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EFFECT OF NITROGEN AND POTASSIUM ON GROWTH MORPHOLOGY OF PLANTAIN *CV.* NENDRAN (AAB) UNDER TERAI REGION OF WEST BENGAL

MAHATO S.K.[1]*, GURUNG S.[1], CHHTERI B.[1] AND SURESH C.P.[2]

[1]Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya Kalimpong, Darjeeling, West Bengal, 734301, India
[2]Faculty of Horticulture, North-Eastern Hill University, Tura Campus, Chandmari - 794 002, Tura, Meghalaya, India
*Corresponding Author: Email: mahatosureshrrs@gmail.com

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Abstract- A field study was conducted to evaluate the performance of Nendran in the Terai Zone of West Bengal, at Uttar Banga Krishi Viswavidyalaya, Pundibari during September 2008. Amongst ten different treatment combinations of inorganic fertilizers were soil applied in split doses except phosphorus to evaluate their effects on the growth pattern of Nendran. Data of the experiments revealed that fertilizer application rates significantly affected the growth of Nendran. Growth rate of Nendran gradually increased up to the shooting stage and the rate decreased afterwards. Moreover, positive effect of N with K has been observed on plant growth and maturity.The highest growth values of Nendran were obtained from treatment representing T_6. Generally, it could be concluded that the treatment of T_6 seems to be the promising treatment which produced the highest vegetative growth at the foot of Himalayas.

Keywords- Plantain, Nendran, NPK, growth.

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Introduction

India is second largest diversified country of indigenous banana in the world. Among different banana cultivars, Nendran is included under plantain types having an AAB genome constitution. Presently plantains are of less importance than banana in terms of world trade in the genus but in West and Central Africa, about 70 million people are estimated to derive more than one quarter of their food energy requirement from plantains [1]. This crop forms the fruit diet of more than 400 million peoples, ranks fourth in the category of stable food products, after rice, wheat, and milk [2]. It is an important source of food in south India, but not known to be an important food in North-East India [3]. In general Nendran is moderately vigorous. Higher and earlier yields were recorded when NPK nutrients were supplied entirely through inorganic form of fertilizers. Inflorescence emergence is accelerated and the period until harvest was shortened, compared with plants receiving no adequate NPK nutrients. Therefore banana require considerable amounts of mineral nutrients to maintain yields. Nitrogen, potash and phosphorus are the major nutrients required in bulk quantities and can be supplied either by fertile soils or by commercial fertilizers [4].

But most of the quality parameters of fruit are significantly influenced by growing (pre-harvest) conditions. Monselise and Goren (1987) [5] have reported that the pre-harvest factors having greatest influence on quality are climate, nutrition and plant growth regulators. Banana being a heavy feeder, it require maximum amount NPK nutrients for growth and development. On comparison with organic manure, inorganic fertilizers give prominent growth and quality parameters of banana. Higher and earlier yields were recorded when NPK nutrients were supplied entirely through inorganic form of fertilizers. Substitution of inorganic form of nutrients with organic form of manures decline the bunch weight [6]. Inflorescence emergence is accelerated and the period until harvest was shortened, compared with plants receiving no adequate NPK nutrients. But absorption and utilization of applied nutrients mainly depend upon the climatic factors as well as soils condition of that particular region.

In context of North Bengal, this area is rich of different genomes of banana mostly AAB and ABB. The popular varieties, which are cultivated in this region, are Malbhog, Munua, Kanchkela, Chinichampa etc. As the people of Bengal have, greater affinity towards consuming chips and this offer great scope for introduction of Nendran (AAB), which is very popular in Kerala and Tamil Nadu for chips. As it is a new cultivar for this region, the performance and standardization of package of practices is most important before introducing the cultivar and very scanty information is available in respect of banana *cv.* Nendran in Bengal. In view of the fact stated above and the following studies were carried out.

