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Short communication

Nutrient dynamics of annual growth-flush in mango (*Mangifera indica* L.)

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Internal nutrient dynamics in mango (cv. Alphonso) were studied during its annual growth flush (January – June, 2002). The study consisted of sampling mature leaves and growth belonging to the previous thirteen seasons at least (representing the seasonal growth of the previous six years) at fruit-set and post-harvest stages of plant growth. The samples were analyzed for N, P, K, Ca and Mg. The study indicated that phosphorus moved from 2nd, 3rd and 4th internodes to current season's growth and accumulated at other internodes, potassium moved from mature leaves to the new growth and accumulated in all the other internodes. Calcium and magnesium moved from 9th and older internodes to current season's growth, whereas, N was mostly remobilized from much older parts and by absorption from soil. The results imply that fertilizer application in productive mango trees should aim at keeping nutrient reserves of the permanent framework well-supplied to achieve sustained fruit production.

Key words: *Mangifera indica,* mango, nutrient dynamics, current season's growth, Internal nutrient reserve

An internal nutrient cycle or nutrient turnover has long been recognized in perennial fruit crops (O'Kennedy and Titus, 1980; Chapin and Kedrowaki, 1985, Williams, 1991). This involves nutrient movement from plant parts not subjected to pruning for long periods (framework) to seasonal growth, which occurs once or more often in a year and remobilization from current season's growth to framework at the end of the growing season. The quantity involved in this 'turnover' is often enough to meet a dominant fraction of nutrient requirement in seasonal growth. This phenomenon has been studied in great detail in deciduous fruit plants where periods of dormancy and growth follow in succession in a year. However, in tropical fruit plants that show no dormancy, the phenomenon needs to be verified. There is reasonable ground to undertake such a study in tropical fruit plants like the mango which grows continuously but has its own cyclic growth-pattern during a year. Mango is a rain-fed fruit plant with a massive framework and a vast root system. The crop puts forth flushes at least twice a year: a minor flush some time after harvest (if conditions are favourable) and a major reproductive flush mid-winter (that lasts upto fruit harvest carried out in the month of June). To verify the phenomenon of nutrient movement, the latter period was chosen when chances of major nutrient movement are expected. Requirement by new growth during this phase is considerable while the season preceding this shows subdued growth, resulting in moderate accumulation of nutrients in the main frame.

Six mango plants aged 15 years, uniform in growth and having been raised on red sandy loam soil (*Typic Haplustalf*) belonging to *Thyamgondlu* series with pH 6.1, organic carbon 0.62%, cation exchange capacity 9.2 cmol kg^{-1} and planted at a spacing of 10m × 10m under rain-fed condition, were selected for this study. From these plants leaves from and thirteen internodes (apex downward) were sampled for analysis before onset of growth, and, again after fruit harvest (when there was complete cessation of growth) during January–June, 2002. It was assumed that changes in nutrient concentrations between these two sampling periods accounted for changes in the nutrient level (stored over a period of six years) due to their movement to the current season growth. Samples were thoroughly dried in a forced-draft hot air oven at 70æ% C, powdered, weighed and analyzed for N, P, K, Ca and Mg by standard analytical procedures (Jackson, 1967).

Changes in nutrient content

Concentration of nitrogen in mature leaf was more or less *at par* during pre- and post-fruiting stages (0.75–0.77%), but distinctly higher than that in the internodes (Fig 1). At both the stages, there was negative gradient observed in N concentration as internodes aged. In respect of phosphorus, pre-fruit set stage contained generally higher concentration in 2nd to 4th internode and the trend reversed from 5th internode onwards (Fig 1). At pre-fruit set stage, 1st internode showed significantly lower P concentration (0.07%) compared to the 2nd to 6th internodes (0.09 – 0.14%), but, had the same P concentration as that in mature leaf. At post-harvest stage, P concentration showed a gradual increase from the 1st to the 6th internode (0.07–0.09%). Significant increase in P concentration (0.09–0.12%) was evident between 6th and 9th internodes which stabilized around 0.13–0.14% at 11th to 13th internodes. Concentration of K was significantly higher at the post-harvest stage (0.73–1.86%) compared to the pre-fruit set stage (0.20–0.69%). In the latter stage (Fig. 1), the 1st internode contained significantly lower K concentration (0.35%) than either the mature leaf (0.65%) or 2nd internode (0.69%). From the 7th to the 13th internode, concentration of K fell again from 0.69% to 0.20%, the reduction being significant at 12th and 13th internodes. At post-harvest stage, mature leaf contained distinctly lower K concentration (0.32%) than internodes. The trend in variation of Ca concentration was similar at both stages of growth. Calcium concentration at pre-fruit set and post-harvest stages varied from 0.92% and 1.16% in the 1st internode, to 1.52% and 2.19% in the 3rd internode, respectively. At both the stages, Ca concentration declined to 0.67–0.68% upto the 8th internode. As internode maturity increased, in the pre-fruit set stage Ca concentration increased to 1.02% and 1.20% in the 11th and 13th internode respectively. Magnesium concentration in various plant parts did not vary between the two stages of growth (Fig 2). At 8th, 10th and 11th internodes, Mg concentration showed significant increase to 0.24, 0.12 and 1.19%, respectively. In the case of post-harvest stage, mature leaf and 1st

