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Growth, yield and quality of vegetable banana Monthan (Banthal-ABB) in relation to NPK fertigation

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ABSTRACT

A field experiment was conducted at Central Horticultural Experiment Station, Bhubaneswar during 2007-08 to assess the effects of NPK fertigation on growth, yield and quality of vegetable banana Monthan (Banthal- ABB). There were five treatments *viz.*, T_1 - Recommended dose of fertilizer (RDF - 200 g N : 80 g P : 220 g K /plant/crop cycle), T_2 - 75% RDF (150 g N : 60 g P : 155 g K /plant/crop cycle)+ application schedule-I (Application of N:P:K in the ratio of 2:1:0 at vegetative growth, 0:2:1 at flowering stage and 1:0:2 at fruit development and maturation stage), T_3- 75% RDF + application schedule-II (Application of N:P:K in the ratio of 3:2:1 at vegetative growth, 1:3:2 at flowering stage and 2:1:3 at fruit developmental and maturation stage), T_4 - 50% RDF (100 g N : 40 g P : 110 g K/plant/crop cycle) + application schedule - I and T_5 - 50% RDF+ application schedule-II laid out in randomized block design with 5 replications. Maximum pseudo-stem height (261.50 cm), stem circumference (65.75 cm), number of hands and fingers (7.20 and 70.12/plant), bunch weight (11.45 kg/plant) and fruit yield (28.63 t/ha), finger size (20.50 × 15.65 cm), finger weight (163.29 g), total leaf area (19.88 m^2), productivity efficiency (0.575 kg/m^2 leaf area) and leaf, fruit and pseudo-stem dry matter (33.45, 15.27 and 9.98%) and leaf nutrient content (N-2.21%, P-0.26% and K-1.98%) and TSS (6.75°B) were recorded due to application of 75% recommended dose of fertilizers + application schedule-II (Applied N:P:K in the ratio of 3:2:1 at vegetative growth, 1:3:2 at flowering stage and 2:1:3 at fruit development stage). Earliest flowering and fruit maturity (12.41 and 17.91 days) were also recorded in the same treatment. Pulp: peel ratio (2.68) was maximum due to 50% RDF + application schedule-II (applied 3:2:1 at vegetative growth, 1:3:2 at flowering stage and 2:1:3 at fruit development and maturation stage) in vegetable banana Monthan (ABB-Banthal).

Key words: Banana, fertigation, fruit yield, leaf NPK content.

INTRODUCTION

Banana is one of the most important fruit crops of India which contributes 19.71% to the global production with annual production of 19.19 mt from an area of 0.562 mha (Singh, 8). It is a wonderful berry and forms staple food for millions of people across the globe by providing more balanced diet than any other fruit or vegetable (Singh, 7). It is nearly fat free but rich in carbohydrate with calorific value of 67 per 100 g edible portion. Apart from the culinary use, the vegetable banana can also be converted into quality processed and value-added products such as chips, snacks, fried pieces and various other preparation in the human diet. There is high demand for vegetable banana in the market but its cultivation is confined to few selected pockets in eastern regions of India. The productivity of vegetable banana is low due to lack of improved package of practices in the region. Balanced nutrition plays a crucial role in production of vegetable banana because it is a heavy feeder crop. Application of nitrogenous fertilizer improves the initial plant vigour whereas; the phosphatic and potassic fertilizers improve the bunch weight and fruit quality (Vishal Nath *et al.*, 12). Under drip irrigation, only portion of soil volume around each plant is wetted and thus traditional methods of fertilizers application is less effective. The limited root zone and reduced amount of mineralization in restricted wetted zone are main reason for the reduced nutrient availability to the plants (Magen, 3). One of the major advantages of fertigation is that it permits timely application of nutrients directly to root zone, reduces leaching losses and increases the fertilizers use efficiency (Rolston *et al.*, 6). The nutrient requirement of banana crop through fertigation has been given as per the crop growth stage (more nitrogen at vegetative growth, more phosphorus at flowering stage and more potassium at finger development and maturation stage) for better crop production in table banana (Kumar and Pandey, 2). The present investigation was aimed to increase production, potential and quality of vegetable banana Monthan Banthal by NPK fertigation in eastern region of India.

MATERIALS AND METHODS

The experiment was conducted at the research farm of the Central Horticultural Experiment Station

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(IIHR), Aiginia, Bhubaneswar (Orissa) during 2007-08. The Research farm at Bhubaneswar is situated at 20°15'N latitude, 85°50'E longitude and 25.5 m above mean sea level. The weather was warm during March-May with more than 35°C average temperature and average peak evaporation was 8.0 mm. The average rainfall received during the cropping season was 1461.9 mm. The soil of the experimental area was red lateritic with poor water holding capacity (Table 1).

