*J. Hortl. Sci.*
**Vol. 5 (1): 53-56, 2010**

# Enhancing fruit yield in 'Ney Poovan' banana (*Musa paradisiaca* L.) by de-navelling and feeding N, K and S through distal stalk-end of the bunch

**S.C. Kotur and S.V. Keshava Murthy**
Division of Soil Science and Agricultural Chemistry
Indian Institute of Horticultural Research, Hessaraghatta
Bangalore - 560 089, Karnatak, India
E-mail: sckotur@iihr.ernet.in

## ABSTRACT

**De-navelling and feeding ammonium sulphate (AS) (5-25 g/plant) with or without potassium sulphate (2.5-12.5 g/plant) blended in 500 g of fresh cow-dung and applied to the distal stalk-end of the bunch of 'Ney Poovan' banana (*Musa* sp. L., AB) showed that the nutrients moved from the blend into the bunch and significantly enhanced weight of the fruits and of the bunch, compared to retention of flower, de-navelling (removal of male inflorescence) and application of 500 g cow-dung only to the excised distal stalk- end of the bunch. De-navelling caused 7.1% (5623 g) higher bunch yield, which increased to 13.9% (5980 g) when cow dung alone was applied after de-navelling. When cow dung was blended with 5 g of AS and 2.5 g of Sulphate of Potash, the response was 66.5% (9362 g) over de-navelling and application of cow dung alone and 78.3% (9362 g) over retention of male bud throughout (5250 g). A significantly higher N content, N uptake, Ndff (nitrogen derived from fertilizer), fertilizer N uptake, utilization of fertilizer and K and S content were observed when cow-dung enriched with AS and SOP was applied. Nitrogen content and all the parameters of N use were distinctly higher in the basal portion of the bunch indicating the flow of the applied nutrients upward from the de-navelled end. Results showed that application of 5 g ammonium sulphate and 2.5 g sulphate of potash blended in 500 g of fresh cow dung to the distal stalk-end of the bunch of 'Ney Poovan' banana was the most promising in boosting the yield, improving the nutritional composition in respect of N, K and S without adversely affecting the fruit quality.**

**Key words:** Bunch size, nutrient feeding, de-navelling, 'Ney Poovan' banana, Musa sp., N, K, S

## INTRODUCTION

Bunch size in banana is manipulated to enhance the size of fingers to suit market demands in South East Asian countries. Nutrients are supplied to the banana plant through soil and foliage, by de-navelling (removal of male inflorescence) and feeding nutrients post-shooting through the distal stalk-end of rachis (Venkatarayappa *et al*, 1976; Prasanna Kumari Amma *et al*, 1986; Ancy *et al*, 1998 and Ancy and Kurien, 2000). De-navelling serves the twin purpose of saving mobilization of food into an unwanted sink in the banana plant and earning additional income when the excised male bud is used as vegetable (Singh, 2001). Therefore, an attempt was made to enhance bunch yield by feeding N, K and S through the excised distal stalk-end of rachis after de-navelling and to determine the movement of these nutrients into the bunch of "Ney Poovan" banana.

## MATERIAL AND METHODS

A field experiment was conducted during 1998-2002 on healthy 'Ney Poovan' banana (*Musa* sp. L., AB) plants at the flowering stage. The crop was raised on red clay-loam soil with pH 5.7, organic carbon 0.3%, cation exchange capacity 8.7 cmol (p+) $kg^{-1}$, exchangeable K 1.1 cmol (p+) $kg^{-1}$, and available S 22 mg $kg^{-1}$. The rachis at the distal end of the bunch was excised along with the male bud by giving a slant cut immediately after all of the pistillate (female) flowers had set fruit and after 4 bracts were shed. One half-kilogram (500g) aliquots of fresh cow dung were blended to form a slurry with the required quantity of fertilizer [5-25 g of ammonium sulphate (AS) / 2.5-12.5 g of sulphate of potash (SOP)] and 100 ml of water. Cow dung contained 22.4% moisture, 1.47% of N, 1.05% of K and 0.39% S on oven-dry basis, which corresponded to 5.7g N, 4.07g K and 1.51g S in 500 g fresh cow dung. The blend was placed in a

polythene bag and tied securely later to dip the excised rachis into the slurry.