Materials and Methods

The experiment was conducted at the Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during 2008-2010. The site is located 26°19' N latitude and 89°29' E longitude and having an attitude of 43 meters above mean sea level. The soil of the experimental field was sandy loam in nature, coarse in texture having poor water holding capacity with low pH (5.23), organic carbon (0.93%), available N (217.21kg ha^{-1}), available P (18.24kg ha^{-1}) and available K (111.89kg ha^{-1}). The climatic condition of terai zone is characterized by high rainfall (above 3000 mm annually), high humidity,

moderate temperature, prolonged winter with high residual soil moisture. To study the effect of different combinations of NPK on the fruit yield of plantain *cv*. Nendran (AAB) under Terai Zone of West Bengal, the investigation was carried out with banana suckers having 2.5 kg average weight with 2m x 2m spacing. The experimental design adopted was randomized block design in which there were ten main plot treatments taking ten treatment combinations of NPK nutrients through inorganic and replicated thrice. Nine different treatment combinations of inorganic fertilizers (Urea + Single super phosphate + Muriate of potash) having 150, 200 and 250g N per plant; 300, 350 and 400g K_2O plant^{-1} and 80g P_2O_5 plant^{-1}, respectively were compared with control (i.e. No N and K applied). Treatments were T1(150g N, 80g P and 300g K plant^{-1}), T2(200g N, 80g P and 300g K plant^{-1}), T3(250g N, 80g P and 300g K plant^{-1}), T4(150g N, 80g P and 350g K plant^{-1}), T5(200g N, 80g P and 350g K plant^{-1}), T6(250g N, 80g P and 350g K plant^{-1}), T7(150g N, 80g P and 400g K plant^{-1}), T8(200g N, 80g P and 400g K plant^{-1}), T9(250g N, 80g P and 400g K plant^{-1}) and T10(00g N, 80g P and 00g K plant^{-1}). Fertilizers as soil application were taken to evaluate their effects on the growth Nendran. All the fertilizers were applied in split doses except phosphorus. Observations on growth characters i.e., pseudo stem height, pseudo stem girth, petiole length, length difference between two succession petiole, number of leaves, leaf area, phyllochron, number of suckers per plant and days between sucker initiation, days to 1st sucker initiation, days to shooting, days between bract opening, days to complete bract opening and days to maturity were recorded at different growth stages of Nendran and data collected from the field experiment were subjected to statistical analysis appropriate to the design RBD (Randomized Block Design) with 10 treatments and 3 replications [7]. The significance of the different sources of variation was tested by Fisher and Snedecor's *'F'* test probability at 0.05 %. For the determination of least significance at 5% level of significance, the statistical table formulated by Fisher and Yates (1963) [8] was consulted.

Results and Discussion

The data presented in [Table-1] clearly revealed the effect of different levels of nitrogen and potassium was significant among different treatments throughout the growth period. Significantly highest pseudo stem height was recorded at all the stages in treatment (T6), which received 250g N, 80g P and 400g K followed by T9 while the least height was observed in control T10. The positive effects of N and K on the growth of total pseudo stem height. An improvement in plant height with application of nitrogen and potassium was also reported by Chandrakumar *et al*. (2001) [9] and Nalina *et al.* (2006) [10]. The growth rate of pseudo stem was more pronounced between 5th and 7th month compared to other stages in all the treatments. After 7th month, the rate of growth was in a decreasing, tend in all the treatments. Numerous studies have also shown that the highest growth of plants in banana was recorded before shooting [11].

Growth rate of stem girth as depicted in [Table-2] gradually increased up to the flowering stage but maximum growth rate of stem girth of plant was observed between 5th and 7th month and the rate decreased afterwards. There was positive effect of N on circumference of pseudo stem with K as explained by Brasil *et al.* (2000) [12]. Similar observations were also reported by Parida *et al.* (1994) [13]. More or less similar observations also recorded at different stages of plant growth. The highest value of stem girth may due to enhanced growth of tissue with nitrogen, potassium and phosphorus. This finding is in close agreement with the findings of Babu and Sharma (2005) [14]. But highest growth of stem has been observed with higher dose of nitrogen in combination with optimum dose of potassium (not beyond 350g per plant) and fixed dose of phosphorus (80g per plant). It may be due to the fact that, vegetative growth increases with increasing nitrogen levels [15].

