (45.29) and shooting stage (65.56) was also highest in T₁. Comparing the leaf characters (number of functional leaves, leaf area, leaf area index and chlorophyll content index) under organic treatments with that of T₀ treated plants, it was found that plants treated with RDF had more number of functional leaves and better leaf character than that of the plants treated with organics.

Keywords: Chlorophyll Content Index, Enriched Compost, Farm Yard Manure, Functional leaves, Leaf Area, Leaf Area Index, Microbial Consortia, Inorganic Fertilizer, Vermicompost

INTRODUCTION

Banana (*Musa* spp.) is one of the most important fruit crops especially in the tropics and sub tropics and is a strategic crop for global food security. Banana is believed to have originated in the hot, tropical regions of South East Asia (Spiden, 1926; Sauer, 1952) and was later introduced to both tropical and sub-tropical regions (Simmonds and Shepherd, 1955). The fruit is grown widely in India and is one of the favourite fruits among all groups of people. In India 29.12 million tonnes of banana is produced from 0.85 million ha area with a productivity of 34.43 t/ha. (Anon., 2018). Banana cultivation has a strategic role in the world food production for its nutritional importance and yield potential which can reach up to 100t/ha (Soares de melo *et al*, 2014). Thus boosting banana production has become one of the important goals of the world agriculture to ensure food security in the future. This could be achieved through proper management practices, use of improved varieties, proper fertilization and so on. To improve the yield of plants the leaf system plays a major role. Leaf is the assimilatory organ of a plant. Productivity in bananas is governed by 'source' and 'sink' units of the plant system. The role of leaf characters such as numbers of functional leaves, leaf area, leaf area index and chlorophyll content in leaves retained mainly at the shooting stage is crucial in determining the yield potential of banana plants. More the number of functional leaves, leaf area exposed to the sun there is better interception and utilization of solar radiation and thereby rise the rate of photosynthesis consequently in more yield.

Thus the aim of the research was to realize the effect of organics and inorganic fertilizer on the leaf characters (number of functional leaves, leaf area, leaf area index and chlorophyll content index) of banana.

MATERIALS AND METHODS

The study was conducted in the Instructional cum Experimental Farm, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali during 2016-2017. Biswanath Chariali District falls in the sub-tropical climatic region having hot and humid summer, dry and cold winter seasons. The station receives an average annual rainfall of 1980.0 mm. The experiment was carried out with five treatments. The treatments (T₁, T₂, T₃ and T₄) were laid out in randomized block design (RDB) replicated five times. The plots size were 6 m x 6 m. In the organic block there were total twenty plots of equal size. Outside the organic block five equal size plots were laid out for the treatment T₀ (inorganic fertilizer application). The banana plantlets were spaced at 2.1m x2.1m. For the purpose of reference, the following notations were used to designate the different treatments.

T₁: FYM + Microbial Consortia

T₂: Enriched Compost

T₃: Vermicompost

T₄: Microbial Consortia

T₀: FYM + NPK (inorganic)

Details of the treatment:

T₁: 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.

T₂: 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

T₃: Vermicompost @ 5 kg/plant at planting
Vermicompost @ 3 kg/plant at 5 months after planting

T₄: During planting 30g/plant Microbial Consortia as slurry
At 5 month after planting 15 g/plant Microbial by mixing with 1 kg compost

T₀: 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 pseudostem 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.

Recording number of functional leaves:

The number of functional leaves at vegetative stage (at 4th month after planting), shooting stage and at harvest were recorded and expressed in numbers. The green and healthy leaves where two third or whole of the total leaf lamina were photosynthetically active were considered as functional leaves. Whereas the leaves where more than two third of the total leaf lamina became yellowish or brown owing to ageing or attack of pest were rejected.

Recording leaf area and leaf area index:

Leaf area was recorded at vegetative stage and at shooting stage. The length of the 3rd youngest leaf from the top was measured along the mid rib from the lamina base to its apex and for width the measurement was taken from the broadest portion of the lamina. For calculating the leaf area of the third leaf the product of length and breadth of the lamina was multiplied with a factor 0.8 (Murray, 1960) and expressed in m². And to compute the total leaf area of the plant, the number of functional leaves present at the time of observation was multiplied with the leaf area of the third leaf.