Treatments used were as follows:

Control: Male bud retained on the bunch till harvest

T1 – De-navelling, by excision of rachis along with the male bud, 10 cm away from the last hand

T2 – [T1 + Dipping if cut end in the slurry of cow dung and 100 ml water]

T3 – [T2 + 5 g of AS]
T4 – [T2 + 10 g of AS]
T5 – [T2 + 15 g of AS]
T6 – [T2 + 20 g of AS]
T7 – [T2 + 25 g of AS]
T8 – [T3 + 2.5 g SOP]
T9 – [T4 + 5 g of SOP]
T10 – [T5 + 7.5 g of SOP]
T11 – [T6 + 10 g of SOP]
T12 – [T7 + 12.5 g of SOP]

Treatments were replicated thrice in Completely Randomized Block design. Harvesting was done at maturity. The bunch was divided into the top portion and bottom portion, each carrying 5 hands. The finger and rachis from the middle of each half of the bunch was sampled, cut into pieces, dried in an oven at 70°C and powdered for N analysis by Kjeldahl method. The dry powder was used to estimate $^{15}N$ abundance in a Mass Spectrometer. Potassium was determined using flame-photometry and S content, by turbidimetry in the digest of the fruit sample in di-acid (9:4 nitric:perchloric acid). Nitrogen derived from fertilizer (Ndff) in the fruit was calculated as under:

$$\text{Ndff (\%)} = \frac{^{15}\text{N abundance in the fruit}}{^{15}\text{N abundance in the fertilizer}} \times 100$$

## RESULTS AND DISCUSSION

### Weight of the bunch and fruit

Weight of the bunch showed significant increase as a result imposition of de-navelling (T1- 7%), applying cow dung (T3-14%), blending AS (23-67%) and AS+SOP (29-78%) over the control. The highest increase was observed with 5g of AS and 2.5g of SOP blended in cow dung (T8) and fed to the bunch followed by 10g of AS alone (T4). Doses of both AS and AS+SOP treatments than these showed relatively reduced response compared to T8 and T4. The trend of improvement in fruit weight of both top and bottom portions in the bunch closely conformed to that in bunch weight. Substantial increase in yield of banana fruits may be attributed to presence of other mineral and bio-chemical ingredients in cow dung. The bottom portion of the bunch, which lies closer to the exogenously applied nutrients, accounted for 46% of the total weight, relative to that of the top portion of the bunch (19-57%) which is located farther from the applied nutrient blend. This was more pronounced in the case of AS+SOP blends. Except treatments 15g+7.5g and 20g+10g of AS+SOP in all the other AS+SOP treatments the bottom portion gained 52-99% weight compared to 35-69% in the top portion. Overall result of this would be plumper fingers in the bottom-half, having improved marketability of the whole bunch. Removal of male bud caused increase in bunch weight and also improved nutrient composition of the fruits because of conservation and utilization of energy for finger development (which would be otherwise lost for opening of the remainder of the flowers); and removal of a strong and active sink competing for photosynthates despite its small size relative to the bunch (Kurien *et al,* 2000; Ancy and Kurien, 2000; Singh, 2001). Further, translocation of nutrients into the infructescence from such exogenous feeding in 'Poovan' (AB), 'Monthan' (AAB) and 'Nendran' (AAB) varieties has been reported by Buragohain and Shanmugavelu (1986), Sobhana and Arvindakshan (1989) and Ancy and Kurien (2000) who fed urea solution directly to the cut-end of the stalk. Ancy and Kurien (2000) reported blackening and rotting of fruits when urea was fed at >50 g and found significant decline in weight of the bunch at 100 g dose. In this study, urea and/or SOP were fed as a blend in the cow dung and no adverse effects on quality parameters like peel:pulp ratio and TSS were observed (either for AS alone or for AS+SOP). However, AS levels higher than 10 g, and, 5g of AS + 2.5g of SOP caused reduction in fruit weight but were superior to control. Ammonium sulphate used in this study can be effectively replaced by urea to supply additional N to the bunch stalk-end as the latter is reported to enhance urease activity in fruits (Ancy *et al*, 1998). This may facilitate hydrolysis of urea to $NH_3$ (and to the $NH_4^+$ form thereafter) for easy absorption and assimilation of N, to effect enhanced bunch yield.