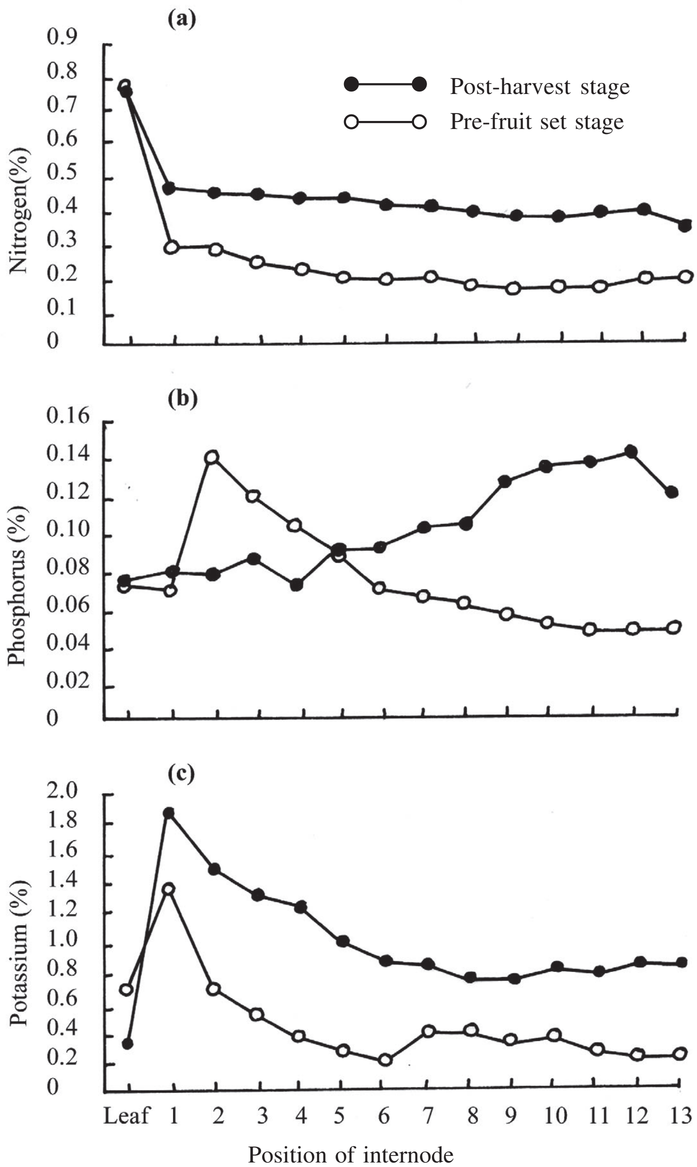

Fig. 1. Changes in concentration (%) of leaf and internodes (1-13) at pre-fruit set and post-harvest stages of annual growth in 'Alphonso' mango in respect of (a) nitrogen (b) phosphorus and (c) potassium