It is evident from [Table-3] that the petiole length significantly varied due to different treatments of N and K fertilizers. The best length increment response was found with three levels of N and K like recorded in T8, T7 and T6 respectively. In all the cases, optimum dose of N and K fertilizer proved effective from their respective lower and upper N and K doses. It has been observed that petiole length was increases by increasing dose of potassium with higher nitrogen rate and fixed dose of phosphorus. Moreover, potassium application increased the uptake of nutrient, regulated water condition within the plant cell and water loss from the plant by maintaining through accelerating the enzymatic activity. Higher metabolic activity with increased levels of N and K in the plant might have helped in accumulation of more metabolites for faster cell division and cell elongation in the meristematic region to improve growth of the plants. Numerous studies have also shown that the highest growth of leaf size of banana was recorded at the highest fertilizer doses [16].

The petiole's lengths differences increased with the advancement of the crop age due to its growth and reached its maximum at harvest irrespective of the treatments tried [Table-4]. Maximum differences between the lengths of two successive petioles were observed in T6 followed by T9, T3 and so on. The effect of nitrogen and potassium on petioles length's differences was significant and positive. The response was higher when fertilizer applications increased from 150 to 250g nitrogen and 300 to 350g potassium.

The effect of nitrogen and potassium on number of leaves per plant was significant and positive [Table-5]. The response was higher when fertilizer applications increased from 150 to 250g nitrogen and 300 to 350g potassium per plant and then remains similar with higher doses (beyond 350g potassium) as in T7, T8 and T9. The favourable effect of nitrogen in promoting growth of plant might be due to the fact that being the major constituent of the chlorophyll, proteins and amino acids, N-application increased more transport of metabolites for growth. The highest rate of nitrogen was superior in terms of number of leaves per plant, in agreement with some of previous investigations [10]. Moreover the effect of potassium application on leaf number in the present investigation also find supports of Venktesan *et al.* (1965) [17] who opined that effect of potassium seemed to be less reflected on the number of leaves rather than on the size of the leaf.

The leaf area showed increasing trend with increasing dose of fertilizer and maximum growth rate was observed at 5th and 7th month of planting. The variation in leaf area of banana was not reflected during initial growth of rhizome. This result might be due to the addition of biomass per plant with increasing dose of fertilizer with respect to the leaf area. Venkatesan et al. (1965) [17] also reported increase in the levels of nitrogen and potassium led to an increase in the area of the individual leaves. As there would be no further leaf production after shooting, the effective leaf available for photosynthetic activity at shooting would naturally be expected to have a determining influence on the subsequent development of the fruits and in turn on the yield. According to Gardener *et al.* (1952) [18] a relatively large amount of vegetative growth are needed to result in heavy production.

Lowest phyllochron was recorded in T6 while maximum phyllochron were observed at T10-controlat all the stages of crop growth. The plants under treatment (T9) recorded second minimum phyllochron days but it was statistically at par with treatment like T3, T8 and T5 at different stages of plant growth. Interval between emergences of two successive leaves progressively increased from 3rd to 4th month of planting. An increase in the phyllochron resulted in a reduction in leaf production which might be due to the prevailing low temperature of December-January. Nitrogen at highest level (250g N plant^{-1}) caused a reduction in phyllochron and thereby enhanced the leaf production [19]. Moreover, higher rate of potassium may affect growth as well as emergence of leaf of banana [20].