### Fruit composition

Contents of N, K and S in the fruit generally improved with application of cow dung alone, or, when blended with fertilizers. When de-navelling alone was done, the effect was significant in respect of K in both portions of the bunch, and, of S in the top portion of the bunch (Table 1). Further improvement in K content in the top portion of the bunch occurred when cow dung was enriched with fertilizers. Composition of the fruit improved with respect to N, K and S significantly when cow dung was blended with AS and AS+SOP. This effect was most pronounced at

**Table 1. Effect of de-navelling and feeding nutrients through the stalk-end of 'Ney Poovan' banana on fresh weight of bunch, fruit weight and its composition**

| Treatment | Bunch weight (g) | Fruit weight (g) | | N in fruit (%) | | P in fruit (%) | | K in fruit (%) | | Ca in fruit (%) | | Mg in fruit (%) | | S in fruit (%) | | Fe in fruit (mg kg$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Top | Bottom | Top | Bottom | Top | Bottom | Top | Bottom | Top | Bottom | Top | Bottom | Top | Bottom | Top | Bottom |
| Control | 5250 | 2578 | 2067 | 0.25 | 0.29 | 0.10 | 0.10 | 1.19 | 1.17 | 0.94 | 0.94 | 0.100 | 0.096 | 0.020 | 0.024 | 66 | 51 |
| T1 | 5623 | 2790 | 2231 | 0.026 | 0.30 | 0.10 | 0.09 | 1.32 | 0.29 | 0.89 | 0.79 | 0.094 | 0.093 | 0.024 | 0.025 | 58 | 49 |
| T2 | 5980 | 3042 | 2328 | 0.25 | 0.30 | 0.09 | 0.09 | 1.36 | 1.31 | 0.80 | 0.67 | 0.092 | 0.080 | 0.024 | 0.027 | 51 | 43 |
| 5g AS (T3) | 6474 | 3074 | 2769 | 0.37 | 0.46 | 0.12 | 0.10 | 1.44 | 1.49 | 0.96 | 1.17 | 0.110 | 0.117 | 0.033 | 0.035 | 81 | 70 |
| 10g as AS (T4) | 8778 | 4072 | 3695 | 0.33 | 0.40 | 0.12 | 0.12 | 1049 | 1.34 | 1.40 | 1.50 | 0.124 | 0.119 | 0.025 | 0.028 | 92 | 134 |
| 15g AS (T5) | 6939 | 3432 | 2808 | 0.36 | 0.34 | 0.11 | 0.11 | 1.45 | 1.41 | 0.97 | 1.21 | 0.118 | 0.111 | 0.029 | 0.035 | 74 | 120 |
| 20g AS (T6) | 8155 | 3713 | 3657 | 0.32 | 0.37 | 0.10 | 0.10 | 1.49 | 1.41 | 1.07 | 1.18 | 0.107 | 0.113 | 0025 | 0.031 | 75 | 101 |
| 25g AS (T7) | 7726 | 3788 | 3174 | 0.33 | 0.42 | 0.10 | 0.10 | 0.41 | 1.42 | 0.96 | 0.98 | 0.104 | 0.111 | 0.028 | 0.031 | 71 | 116 |
| 5g AS + 2.5g SOP (T8) | 9362 | 4354 | 4119 | 0.32 | 0.36 | 0.12 | 0.13 | 0.62 | 1.55 | 1.18 | 1.44 | 0.121 | 0.117 | 0.027 | 0.033 | 98 | 139 |
| 10g AS + 5g SOP (T9) | 7342 | 4222 | 2397 | 0.37 | 0.45 | 0.11 | 0.12 | 0.46 | 1.46 | 0.94 | 1.15 | 0.116 | 0.100 | 0.037 | 0.035 | 92 | 116 |
| 15g AS + 7.5g SOP (T10) | 6780 | 3434 | 2691 | 0.31 | 0.36 | 0.11 | 0.11 | 0.51 | 1.45 | 1.15 | 1.15 | 0.114 | 0.109 | 0.031 | 0.036 | 85 | 106 |
| 20g AS + 10g SOP (T11) | 6943 | 3498 | 2777 | 0.31 | 0.35 | 0.11 | 0.11 | 0.43 | 1.42 | 1.08 | 1.03 | 0.114 | 0.104 | 0.029 | 0.034 | 82 | 85 |
| 25g AS + 12.5g SOP (T11) | 7342 | 3471 | 3151 | 0.33 | 0.34 | 0.11 | 0.11 | 0.45 | 1.37 | 1.05 | 1.05 | 0.107 | 0.107 | 0.027 | 0.034 | 75 | 101 |
| SEM (±) | 226.2 | 120.3 | 121.2 | 0.009 | 0.007 | 0.003 | 0.002 | 0.032 | 0.024 | 0.003 | 0.004 | 0.0019 | 0.0032 | 0.0007 | 0.0006 | 2.2 | 5.4 |
| CD *(P=0.05)* | 660.1 | 353.8 | 348.7 | 0.025 | 0.022 | 0.007 | 0.006 | 0.095 | 0.069 | 0.089 | 0.011 | 0.0056 | 0.0093 | 0.0020 | 0.0017 | 6.4 | 15.7 |