Micro-propagated banana were planted in pre-filled pits of 60 cm × 60 cm × 60 cm size during November, 2007 at a spacing of 2 m × 2 m in experimental field. There were five treatments, *viz.*, T_1 - Recommended dose of fertilizer (RDF = 200 g N : 80 g P : 220 g K/plant/year), T_2 - 75% RDF (150 g N : 60 g P : 165 g K /plant/year) + Application schedule-I (application of N:P:K in the ratio of 2:1:0 at vegetative growth, 0:2:1 at flowering stage and 1:0:2 at fruit developmental stage), T_3 - 75% RDF + application schedule-II (application of N: P: K in the ratio of 3:2:1 at vegetative growth, 1:3:2 at flowering stage and 2:1:3 at fruit development stage), T_4 - 50% RDF (100 g N : 40 g P : 110 g K/plant/year) + application schedule-I (application of N:P:K in the ratio of 2:1:0 at vegetative growth, 0:2:1 at flowering stage and 1: 0:2 at fruit developmental stage) and T_5 - 50% RDF + application schedule-II (application of N:P:K in the ratio of 3:2:1 at vegetative growth, 1:3:2 at flowering stage and 2:1:3 at fruit development stage) laid out in Randomized block design with five replications. Water soluble fertilizers like urea as a source of nitrogen, orthophosphoric acid as phosphorus and muriate of potash as potassium were injected through drip irrigation system on alternate day as per the crop nutrient requirement (vegetative growth, flowering and fruit maturation stage) in main crop. The concentration of nutrient solution passing through irrigation water was around 1.0-1.5%. A separate laterals line (16 mm) was laid for each treatment and two emitters of 4 lph (litre per hour) capacity placed at a distance of 30 cm on either side of the plant were provided for drip irrigation. The drip irrigation was operated on a daily basis replenishing 80% of USWB class- A pan evaporation losses (Hegde and Srinivas, 1). Each treatment consisted of five rows of 125 plants. All suckers were removed from plant until flowering.

Mature bunches were harvested and weighed for working out estimated fruit yield per hectare. The pulp was extracted through muslin cloth and TSS was determined by using hand refractometer (0-32°Brix) from 10 randomly selected ripe fruits from each treatment. Five plants were sampled in each treatment at harvest and partitioned into leaf, fruit and pseudo-stem. The samples were dried in digital hot oven at 65°C for 72 h. After drying, the weight of leaf, pseudo stem and fruit were recorded and values were presented on per cent basis. The dry leaves were milled to a powder for nutrient analysis. The leaves nitrogen, phosphorus and potassium content were determined as per Page *et al.* (4). The data were analyzed statistically as per Steel and Torrie (10) for interpretation of results and drawing conclusions.

RESULTS AND DISCUSSION

Application of NPK through fertigation influenced the vegetative growth, flowering, bunch weight and yield (Table 2) in banana variety Monthan (Banthal). Maximum pseudostem height, stem circumference were recorded with the application of 75% RDF + application schedule-II (application of N:P:K in the ratio of 3:2:1 at vegetative growth, 1:3:2 at flowering stage and 2:1:3 at fruit development stage) in banana. Significantly early flowering and fruit maturation (12 and 18 days) were recorded with the application of 75% RDF + application schedule-II. Application of 75% recommended dose of fertilizers + application schedule-II enhanced the bunch weight and yield by 8.29 and 8.31% respectively. Non significant variations were observed in respect of number of hands/bunch under different treatment. The improvement in plant growth and fruit yield with NPK fertigation was due to reduced loss of applied nutrients by leaching and also timely application of nutrient directly to the root zone of plant and improving the fertilizer use efficiency (Rolston *et al*., 6). Similar findings were reported by Srinivas *et al.* (9) while working on banana under Bangalore conditions.

Significantly improved fruit size by 8.80% was recorded with the application of 75% RDF + application schedule-II in vegetable banana (Table 3). Application of 75% recommended dose of fertilizers

Table 1. Physico-chemical properties of banana field soil.

Property	Per cent	Property	Nutrient (kg/ha)
Sand	81.80	Nitrogen	190.80
Silt	9.72	Phosphorus	23.96
Clay	8.48	Potassium	116.94
Organic carbon	0.20	-	-

Table 2. Effect of NPK fertigation on growth and yield of banana Monthan (ABB-Banthal).

Treatment	Pseudostem (cm)		Days to shooting	Days to maturity	Bunch wt. (kg)	No. of hands	No. of fingers	Yield (t/ha)
	Height	Circum.						
T_1	248.80	62.90	255	346	10.50	6.50	65.44	26.25
T_2	228.20	61.45	263	363	8.92	5.75	58.24	22.30
T_3	261.50	65.75	243	328	11.45	7.20	70.12	28.63
T_4	211.20	58.32	274	365	8.30	5.55	55.24	20.75
T_5	243.40	62.43	251	340	10.42	6.30	64.28	26.05
CD at 5%	11.43	2.32	9.46	12.67	0.75	NS	4.42	1.97

Table 3. Effect of NPK fertigation on fruit characters of banana Monthan (ABB-Banthal).