Maximum number of sucker was recorded with T9 and it was followed by the treatments T8, T7, T6, T5 and so on while the least number of suckers was observed under T10-control at all stages of plant growth. The number of suckers produced upto harvesting was markedly influenced by the application of higher levels of potassium (400g K_2O plant^{-1}) in combination with nitrogen. Increasing number of suckers in this study may result in a rapid crop cycle hence, increasing

Table-1. *Effect of different doses of N and K on pseudo stem height of Nendran*

Treatments	Pseudo stem Height (cm)							
	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	Shooting stage
T_1	43.25	56.33	131.01	220.18	269.12	324.34	348.83	351.00
T_2	50.58	65.33	144.12	233.52	283.66	339.32	361.67	364.75
T_3	58.58	71.36	161.08	249.41	294.66	351.25	371.14	375.33
T_4	45.75	58.58	134.41	224.51	272.14	328.76	355.08	354.50
T_5	52.08	68.66	146.37	236.16	286.83	343.41	364.25	369.83
T_6	63.91	76.91	169.50	259.25	305.75	359.51	381.12	385.83
T_7	47.20	61.91	136.92	226.25	276.23	333.41	359.76	357.25
T_8	53.89	69.08	149.75	239.81	288.58	346.91	368.52	373.67
T_9	60.85	73.85	163.76	253.99	297.39	355.83	373.08	377.00
T_{10}	29.66	46.49	116.24	203.58	246.75	283.99	331.83	343.18
SEm ±	1.132	1.035	1.151	1.088	2.137	1.483	1.003	1.551
CD at 0.05	2.380	2.175	3.420	3.233	6.351	3.117	2.981	3.259

Table-2. *Effect of different doses of N and K on pseudo stem girth of Nendran*

Treatments	Pseudo stem Girth (cm)							
	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	Shooting stage
T_1	12.96	18.67	32.85	46.58	59.41	64.83	72.52	76.37
T_2	14.43	22.57	36.41	52.56	66.07	68.25	76.11	79.04
T_3	16.67	27.13	39.28	59.42	71.47	74.75	9.84	82.93
T_4	12.16	18.94	33.18	47.34	61.58	65.11	73.05	77.26
T_5	14.81	22.99	36.83	53.05	66.71	69.45	76.84	79.25
T_6	19.83	33.25	44.09	65.97	75.85	78.36	83.25	87.12
T_7	13.88	19.11	33.62	47.91	62.25	65.84	73.51	77.78
T_8	15.16	23.16	37.17	53.51	67.26	69.74	77.58	80.41
T_9	16.92	29.65	40.25	59.83	72.00	75.25	80.51	83.39
T_{10}	9.62	15.25	26.13	39.53	48.58	56.46	65.42	71.71
SEm ±	0.832	1.196	1.732	1.542	1.193	1.550	*1.217*	*1.329*
CD at 0.05	1.748	2.513	3.639	3.240	2.508	2.426	*2.554*	*2.793*

Table-3. *Effect of different doses of N and K on petiole length of Nendran leaf*

Treatments	Petiole length (cm)							
	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	Shooting stage
T_1	5.48	8.85	18.87	29.69	37.46	46.72	55.43	58.65
T_2	5.61	9.38	19.36	29.9	38.04	47.12	56.13	59.20
T_3	5.88	9.59	19.81	30.4	38.86	48.75	56.8	59.72
T_4	5.90	10.75	20.64	30.69	40.71	49.46	57.65	62.38
T_5	6.19	11.13	20.93	31.51	41.15	49.97	58.05	62.8
T_6	6.75	11.46	21.45	31.9	41.88	50.44	58.66	63.23
T_7	8.48	12.6	22.25	32.56	43.58	52.42	59.63	64.66
T_8	8.76	11.97	22.87	32.3	43.91	52.86	59.97	64.98
T_9	9.58	13.75	23.73	33.74	47.82	53.69	63.91	68.19
T_{10}	4.46	7.51	16.52	27.85	31.62	49.42	49.61	53.28
SEm ±	0.362	0.500	0.776	0.509	1.389	2.085	1.206	1.032
CD at 0.05	0.762	1.050	1.632	1.070	2.919	4.381	2.535	2.168

