

Article history :

Received : 22.01.2016

Revised : 14.04.2016

Accepted : 26.04.2016

Impact of alternative energy sources on growth and yield of banana cv. GRAND NAINE

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ABSTRACT : Of late growing awareness on health and environmental issues associated with the intensive use of chemical inputs has led to interest in alternate forms of agriculture in India as well as in the world. An investigation was carried out during 2010-2011, to study the effect of organic manures, organic amendments and green manures in comparison with inorganic fertilizers on growth, development, yield and yield of banana cv. GRAND NAINE. The treatment T₁₀ with the combined application of organic manures, amendments and green manures (Farmyard manure @ 10 kg + Neem cake @ 1.25 kg + Vermicompost @ 5 kg and Wood ash @ 1.75 kg /plant + triple green manuring with sunhemp + Double intercropping of Cowpea + biofertilizers viz., Vesicular Arbuscular Mycorrhizae @ 25 g, *Azospirillum* @ 50 g, Phosphate Solubilizing Bacteria @ 50 g and *Trichoderma harzianum* @ 50 g/plant) registered the maximum growth (Pseudostem height and girth – 218 and 69.53 cm, number of leaves – 14.56 and leaf area index – 3.79) and yield (bunch weight – 27.96 kg, finger length and girth – 23.56 and 15.12 cm, finger weight – 280.25 g, pulp and peel weight – 194.13 and 65.27 g) characters under drip irrigation.

KEY WORDS : Organic manures, Amendments, Growth, Yield

HOW TO CITE THIS ARTICLE : Vanilarasu, K., Balakrishnamurthy, G. and Soorianathasundaram, K. (2016). Impact of alternative energy sources on growth and yield of banana cv. GRAND NAINE. *Asian J. Hort.*, 11(1) : 63-67, DOI : 10.15740/HAS/TAJH/11.1/63-67.

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Grand Naine is a popular variety grown mostly in all export oriented countries of Asia, South America and Africa. This is a superior selection of Giant Cavendish which was introduced to India in 1990's. Due to many desirable traits like excellent fruit quality, immunity to Fusarium wilt etc., it has proved as a better variety (Singh and Chundawat, 2002). More than five lakhs small and medium farmers depend on banana cultivation for their livelihood in our country (Vidhya *et al.*, 2007). Though farmers spend huge amount on fertilizers, only 50 per cent of potential yield is realized due to poor fertilizer use efficiency. Banana is a heavy feeder of nutrients and nearly 25 to 30 per cent of cost of inputs goes for fertilizers and manures. It is estimated

that a crop of 50 t of banana in 1 ha removes 320 kg of N, 32 kg of P₂O₅ and 325 kg of K₂O every year (Lahav and Turner, 1983). Hence, it is of importance to maintain high degree of soil fertility by timely and judicious application of NPK to achieve fruit yield and quality of banana. However, increased use of chemical fertilizers for production of banana has resulted in several undesirable consequences, in the fragile soil eco-system leading to gradual decline in productivity (Prabhuram, 1992). Delvaux (1999) opined that intensive banana cropping system for export and local markets involving high inorganic inputs may result in rapid environmental degradation and in decreasing cycle-to-cycle crop yields. Hence, there is a burgeoning interest to develop and

standardize eco-friendly approaches for sustainable production of crops and in this context, organic manures and their amendments play a major role. Organic amendments like biofertilizers can partly replace the nutrient requirement of the crops by enhancing the availability of nutrients in rhizosphere for the usage of crop plants and Garhwal *et al.* (2014) revealed that application of 80 kg farm yard manure (FYM) per plant significantly increased trunk diameter, fruit yield, number of fruits, average fruit weight, fruit diameter, fruit length, volume of fruit, peel weight, weight of sacs. With this background the present study were carried out the influences of organic manures and amendments on growth and yield of banana.

RESEARCH METHODS

The present investigation was carried out at Horticultural College and Research Institute, TNAU, Coimbatore, during the year 2010-11 in banana (*Musa* sp.) cv. GRAND NAINA. The experiment was laid out in a Randomized Block Design with twelve treatments and four replications. The treatments comprised of organic manures, amendments and green manures viz., FYM @ 10kg/plan + Neem cake @ 1.25kg/plant + vermicompost @ 5 kg/plant and wood ash @ 1.75 kg/plant (T₁), FYM @ 10kg/plant + Neem cake @ 1.25kg/plant + vermicompost @ 5 kg/plant and wood ash @ 3.75 kg/plant (T₂), FYM @ 15kg/plant + Neem cake @ 1.875kg/plant + vermicompost @ 7.5 kg/plant and wood ash @ 625 g/plant (T₃), FYM @ 15kg/plant + Neem cake @ 1.875kg/plant + vermicompost @ 7.5 kg/plant and wood ash @ 2.625 kg/plant (T₄), Control - absence of organic and inorganic sources (T₅), Triple green manuring with sunhemp + cowpea + cowpea as inter-crop (T₆), Arbuscular mycorrhizae @ 25 g/plant + *Azospirillum* @ 50 g/plant + *PSB* @ 50 g and *Trichoderma harzianum* @ 50 g/plant (T₇), T₁ + T₆ (T₈), T₁ + T₇ (T₉), T₁ + T₆ + T₇ (T₁₀) and the absolute control treatments (inorganic) 300 : 100 : 300 g NPK /plant (T₁₁), 110 : 35 : 330 g NPK /plant (T₁₂).