Treatment	Finger size (cm)		Finger wt. (g)	Pulp wt. (g)	Peel wt. (g)	Pulp/peel ratio	TSS (°Brix)
	Length	Circum.					
T_1	19.45	13.62	140.58	99.87	40.71	2.45	6.25
T_2	18.63	13.15	151.44	109.29	42.15	2.59	5.80
T_3	20.50	15.65	163.29	118.06	45.23	2.61	6.75
T_4	18.45	12.76	150.25	108.50	41.75	2.59	5.30
T_5	19.05	13.12	155.80	113.55	42.25	2.68	5.50
CD at 5%	1.12	1.35	12.53	8.56	4.21	-	1.20

+ application schedule-II increased fruit weight and pulp weight by 13.90 and 15.40% over recommended dose of fertilizers in banana. Minimum peel weight (40.41 g) was recorded with the soil application of recommended dose of fertilizers. Pulp: peel ratio was maximum with the application of 50% RDF + application schedule-II (N:P:K in the ratio of 3:2:1 at vegetative growth, 1:3:2 at flowering stage and 2:1:3 at fruit development stage). Maximum total soluble solids was estimated with the application of 75% RDF + application schedule-II in banana fruit at maturity stage. The improvement in finger weight and pulp: peel ratio with the application of 75% recommended dose of fertilizer (RDF) in the ratio of 3:2:1 at vegetative growth, 1:3:2 at flowering stage and 2:1:3 at fruit maturation stage was due to proper supply and translocation of nutrient through out the fruit developmental stage. The findings are in conformity with the results of Hegde and Srinivas (1), Pandey *et al.* (5), and Srinivas *et al.* (9).

Leaf number and leaf area as influenced by the different fertigation treatments have been presented in Table 4. Leaf number did not show significant variations among the different treatments but maximum leaf number was counted in the treatment of 75% RDF + application schedule-II. The total leaf area (19.88 m^2/plant) was maximum with the treatment of 75% RDF + application schedule-II followed by recommended dose of fertilizers (19.51 m^2) and 50% RDF + application schedule-II (19.36 m^2) respectively. The highest productivity efficiency (0.575 kg/m^2 leaf area) was estimated with 75%

Table 4. Effect of NPK fertigation on leaf number, area and productivity efficiency in banana 'Monthan' (ABB-Banthal).

Treatment	Total leaf/plant (planting to shooting)		Productivity efficiency (kg/m^2 leaf area)
	Number	Area (m^2)	
TI	34	19.51	0.538
T2	34	18.12	0.492
T3	35	19.88	0.575
T4	33	17.02	0.487
T5	34	19.36	0.538
CD at 5%	NS	0.24	-

RDF + application schedule-II. This is because of proper and timely application of plant nutrient and translocation in the aerial part of plant as per the crop growth stage (Rolston *et al*., 6).

Leaf, fruit and pseudo stem dry matter content were also influenced by different levels of nutrient and application schedule in banana (Fig. 1). Maximum leaf, fruit and pseudo stem dry matter content was recorded with the application of 75% RDF + application schedule-II in vegetable banana. Maximum dry matter content was recorded in 75% RDF + application schedule-II due to more uptake of nutrient from the soil through root system and translocated to aerial parts of the plant (leaf, fruit and pseudostem) in banana for better plant growth and fruit yield. Results are in conformity with the findings of Kumar and Pandey (2).

The maximum leaf nitrogen and potassium content were recorded with the application of 75% RDF + application schedule-II. Leaf phosphorus content showed non-significant variations among different treatments (Table 5). The maximum leaf nitrogen and potassium content was recorded in 75% RFD + application schedule-II due to application of fertilizers through irrigation water as per the growth stages in banana. The present findings are inconformity with the findings Turner and Barkus (11), and Srinavas *et al*. (9).

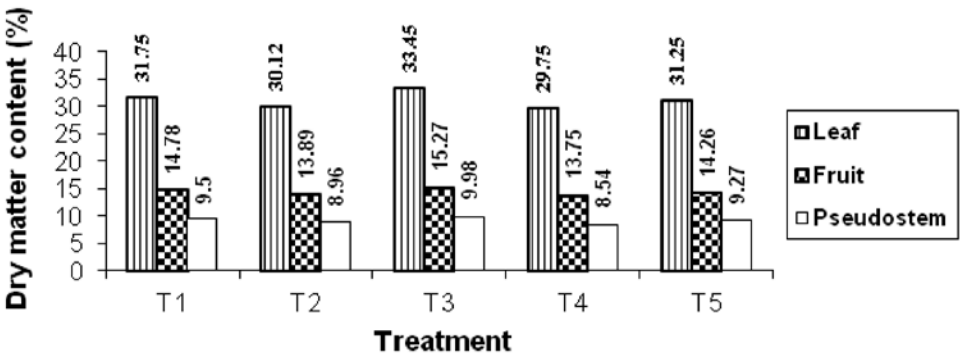

Fig. 1. Effect of NPK fertigation on leaf, fruit and pseudostem dry matter content in vegetable banana.

Table 5. Effect of NPK fertigation on leaf nutrient status in banana Monthan (ABB-Banthal).

Treatment	Leaf nutrient content (%)		
	Nitrogen	Phosphorus	Potassium
TI	2.11	0.23	1.95
T2	2.06	0.21	1.92
T3	2.21	0.26	1.98
T4	1.75	0.21	1.65
T5	1.86	0.22	1.68
CD at 5%	0.21	NS	0.19

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