J. Hortl. Sci.
Vol. 10(1):107-108, 2015

Short communication

Bio-fortification with iron and manganese for enhanced bunch yield in 'Robusta' banana through direct nutrient-feeding

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ABSTRACT

Enhancement of bunch weight together with bio-fortification with Fe and Mn was attempted in 'Robusta' banana by enriching with 0-1.25g bunch^{-1} each of $FeSO_4$ (heptahydrate) and $MnSO_4$ (monohydrate). Bunch yield and content of Fe and Mn in the pulp substantially increased by direct nutrient feeding of bunches with 7.5g each of urea and SOP besides 0.75g each of $FeSO_4$ and $MnSO_4$. The improved technique holds promise for combating anemia in humans by bio-fortification of banana with Fe besides supplemental Mn in diet.

Key words: Bunch size, direct nutrient feeding, 'Robusta' banana, *Musa* sp., Bio-fortification, Fe and Mn content of pulp

Manipulation of bunch development in banana to ensure uniformity in fruit size and high yield was achieved in different varieties of banana by Kotur *et al* (2012) using direct nutrient-feeding to the de-navelled distal end of rachis after fruit set. Using ^{15}N-labelled urea, it was demonstrated earlier (Kotur and Keshava Murthy, 2008) that over 42% of N blended in cow-dung slurry enriched with urea and sulphate of potash (SOP) could be mobilized into the bunch, with concomitant inflow of other nutrients present in the enriched cow-dung. Improvement in Fe and Mn content from 53 and 4.8µg g^{-1}, respectively, in the whole banana fruit (pulp + peel) under 'Control', to 115 and 14.9µg g^{-1}, respectively, was obtained in direct nutrient-feeding with a blend of 7.5g each urea and SOP in cow-dung in 'Robusta' banana (Kotur and Keshava Murthy, 2010). Therefore, further enhancement in bunch weight, and fruit bio-fortification with these micronutrients important for human nutrition (Nair and Iyengar, 2009; INSA, 2011) was attempted by enriching the blend with $FeSO_4$ (heptahydrate) and $MnSO_4$ (monohydrate). 'Control' bunches retained the male flower until harvest, while, other treatments involved direct nutrient-feeding of the de-navelled distal end of rachis (after shed of 15-18 spathes) with 500g fresh cow-dung enriched with 7.5g each of urea and SOP dissolved in 100ml of water. Uniform bunches carrying 10 hands (with average number of fingers at 132 ± 6.8) were selected for receiving the treatments. The blend was further enriched with $FeSO_4$ and $MnSO_4$ in the range of 0-1.25g each (Table 1) used in 3 replications. After harvest, fruit and bunch weight was recorded. Pulp from fruits ripening at ambient conditions was sampled, sliced, held in on oven at 70°C to dryness, and powdered. The powder was digested in 9:4 nitric:perchloric acid mixture. Iron and manganese in the digest were determined using an atomic absorption spectrophotometer. Data was analyzed taking the experiment design as a completely randomized unit.

Table 1. Effect of de-navelling and direct feeding of Fe and Mn blended with urea, SOP and cow-dung in 'Robusta' banana bunch

Treatment	Fruit weight (kg/bunch)	Bunch weight (kg)	Fe content (µg g^{-1})	Mn content (µg g^{-1})
Control	13.934	14.685	25.8	1.1
Cow dung + Urea + SOP	19.551	20.621	31.8	2.4
Cow dung + Urea + SOP + 0.25g each of $FeSO_4$ and $MnSO_4$	20.702	21.833	35.2	2.8
Cow dung + Urea + SOP + 0.50g each of $FeSO_4$ and $MnSO_4$	22.329	23.496	48.5	3.0
Cow dung + Urea + SOP + 0.75g each of $FeSO_4$ and $MnSO_4$	24.466	25.806	59.9	3.8
Cow dung + Urea + SOP + 1.00g each of $FeSO_4$ and $MnSO_4$	19.413	20.465	58.9	4.3
Cow dung + Urea + SOP + 1.25g each of $FeSO_4$ and $MnSO_4$	17.246	18.194	43.5	3.2
SEm (±)	0.4459	0.4730	1.74	0.21
CD *(P=0.05)*	1.3013	1.3803	5.08	0.35

Direct nutrient feeding using cow-dung enriched with urea and SOP increased fruit and bunch weight by 40% to 76% over the 'control' owing to enrichment with $FeSO_4$ and $MnSO_4$ (Table 1). This accounted for 25% enhancement over application of cow-dung enriched with only urea and SOP. Significant decline in fruit and bunch weight occurred at 1.00 and 1.25g each of $FeSO_4$ and $MnSO_4$, but, fruit and bunch weight was similar to that obtained in just urea + SOP blended with cow-dung. With regard to Fe and Mn content of pulp, significant increase was observed in enriched cow-dung with up to 1.0g each of $FeSO_4$ and $MnSO_4$ per bunch, declining significantly at 1.25g each of the two nutrients. However, these values were smaller than reported earlier (Kotur and Keshava Murthy, 2010), as, only the pulp was studied which has much lower nutrient content relative to the fruit peel. These results indicate that it is possible to increase bunch yield further as also the content of Fe and Mn in pulp substantially, by direct nutrient-feeding of 'Robusta' bunches with 7.5g each urea and SOP along with 0.75 each of $FeSO_4$ and $MnSO_4$. There is also a scope for adding nutrients other than N, K, S, Fe and Mn to the blend of cow-dung to optimize the use of direct nutrient-feeding of banana bunch. This can help maximize bunch yield and improve nutrient status in the pulp, to boost the food-value of banana fruit. However, neutraceutical implication in terms of bio-availability of Fe and Mn to humans remains to be seen through suitable clinical trials. This improved technique holds promise for combating anemia among humans besides supplementing Mn in their diet. Nair and Iyengar (2009) opined that food-based approaches for increasing iron and other haematopoietic nutrient content are important for correction of iron deficiency anemia in humans.

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(MS Received 07 December 2013, Revised 17 November 2014, Accepted 20 November 2014)