For calculating the Leaf area index (LAI) at vegetative stage and at shooting stage the method of (Williams, 1946) was adopted.

$$\text{LAI} = \frac{\text{Leaf area of plants}}{\text{Area of the land occupied by the plants}}$$

Recording chlorophyll content index:

The chlorophyll content index (CCI) values were estimated with the help of Chlorophyll Meter (Model: CCM-200, CID, Inc, USA). For measuring the CCI the third leaf from the apex of the plant was selected. The data were collected from three different segments - at the apex, middle and at the base of the lamina and the average chlorophyll content index was calculated. CCI values were measured at vegetative and shooting stage.

RESULTS AND DISCUSSION**Effect on number of functional leaves:**

The number of function leaves at different growth stages is presented at table 1
Leaves are the vital contributors of yield through the process of photosynthesis. High leaf

production in banana reflects the increasing rate of plant growth (Sathyanarayana, 1985). The yield and quality of fruits is highly influence by the number of functional leaves since they act as a source to the developing fruits (Badgujar *et al.*, 2010). The number of leaves produced and leaf longevity have keen effect on fruiting of banana (Barkar and Steward, 1962; Simmonds, 1966; Turner, 1970). Retention of 8.0 numbers of leaves at shooting was sufficient to achieve maximum yield and finger length in banana (Robinson *et al.*, 1992). The T₀ (FYM + NPK) treated plants were found to have higher number of functional leaves than that of organics at all stages of observation. The plants treated with inorganic fertilizer produced functional leaves 9.52, 13.73 and 6.40 at vegetative stage, shooting and harvesting stage. Whereas in organic treated plants, the numbers of functional leaves were 7.92 at vegetative stage, 11.26 at shooting and 4.93 at harvest. This might be due to the combine effect of FYM and inorganic fertilizer that improved the fertility and physio-chemical properties of soil that helped easy release nutrient for producing more number of leaves. Badgujar *et al.* (2010) noticed highest pseudostem height, pseudostem girth, total number of leaves, days taken to shooting and less number of days for harvesting when the plants were fertilized with application of 20 kg FYM + 1 kg neem cake + 200:40:200 g NPK per banana plant. Among the organics, maximum numbers of functional leaves were produced in T₁ (FYM + microbial consortia) at shooting (12.46) and at harvest (5.37) which might be due the application of both organics and bio-fertilizer which have increased the soil microbial population and activities, and as a result the uptake of phosphorus and nitrogen had improved (Turner, 1970). Similar results were reported with the application of organics and bio-fertilizers in colocasia by Mahajan (2009). Jeeva *et al.* (1988) found that inoculation of banana cv. Poovan with *Azospirillum* enhanced the height and girth of pseudostem, leaf production, leaf area, total number of leaves and number of suckers.

Table 1: space

Effect on leaf area and leaf area index:

Leaf area has great effect on photosynthetic efficiency of a plant as it determines light interception as well as light assimilation. Bigger leaf area supports the plant to synthesize more metabolites by exhibiting high photosynthetic rate during the period of growth and development in banana (Mahadevan, 1988). Leaf area index (LAI) of a crop plant is one of the primary factors influencing canopy net photosynthesis (Hansen and Hitz, 1982). With the increase in LAI the accumulation of dry matter also increases through the process of photosynthesis. It is a positive index with direct influence on plant growth. Significant effects on leaf area and leaf area index due to different organic treatments were observed on (Table 2) recorded at 4th month after planting and at shooting. Among the organic treatments, the maximum leaf area at 4th month after planting and at shooting was achieved at T₁ (FYM + microbial consortia). At 4th month after planting, T₁ (2.69 m²) was at par with T₂ (2.52 m²) and they were followed by T₃ (2.45 m²) and T₄ (2.41 m²). The highest leaf area was recorded at T₁ (11.17 m²) at shooting and was at par with T₃ (9.40 m²) and they were followed by T₂ (9.03 m²) and T₄ (8.89 m²). From the observation, it was found that the T₀ (FYM + NPK) was higher in both the stages *i.e.* at 4th month after planting (2.52 m²) and shooting (11.00 m²) than the mean of organic manures *i.e.* 2.51 m² at 4th month after planting and 9.62 m² at shooting. The maximum leaf area index among the organics at 4th month after planting and at shooting was achieved at T₁ (FYM + microbial consortia) *i.e.* 0.60 and 2.60 respectively. The T₀ (FYM + NPK) was higher in both the stages *i.e.* 0.57 at 4th month after planting and 3.57 at shooting than mean of organics *i.e.* 0.56 at 4th month after planting and 2.19 at shooting.