The recommended spacing of 1.8m x 1.8m was adopted for planting. Suckers of cv. GRAND NAINA obtained from organic field were planted for all the treatments. For absolute control treatment, suckers collected from inorganic field were pared and pralinaged with furadan granules @ 40g/ sucker and planted in the field located adjacent to organic farming trial during July, 2010. Among the twelve treatments ten treatments were

organic treatments (Nutrients equal to the recommended dose of inorganic fertilizers) supplied with organic manures and amendments (FYM and Neem cake were applied as basal dose, Vermicompost, Vesicular arbuscular mycorrhizae, *Azospirillum*, phosphate solubilizing bacteria and *Trichoderma harzianum* were applied after three month of planting and wood ash was applied after five month of planting) rest of them were inorganic treatments with three levels of inorganic fertilizers were applied as 3rd, 5th and 7th month after planting. Observations were taken up from centrally located four plants. Drip irrigation was provided to the experimental plots depending on soil moisture availability. Recommended cultural practices (except nutrient management) and plant protection measures were carried out regularly.

Recording morphological parameters of banana :

Four uniform plants were selected randomly in each treatment for recording the following observations on morphological characters of banana at vegetative and reproductive stage of plants. Height of pseudostem was measured from the base of the trunk to the axis of the youngest leaf and girth was measured at 30 cm height from the ground level expressed in centimeters (cm). The leaf area index was calculated using the formula suggested by Watson (1952).

Recording yield and yield attributes of banana :

Weight of the bunch was recorded including the peduncle measuring 20 cm above the first hand and expressed in kilograms (kg). The following finger characters were recorded from the middle finger of the second hand. Finger length was measured from the base of the pedicel to the tip of the fruit along the convex side and expressed in centimeters. Circumference at mid position of a representative finger was measured using a nylon thread and expressed in centimeters for finger girth. Five middle fingers in the top and bottom rows of the second hand were selected as representative fingers (Gottreich *et al.*, 1964) to record the average weight of fingers. Pulp and peel weight was measured by weighing the fruit pulp and peel after removing the peel and expressed in grams (g).

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Effect of different organic manures and amendments on growth characters of banana :

The growth characters like pseudostem height (225.25 cm) and girth (72.25 cm) was maximum in the treatment T₁₁ (300: 100: 300 g NPK/plant) (Fig. 1) this might have been due to the effect of chemical fertilizers that supply the nutrients in readily available form to the plants immediately after application (Upadhyay, 1988) and more particularly with respect to nitrogen which helped in increasing the values of pseudostem height and girth. The absorbed nitrogen ultimately leads to the formation of complex nitrogenous substances like

proteins and amino acids to build up new tissues.

The treatment T₁₀ with combined application of organic manures, amendments and green manures registered the maximum leaf area index (3.79) and more number of leaves (14.56), compared to inorganic treatments and control. The increased growth parameters could be attributed to the combined application of organic manures and amendments. The presence of vermicompost around the plants throughout the period of growth, which is a source of humus, N- fixers and nutrients, might have resulted in the higher values of vegetative parameters. Also, the enhancement in growth

Table 1 : Effect of alternative energy sources on yield and yield characters banana cv. GRAND NAINA						
Treatments	Yield (kg/plant)	Finger length (cm)	Finger girth (cm)	Finger weight (g)	Pulp weight (g)	Peel weight (g)
T ₁	20.83	22.54	14.25	245.56	166.52	56.38
T ₂	22.45	22.76	13.98	245.27	167.96	57.46
T ₃	23.39	21.96	13.72	241.23	165.21	55.23
T ₄	22.49	22.64	14.23	230.76	154.53	52.29
T ₅	16.36	20.50	12.87	205.23	135.27	46.23
T ₆	20.59	21.20	13.69	218.52	142.25	48.39
T ₇	19.82	22.83	14.92	254.53	173.26	58.75
T ₈	20.32	22.76	13.87	265.72	179.18	61.66
T ₉	24.06	22.95	14.12	270.67	184.92	63.54
T ₁₀	27.96	23.56	15.12	280.25	194.13	65.27
T ₁₁	24.47	22.36	13.79	228.15	150.88	51.26
T ₁₂	26.93	22.93	13.88	231.24	153.62	51.54
S.E.±	1.01	0.26	0.17	3.68	1.89	0.82
C.D. (P=0.05)	2.06	0.53	0.34	7.48	3.84	1.66