Table-4. *Effect of different doses of N and K on difference between petiole's lengths of Nendran leaf*

Treatments	Difference between petiole's lengths (cm)							
	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	Shooting stage
T_1	1.33	1.89	2.41	2.88	3.09	3.35	4.33	4.97
T_2	1.54	2.65	3.40	3.61	3.80	4.58	5.04	5.74
T_3	1.73	3.16	4.18	4.04	4.14	5.47	6.11	6.74
T_4	1.37	2.15	2.65	3.09	3.32	3.84	4.43	5.22
T_5	1.57	2.99	3.48	3.69	3.86	4.64	5.16	5.81
T_6	1.86	3.38	4.7	5.45	5.57	5.68	6.76	7.19
T_7	1.42	2.28	2.85	3.17	3.69	4.06	4.56	5.36
T_8	1.62	3.43	3.62	3.75	3.99	4.71	5.25	5.87
T_9	1.78	3.23	4.29	4.33	4.37	5.53	6.25	6.87
T_{10}	1.03	1.17	1.73	1.96	2.49	3.00	3.51	4.06
SEm ±	0.119	0.290	0.377	0.477	0.402	0.390	0.467	0.546
CD at 0.05	N.S.	0.869	1.130	1.428	1.205	1.168	1.397	N.S.

Table-5. Effect of different doses of N and K on leaf number of Nendran

Treatments	Number of leaf							
	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	Shooting stage
T_1	4.33	7.83	11.42	18.42	22.50	24.08	26.17	30.00
T_2	5.95	10.17	14.38	20.17	24.45	27.17	29.42	32.83
T_3	7.98	12.50	17.50	22.25	26.48	28.08	31.75	34.98
T_4	4.75	8.00	11.83	18.50	22.95	24.50	26.85	30.75
T_5	6.25	10.42	14.77	20.83	24.72	27.83	29.88	33.12
T_6	10.13	14.25	19.75	23.83	28.25	30.92	34.00	36.90
T_7	4.92	8.48	12.12	18.75	23.33	25.28	27.33	31.33
T_8	6.50	10.50	15.25	21.08	25.00	27.22	30.17	33.45
T_9	8.95	12.90	17.50	22.33	26.83	28.17	31.93	35.17
T_{10}	3.15	5.75	7.42	15.33	21.08	21.92	24.83	26.09
SEm ±	0.523	0.462	0.632	0.690	0.526	0.596	0.525	0.536
CD at 0.05	1.099	0.971	1.328	1.450	1.105	1.253	1.103	1.126

Table-6. *Effect of different doses of N and K on leaf area of Nendran*

Treatments	Leaf area (m^2)							
	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	Shooting stage
T_1	0.062	0.075	0.450	0.807	1.156	1.217	1.389	1.425
T_2	0.068	0.078	0.452	0.822	1.164	1.223	1.397	1.434
T_3	0.070	0.079	0.454	0.841	1.166	1.227	1.409	1.435
T_4	0.076	0.082	0.496	0.884	1.222	1.295	1.437	1.454
T_5	0.078	0.084	0.503	0.889	1.227	1.302	1.444	1.467
T_6	0.080	0.085	0.519	0.896	1.233	1.314	1.453	1.466
T_7	0.087	0.094	0.537	0.929	1.336	1.378	1.486	1.524
T_8	0.088	0.095	0.541	0.932	1.363	1.385	1.505	1.502
T_9	0.091	0.101	0.548	0.937	1.387	1.496	1.546	1.563
T_{10}	0.044	0.052	0.439	0.737	1.103	1.126	1.305	1.337
SEm ±	0.0011	0.0023	0.0020	0.0014	0.0082	0.0059	0.0152	0.0154
CD at 0.05	0.0023	0.0048	0.0043	0.0030	0.0172	0.0125	0.0320	0.0324