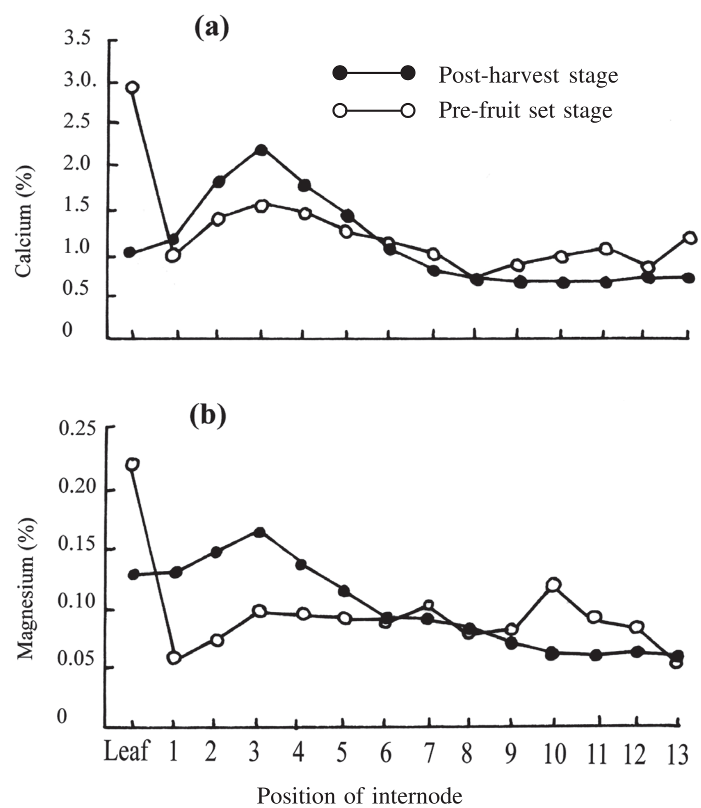

Fig. 2. Changes in concentration (%) of leaf and internodes (1-13) at pre-fruit set and post-harvest stages of annual growth in 'Alphonso' mango in respect of (a) calcium and (b) magnesium

internode showed the same Mg concentration (0.12%), which significantly increased to 0.16% at the 3rd internode. From then onwards, Mg concentration decreased rapidly upto the 6th internode (0.16–0.09%), while it decreased gradually between 8th and 13th internodes (0.07-0.06%).

Dynamics of nutrient mobilization

Growth taking place between pre-fruit set and post-harvest stages is the major growth phase in annual growth cycle of the mango. During this phase, the plant puts forth flower-panicles profusely, along with considerable vegetative flush. The plant carries the crop load for a period of at least 4 months. During this period, flower- panicles, vegetative flush and the fruit act as a sink for nutrients and photosynthates. Therefore, to meet the nutrient demand of these plant parts, nutrients need to move from older plant parts to the new growth (in addition to nutrients absorbed from the soil). Although plants absorb nutrients from soil, this source is not sufficient to meet the plant's demand since, the rate of nutrient absorption is inadequate. A change in nutrient concentration encountered in the internodes between these growth stages provides some insight into the movement of nutrients.

No decrease in N concentration was seen either in the leaf or the internodes at the post-harvest stage. On the other hand, N concentration increased in all the internodes. This indicates possibility of N mobilization from old parts of the tree (like primary/ secondary branches, trunk and root) in addition to N absorption from soil. There was significant decrease in P concentration in the 2nd, 3rd and 4th internodes at the post-harvest stage, indicating movement of P to the new growth to meet the plant's requirement. Further, it was seen that 7th to 13th internodes had higher P concentration at the post-harvest stage indicating that P absorbed from soil/fertilizer and P mobilized from older plant parts accumulated in these internodes for future use. In the case of K, considerable part of requirement of new growth came from mature leaf, since K concentration in the mature leaf at post-harvest stage was only half of that at the pre-fruit set stage. However, K absorbed from soil accumulated in all the nodes (1st to 13th) as in the case of N, resulting in two-fold increase in mean K concentration. During the next growth phase i.e., between August - November, K may move from these internodes to the newly emergent seasonal growth. Calcium and Mg moved from mature (8th to 11th) internodes to younger internodes, and further to the new growth during the post-harvest stage. Magnesium too moved from older leaves to the new growth. Growth is a physiological, biochemical and cytological process confined to terminal portions of plants. It sets in motion several other processes of the plant, of which movement of nutrients from older plant parts to the newly emerging growth is important. Therefore, the permanent framework of a tree including trunk and branches of different order, play an important role in supplying nutrients required for seasonal growth of leaves, flowers and fruits. This implies that fertilizer application in productive mango trees should aim at keeping nutrient reserves of the permanent framework well-supplied, to achieve sustained fruit production. Nonnetheless, immediate response to applied fertilizer is elusive in practice.

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