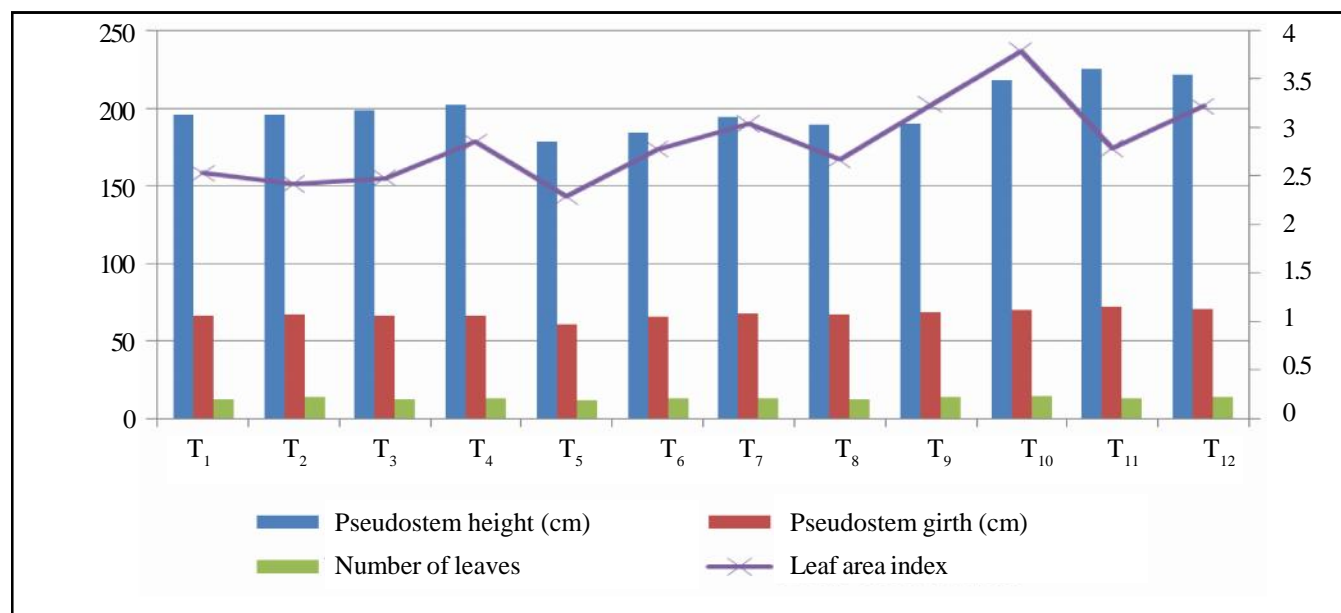


Fig. 1 : Effect of alternative energy sources on growth characters of banana cv. GRAND NAINA

attributes of banana due to *Azospirillum* may be on account of its direct role in nitrogen fixation, uptake of nutrients more specifically nitrogen and also due to the production of phytohormones like indole acetic acid, gibberellins, cytokinin like substances (Tien *et al.*, 1979).

Effect of different organic manures and amendments on yield and yield attributes of banana:

The yield and yield attributing characters like bunch weight, average finger length, weight and finger girth revealed superior performance of T₁₀ followed by T₉ (Table 1), the highest bunch weight (27.96 kg), finger length (23.56 cm), finger weight (280.25 g) and finger girth (15.12 cm) which received the combined application of organic manures, amendments and green manures. The increased weight of bunch with organic nutrient application might have first improved the internal nutritive condition of plant leading to increased growth and vigour associated with photosynthesis from source to sink and finally translocation of assimilates into the fruits (Akash Sharma *et al.*, 2013). The efficiency of bio-agents can be well exploited with the use of organic manures and biofertilizers which might have improved the yield parameters through better availability and uptake of nutrients from plant roots and enhancing the source sink relationship and thereby increasing the movement of carbohydrates from the leaves to the fruits. Similar to the present findings, the increase in fruit characters due to the incorporation of organic manures and amendments was reported by earlier workers like Yadav (2006) and Sha and Karuppaiah (2010).

The fruit physical properties like fresh and ripened weight (280.25 and 259.40 g), pulp and peel weight (194.13 and 65.27 g) were also highest in the treatment (T₁₀) which received organic amendments along with organic manures, biofertilizers and green manures (Table 1). This might be due to the availability of more friable and porous soil having more nutrients obtained from organic manures, amendments and green manures applied to the plant and hence improvement in yield attributing characters of fruit. Similar results were also documented by Abd Ei- Naby and EI Sanbaty (2005) in banana.

Conclusion :

Combined application of alternative energy sources like organic manures, amendments and green manures which was highly effective, economical and eco-friendly

approaches for sustainable production of banana when comparing to application of energy sources through chemical fertilizers like urea, phosphorus and potassium.

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