Table-7. *Effect of different doses of N and K on leaf phyllochron of Nendran*

Treatments	Phyllochron (days)							
	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	Shooting stage
T_1	7.58	8.33	7.16	8.67	8.75	14.15	14.50	18.92
T_2	5.91	6.33	4.55	7.09	7.41	11.16	14.13	18.67
T_3	5.58	5.83	5.23	5.98	6.08	9.91	13.82	17.75
T_4	7.33	7.09	6.44	8.08	8.58	13.33	13.58	18.09
T_5	5.75	6.15	6.00	6.75	6.75	11.00	13.64	16.58
T_6	4.12	5.50	4.32	4.61	5.81	7.12	10.67	11.75
T_7	6.75	6.58	6.00	7.91	8.34	12.17	13.5	16.68
T_8	5.66	6.07	5.50	6.18	6.65	10.15	13.25	14.11
T_9	5.54	5.91	5.25	5.58	5.91	8.83	12.82	13.34
T_{10}	8.67	9.08	8.49	9.83	11.67	16.03	16.58	21.58
SEm ±	0.404	0.330	0.432	0.398	1.130	0.725	0.954	0.693
CD at 0.05	0.849	0.694	0.909	0.836	2.374	1.524	2.005	1.457

Table-8. *Effect of different doses of N and K on number of suckers of Nendran*

Treatments	Number of suckers						
	6rd month	7th month	8th month	9th month	Shooting stage	Fruiting stage	Harvesting stage
T_1	1.33	2.83	5.58	6.58	7.25	7.65	7.73
T_2	1.58	3.08	6.00	6.92	7.58	8.00	8.50
T_3	2.17	3.33	6.25	7.42	7.83	8.17	8.25
T_4	1.42	2.92	5.67	6.75	7.33	7.73	7.85
T_5	1.67	3.17	6.08	7.17	7.67	8.08	8.65
T_6	2.33	3.42	6.33	7.50	7.92	8.25	8.45
T_7	1.50	3.00	5.75	6.83	7.42	7.92	7.98
T_8	1.92	3.42	6.25	7.25	7.75	8.17	8.78
T_9	2.50	3.50	6.42	7.67	8.33	8.67	8.80
T_{10}	1.08	1.83	4.33	5.83	6.50	6.75	7.17
SEm ±	0.341	0.342	0.363	0.432	0.346	0.280	0.583
CD at 0.05	0.717	0.718	0.762	0.908	0.727	0.588	1.225

assimilation rate resulting in higher growth. Numerous studies have also shown same results on potassium application [19,21] but higher rate of single nitrogen may cause decrease in number of offshoots [22]. Baruah and Mohan (1985) [23] also observed a higher rate of sucker production with 240g N plant^{-1} and 330g K_2O plant^{-1}.

The different stages of crop growth revealed that fertilizer applications significantly influenced the days required for initiation of two succession suckers at 6th, 7th, 8th, 9th, shooting, fruiting and at harvest. In different doses of fertilizer applications, days to two succession suckers initiation was maximum at the early stages of crop growth and kept on decreasing with advancement of crop age up to fruiting, thereafter it declined till maturity of the crop. The best sucker's initiation response was found with three levels of N and K like which is recorded in treatments like T9, T6 and T5 with respect to higher rate of nitrogen with that the number of suckers produced by each plant is highest at higher potassium potassium and this might caused the production of maximum numbers of suckers under these treatments. These treatments took minimum days for initiation of suckers at all the stages of plant growth.

Treatment representing T9 caused earlier sucker production (140.38 days) while the control plants (T10) took maximum days (172.08) for producing first sucker. In other treatments, the period for sucker production ranges from 146-157 days.

It has been observed that number of suckers produced by each plant is highest at plot receiving higher rate of potassium [21] and this may be due to the effect of potassium on developments of sucker from banana rhizome which may lead earlier sucker's emergence.

