Nitrogen recycling in mango orchards from litterfall and pruning biomass

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Abstract

Mango production systems in the NT require low nitrogen (N) inputs, with excess applied N having negative impacts on fruit quality. Crops remove ~0.85 kg N t^{-1} of fruit harvested, or 13-20 kg N ha^{-1}. Potential in-orchard N cycling from litterfall and pruning biomass is not accounted for when calculating orchard N needs. To increase precision in N application, we monitored litterfall and pruning biomass from Calypso® and Kensington Pride mango cultivars. Mean annual litterfall was 1.3 t ha^{-1} and pruning biomass 1. 2 t ha^{-1}. The litterfall provided 12 kg N ha^{-1}, predominantly from flowers (4.4 kg) and leaves (5.15 kg) while pruning biomass provided 8.4 kg N ha^{-1}. Results indicate that biomass recycled in mango orchards is a significant source of N for the trees, similar in quantity to fertiliser applied N.

Keywords: leaf litter, mango orchard, nitrogen cycling, pruning biomass

1. Introduction

In the mango production system, falling leaves and other plant parts (dried branches, flowers, fruits) as well as end of season pruning biomass constitute the litterfall. Growers prune trees after harvest to maintain canopy shape, control vigour and promote new growth. However, the amount and nutrient content of mango plant material abscised and pruned from mango trees over time has not been documented, nor is it considered when applying N seasonally. As part of a project on enhancing nitrogen use efficiency in horticultural systems and how various factors impact on the nitrogen required, this study examined the seasonal quantity of litterfall from two mango orchards in the Northern Territory (NT), Australia.

2. Litterfall and pruning collection

The study was conducted in Calypso® (formerly known as B74) and Kensington Pride (KP) mango orchards in the NT. Litterfall was captured in trays (n=10) randomly placed under experimental trees and collected every 2-3 weeks during 2017-2018 (Figure 1). Also, approximately 30 cm of material was mechanically removed from the top and sides of the tree canopy during pruning. In most orchards, prunings are mulched onto the orchard floor but we collected the biomass using tarpaulins placed under tree canopies prior to pruning events (n=10). Collected materials were separated into leaves, flowers, panicles, fruits and branches and total N analysed, based on a planting density of 250 trees ha^{-1}.

3. Results and Discussion

The majority of natural biomass abscission occurs after floral induction through to fruit maturity, approximately 100 days. Differences were noted in abscission of biomass components between varieties and sites over time (Figure 2a & b), however when annual abscised and pruned biomass were combined, the values were similar with Calypso generating 4 tons ha^{-1} and KP 4.2 tons ha^{-1} (Figure 3a & b).

Nutrient analysis of the biomass showed that in Calypso®, the abcisised biomass contained 11.2 kg N ha^{-1}, and prunings 7.6 kg N ha^{-1} (Figure 4a). The KP abscised biomass had 13 kg N ha^{-1} and prunings 9.2 kg N ha^{-1} (Figure 4b). When combined, the quantity of N in abscised biomass and prunings of Calypso® and KP orchards were similar, being 18.8 and 22.2 kg N ha^{-1} respectivley.

These results suggest that seasonal abscission of tree biomass and pruning events contribute a significant amount of nitrogen for in-situ recycling and must be included when calculating orchard N needs in commercial orchards.

Figure 1. Litterfall was collected at commercial mango orchards in traps (n=10) and pruning material collected on tarpaulins (n=10) in the Darwin region, Northern Territory, Australia.

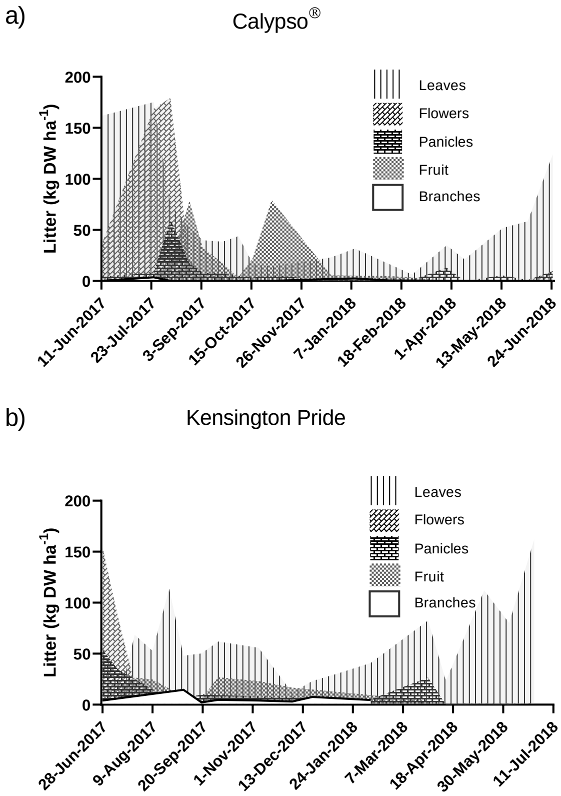

Figure 2. Abscised material from Calypso® (a) and KP (b) mango trees was collected over 12 months, 2017-2018 and the biomass separated into leaves, flowers, pedicels, fruit and branches. Seasonal differences in dry biomass components were noted between varieties and locations over time.

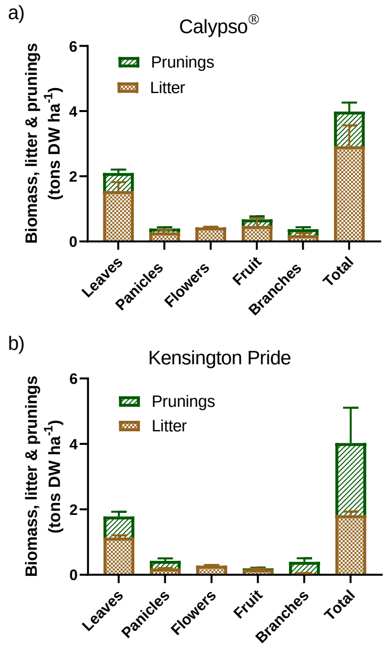

Figure 3. Combined weights of abscised and pruned material from Calypso® ,4.0 tons DW $year^{-1}$ (a) and KP, 4.03 tons DW $year^{-1}$ (b) were similar.

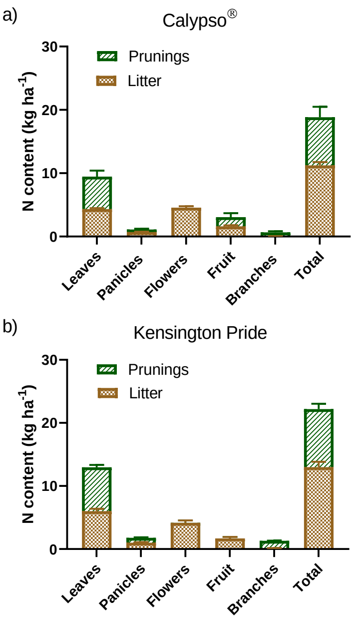

Figure 4. Leaves and flowers contained the highest amounts of N, for both Calypso® (a) and KP (b). Total N content was similar for both varieties in combined abscised and pruned biomass.

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