The higher leaf area and leaf area index in these treatments might be justified to be readily available nutrient in soil, improved biological properties and more moisture

availability due to the treatment effects. Ray (1994) reported that with the increase in soil moisture level the leaf area in banana increased.

Table 2: space*

Effect on chlorophyll content index:

The chlorophyll content index was recorded at 4th month after planting and at shooting (Table 3). The photosynthetic pigments are one of the important factors which can limit the yield of crop by reducing photosynthesis. The organic treatments could not influence chlorophyll content index significantly at both the stages of observation. The data revealed that the maximum chlorophyll content index at 4th month after planting was achieved at T₁ (45.29) and lowest (42.26) at T₃. At shooting, the maximum chlorophyll content index was achieved at T₁ (62.56) which decreased gradually *i.e.* 60.32 at T₂, 54.91 at T₃ and 51.19 at T₄. The values of chlorophyll content index in T₀ treated plants was higher in both the stages *i.e.* at 4th month after planting (49.17) and at shooting (66.29) as compared to mean of organics *i.e.* at 4th month after planting (44.05) and at shooting (57.24). The result of higher chlorophyll content in T₀ might be due the application of inorganic manure along with FYM. (Amujoyegbe *et al.* (2007); Ghosh *et al.* (2004) reported similar results in maize and soybean. By increasing dosage of inorganic fertilizer that supplemented with organic fertilizer found in the increase of total chlorophyll content (Purbajanti *et al.*, 2019). The organics alone could not adequate the nutrient supply that responsible for chlorophyll biosynthesis as compared to T₀ treated plants. However FYM + inorganic fertilizer improved the nutrient absorption specially nitrogen and phosphorus thus chlorophyll biosynthesis was optimized.

Table 3: space*

CONCLUSION

From the study it can be conclude that the leaf characters were superior when the plants were treated with both FYM + inorganic fertilizer in contrast to only organics. The research was taken for a period of only one year thus the organics could not show at par results with the inorganics. It is known that organic cultivation required atleast a period of three years to perform equally good with inorganics and in due course the result would be better due to the improvement of soil status.

UNDER PEER REVIEW

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UNDER PEER REVIEW

Table 1: Number of functional leaves at different growth stages

Treatments	Functional leaves at		
	Vegetative stage	Shooting stage	Harvest stage
T ₁ : FYM+ Microbial consortia	7.97	12.46	5.37
T ₂ : Enriched compost	8.07	11.40	5.00
T ₃ : Vermicompost	7.62	11.16	4.54
T ₄ : Microbial consortia	8.02	10.04	4.82
SEd±	0.18	0.76	0.42
CD (P=0.05)	0.31	1.32	0.74
Organics (Mean)	7.92	11.26	4.93
T ₀ : RDF (Mean)	9.52	13.73	6.40

RDF= Recommended dose of fertilizer

Table 2: leaf area and leaf area index at different growth stages

Treatments	leaf area		leaf area index	
	Vegetative stage	Shooting stage	Vegetative stage	Shooting stage
T ₁ : FYM+ Microbial consortia	2.69	11.17	0.60	2.60
T ₂ : Enriched compost	2.52	9.03	0.57	2.03
T ₃ : Vermicompost	2.45	9.40	0.55	2.13
T ₄ : Microbial consortia	2.41	8.89	0.54	2.02
SEd±	0.12	1.14	0.02	0.29
CD = (0.05)	0.20	1.99	0.04	0.51
Organics (Mean)	2.51	9.62	0.56	2.19
T ₀ : RDF (Mean)	2.52	11.0	0.57	3.57

RDF= Recommended dose of fertilizer

Table 3: chlorophyll content index at different growth stages

Treatments	Chlorophyll content index at	
	Vegetative stage	Shooting stage
T₁ : FYM+ Microbial consortia	45.29	62.56
T₂ : Enriched compost	44.70	60.32
T₃ : Vermicompost	42.26	54.91
T₄ : Microbial consortia	43.97	51.19
SEd±	3.31	6.60
CD (P=0.05)	NS	NS
Organics (Mean)	44.05	57.24
T ₀ : RDF (Mean)	49.17	66.29

RDF= Recommended dose of fertilizer, NS = Non-significant