Table-9. *Effect of different doses of N and K on days between suckers initiation of Nendran*

Treatments	Days between suckers initiation						
	6rd month	7th month	8th month	9th month	Shooting stage	Fruiting stage	Harvesting stage
T_1	18.92	13.50	12.5	11.83	11.25	10.25	10.42
T_2	17.50	13.25	12.25	11.08	10.25	9.33	9.58
T_3	16.67	12.17	10.50	9.42	9.33	8.58	9.17
T_4	15.83	11.25	10.08	9.33	8.75	7.75	7.92
T_5	14.17	10.83	9.83	8.25	8.17	7.58	7.83
T_6	14.00	9.92	9.00	8.17	7.92	6.83	7.17
T_7	13.58	9.25	8.75	8.08	7.83	6.67	6.50
T_8	12.92	8.33	8.17	8.00	7.17	5.67	6.42
T_9	11.17	8.08	7.08	6.08	5.92	5.17	5.92
T_{10}	19.17	14.92	14.42	14.0	12.83	11.83	12.08
SEm ±	0.459	0.848	0.957	0.997	0.432	0.527	0.842
CD at 0.05	1.376	2.539	2.865	2.986	1.294	1.577	2.522

Table-10. *Effect of different doses of N and K on sucker production, shooting and maturity of Nendran*

Treatments	Days to 1stsucker initiation	Days to shooting	Days between bract opening	Days to complete bract opening	Days to maturity
T_1	157.25	313.58	2.00	9.67	91.67
T_2	156.00	309.75	1.57	7.83	87.75
T_3	155.53	305.17	1.38	6.83	85.67
T_4	151.42	308.83	1.89	9.58	90.25
T_5	150.00	302.42	1.51	7.67	87.08
T_6	149.47	287.75	1.27	6.58	82.92
T_7	146.95	308.17	1.77	9.33	89.92
T_8	146.93	300.58	1.46	7.58	87.00
T_9	140.38	295.17	1.32	6.92	85.33
T_{10}	172.08	317.66	2.38	10.33	97.83
SEm ±	1.9209	1.7899	0.1103	0.456	1.0512
CD at 0.05	4.0358	3.7604	0.2318	1.354	2.2085

Early emergence of flower (287.75 day) was noted with treatment (T6) as compared to other treatments and it was followed by the treatments T9, T3, T8, T5 and so on. The other treatment induces shooting in ranges from 294-309 days. The best shooting increment response was found with three levels of N and K like which is recorded in treatments like T6, T9 and T8 with respect to higher rate of nitrogen with potassium. Early shooting in banana is a desirable trait and higher dose of nitrogen was found to effect the days required for shooting. Decrease in the days required from planting to shooting by application of higher nitrogen rate with higher potassium was reported by Parida et al. (1994) [13]. In a trial of Hasan et al. (2001) [19] on banana had proved that the application of potassium ranges from 400-500g plant^{-1} causes earlier shoot productions as compare to plot receiving no N and K nutrient. It has been found that higher rate of N and K reduces the days to harvest from shooting and total crop duration, which had been also confirmed by trial of Arumugam and Manivannan (2001) [24].

The treatment having optimum dose of fertilizer (T6) took minimum time (1.27 days) for bracts opening while maximum days (2.38) was observed in control plots (T10).The minimum days for complete bract opening (6.58 days) was recorded with application of optimum dose of potassium (350g) in combination with higher dose of nitrogen (250g) and fixed dose of phosphorus (80g) representing plot T6.

Minimum days required for fruit maturity from flowering was 82.92 days recorded in the plants treated with nitrogen 250g, phosphorus 80g and 350g potassium (T6) while maximum (97.83 days) from plants belong to control treatment. Maturity duration was varied from 85 to 91 days in the other treatments. The best response with respect to maturity was found with three levels of N and K as it is recorded in treatments like T9, T3 and T8 with respect to higher rate of nitrogen and potassium. In this study, it has been found that higher rate of N and K reduces the days to harvest from shooting and total crop duration which had been also confirmed by trial of Arumugam and Manivannan (2001) [24]. Moreover potassium has special effect on the fruit maturation process [25].