**Table 2. Effect of feeding various levels of ammonium sulphate and sulphate of posash on different parameters of N use in fruits of 'Ney Poovan' banana**

| Treatment | Ndff (%) | | | Fertilizer N uptake (g) | | | Fertilizer utilization (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Top | Bottom | Mean | Top | Bottom | Total | Top | Bottom | Total |
| 5g AS | 1.74 | 7.34 | 4.68 | 0.065 | 0.300 | 0.365 | 6.45 | 30.04 | 36.49 |
| 10g AS | 2.72 | 9.61 | 6.30 | 0.109 | 0.418 | 0.527 | 5.53 | 20.90 | 26.43 |
| 15g AS | 1.63 | 9.05 | 4.97 | 0.063 | 0.285 | 0.348 | 2.08 | 9.49 | 11.57 |
| 20g AS | 2.38 | 9.63 | 6.17 | 0.086 | 0.385 | 0.471 | 2.16 | 9.62 | 11.78 |
| 25g AS | 2.79 | 9.11 | 6.02 | 0.109 | 0.370 | 0.479 | 2.19 | 7.39 | 9.58 |
| 5g AS + 2.5g SOP | 2.51 | 6.66 | 4.59 | 0.113 | 0.303 | 0.416 | 11.31 | 30.22 | 41.53 |
| 10g AS + 5g SOP | 2.30 | 7.19 | 4.64 | 0.115 | 0.332 | 0.447 | 5.74 | 16.61 | 2.35 |
| 15g AS + 7.5g SOP | 4.43 | 9.07 | 6.60 | 0.143 | 0.259 | 0.402 | 4.77 | 8.64 | 13.41 |
| 20g AS + 10g SOP | 3.97 | 2.89 | 3.45 | 0.130 | 0.087 | 0.217 | 3.26 | 2.17 | 5.43 |
| 25g AS + 12.5g SOP | 3.23 | 4.93 | 4.10 | 0.109 | 0.189 | 0.298 | 2.18 | 3.78 | 5.96 |
| SEM (±) | 0.152 | 0.382 | 0.197 | 0.0073 | 0.202 | 0.332 | 0.324 | 1.084 | 1.083 |
| CD *(P=0.05)* | 0.450 | 1.143 | 0.582 | 00223 | 0.604 | 0.997 | 0.964 | 3.223 | 3.224 |