References

[1] Robinson J.C. (1996) *Bananas and Plantains. CAB International, Oxon, UK.*

[2] Anonymous (1999) *Food and Agriculture Organization Book. Food and Agriculture Organization, Geneva.*

[3] Sebastian L. (2006) *Studies of the variants among in vitro regenerated plants in banana v. Nendran and Poovan with special reference to ontogeny of shoot and floral apices. Ph. D. Thesis, Research and Post Graduate department of Botany, St. Thomas College, Kerala, India*. pp. 5-6.

[4] Zake Y.K., Bwaniki D.P. and Nkwiine C. (2000) *Acta Horticulturae,* No. 540, 285-292.

[5] Monselise S.P. and Goren R. (1987) *Hort. Science,* 22, 1185-1189.

[6] Soorianathasundaram K., Kumar N. and Shanthi A. (2001) *South Indian Horticulture* 49(Special), 109-114.

[7] Gomez K.A. and Gomez A.A. (1984) *Statistical methods of agricultural research, 2nd edition, John Wiley and sons, New York, USA*.

[8] Fisher R.A. and Yates F. (1963) *Statistical table for biological, agricultural and medical research, Oliver and Boyd Ltd., Edinburg*.

[9] Chandrakumar S.S., Thimmegowda S., Srinivas K., Reddy B.M.C. and Devakumar N. (2001) *South Indian Horticulture,* 49(Special), 92-94.

[10] Nalina L., Kumar N. and Soorianathasundram K. (2006) *Crop Research,* 31(1), 72-74.

[11] Hasan M.A. Suresh C.P., Bhattacharya S. and Chattopadhyay P.K. (1999) *Environment and Ecology,* 17(3), 560-562.

[12] Brasil E.C., Oeiras A.H.L., Menezes A.J.E. A-de. and Veloso C.A.C. (2000) *Pesquisa Agropecuaria Brasileira,* 35(12), 2407-2414.

[13] Parida G. N., Ray D. P., Nath N. and Dora D. K. (1994) *Indian Agriculturist,* 38(1), 43-50.

[14] Babu N. and Sharma A. (2005) *Orissa Journal of Horticulture,* 33(2), 31-35.

[15] Shawky I., Bondok A., El-Shazly S. and El-Gazzar A. (1993) *Annals of Agricultural Science, Cairo*., 38(2), 699-710.

[16] Pandey V., Kumar D. and George S. (2005) *Indian Journal of Horticulture,* 62(2), 122-126.

[17] Venkatesam C., Venkata R.T. and Rangacharlu V.S. (1965) *Indian. J. Hort,* 22, 178-185.

[18] Gardener B.R., Broadford F.C. and Hooker H.D. (1952) The Fundamentals of Fruit Production. *Mc.Graw-Hill Book Company, New York*.

[19] Hasan M.A. Singh B., Das B.C. and Suresh C.P. (2001) *Orissa Journal of Horticulture*, 29(1), 69-73.

[20] Miao Q., Lun X.J. and Liang X.Y. (1993) *Soils and Fertilizers, Beijing,* (2), 4-7.

[21] Saleem A.T. and El-Khoreiby A.M.K. (1991) *Bull. of Agri. Univ. Cairo*., 42, 247-258.

[22] Fontes P.S.F., Carvalho A.J.C-de., Cereja B.S., Marinho C.S. and Monnerat P.H. (2003) *Revista Brasileira de Fruticultura,* 25(1), 156-159.

[23] Baruah P.J. and Mohan N.K. (1985) *Effect of potassium on vegetative growth of banana (Musae, AAA, Cavendish Sub group "Jahaji") Banana Newsletter,* 8, 23-24.

[24] Arumugam S. and Manivannan K. (2001) *South Indian Horticulture*, 49, 362-364.

[25] Fox R.L. (1989) *Detecting mineral deficiencies in tropical and temperate crops. West view Tropical Series 7. West view Press, Boulder,Co*.