5g of AS with or without SOP, and generally higher levels of these showed reduction in the mineral composition of the fruit.

### N use parameters studied

In respect of Ndff and fertilizer uptake by fruit, there was improvement upto 10g of AS and 15g of AS+7.5g of SOP. However, addition of more AS or AS+SOP showed no further improvement of Ndff in both the portions of the bunch. Maximum absorption of N was observed at 15g AS+7.5g SOP among treatments. Fertilizer use decreased significantly with increased amount of N in the blend. This was most pronounced between 5 and 10g of AS in the bottom portion, with or without SOP. It is noteworthy that N content (Table 1) and all the parameters of N use (Table 2) were distinctly higher in the bottom portion of the bunch due to its proximity to exogenous source of N compared to that in the top portion indicating the upward flow of applied nutrients from the de-navelled end. Utilization of fertilizer decreased with increasing input of fertilizer N in the blend which is phenomenon observed in fertilizer experiments. Among various treatments, blending 5g of AS and 2.5g of SOP in cow dung showed maximum utilization (41.53%) of applied N.

In conclusion, it is stated that de-navelling caused 7.1 % higher bunch yield which increased to 13.9% when cow dung alone was applied. When cow dung was blended with 5 g of AS and 2.5 g of SOP, the response was 66.5% increase over de-navelling and application of cow dung alone, and 78.3% increase over retention of male bud until harvest.

## ACKNOWLEDGEMENT

The authors gratefully thank the Director, Indian Institute of Horticultural Research, Bangalore, for encouragement and facilities, and, Shri N.K. Kacker, Technical Officer, for technical help.

## REFERENCES

Ancy, T.K., Kurien, S., Augustin, A. and Balachandran, P.V. 1998. Urease activity in banana fruit. *J. Pl. Nutrition,* **21**:2127-40

Ancy, T.K. and Kurien, S. 2000. Bunch stalk feeding of urea in banana, *Musa* (AAB group) 'Nendran'. *Sci Hort.,* **84**:205-12

Buragohain, R. and Shanmugavelu, K.G. 1986. Studies on the effect of post-shooting application of urea in 'Vayal vazhai' banana (ABB). *Banana Newslett.,* **9:**16-8

Kurien, S., Anil, B.K., Rajeevan, R.K., Bharathan and Krishnan, S. 2000. Phosphorus mobilization to uneconomic tissues and effects of bunch trimming regimes in banana. *Sci. Hort.,* **82**:25-35

Prasanna Kumari Amma, S., Babylatha, A.K., Pushkaran, K. and Kurien, T.K. 1986. Studies on the effect of removing terminal hands and male bud on the yield and fruit size of banana *Musa* (AAB group) 'Palayankodan'. *South Ind.Hort.,* **34**:204-9

Singh, H.P. 2001. Banana. *In*: *Handbook of Horticulture*, Chadha, K.L. (Ed.). p.152, Indian Council of Agricultural Research, New Delhi.

Sobhana, A. and Aravindakshan, M. 1989. Translocation of banana after shooting. *J. Nuclear Agri. and Biol.,* **18**:243-5

Venkatarayappa, T., Narasimham, B. and Venkatesan, C. 1976. Effect of post-shooting application of urea on development and composition of banana fruit. *South Ind. Hort.,* **19**:109-17

*(MS Received 23 September 2009, Revised 24 March, 2010)*