

PLANT NUTRITION PANEL SUMMARY

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When reading the reports presented from this session, and the other sessions, it is important to keep in mind the differences in the vegetative and reproductive growth characteristics of 'Hass' trees grown in South Africa, Australia, New Zealand, and California. This is important in order to understand the basis for the fertilization and tree management strategies used in each country. The following information was provided by the panel members: Nigel Wolstenholme, Co-Chair, and Piet Stassen for South Africa, Jonathan Cutting for New Zealand, and Simon Newett for Australia.

The relative vigor of 'Hass' trees and their tendency to be vegetative as opposed to reproductive is greatest in South Africa and Australia. New Zealand 'Hass' avocado trees are less vigorous, but are still more vigorous than 'Hass' trees grown in California.

South Africa, Australia, and California produce spring blooms dominated by indeterminate floral shoots, whereas in New Zealand, 'Hass' bloom is dominated by determinate inflorescences. Determinate inflorescences set significantly more fruit that survive to harvest than indeterminate inflorescences.

Yields were greatest in New Zealand, with 9.4 metric tons/ha (60 to 200 trees per ha) with average fruit size 260 - 290 g/fruit. The New Zealand goal is 15 metric ton/ha with fruit greater than 280 g/fruit (greater than size 40). South Africa was second with an average of 7.5 metric ton/ha (200 to 800 trees per ha) and good orchards that produced 10 metric ton/ha. Australia's production was very similar to South Africa, approximately 7 metric ton/ha (100 to 312 trees per ha). Australia has good orchards that routinely produce 15 to 20 metric tons/ha and one that produced 50 metric tons/ha once. California's average was 6.9 metric ton/ha (247 to 346 trees per ha) [calculated from the report of M. L. Arpaia in the *California Avocado Grower* (April 1998)]. Interestingly, Dr. Arpaia reported that there have been only 7 years in the last 25 years in which average production in California exceeded 7.3 metric ton/ha and that in each case yield the following year was 41% less.

The length of time from bloom to harvest in South Africa is 8 to 10 months, in Australia from 6 months in tropical areas to 16 months in Mediterranean climate zones and in New Zealand 8 to 11 months, whereas in California the time from bloom to harvest is 11 to 18 months. This may be an additional factor influencing overall productivity and alternate bearing.

In South Africa, spring is hot and dry and growers mulch to keep the roots healthy and the tree free from stress. This mulch provides as much as 75 kg N/ha/year that increases the vigor and vegetative growth of the 'Hass' tree. High nitrogen availability in combination with the warm, humid summer climate (800 to 1200 mm rain per year) results in one meter of new shoot growth per year. On a 5 x 5 meter spacing, the trees are crowded in 5 years. In South Africa, yield increases as trunk circumference increases up to 80 cm (a 10 to 12 year-old trees) with no yield increase thereafter. The high level of rain leaches the soil, resulting in a need to supply both calcium and boron. In addition, the oversupply of nitrogen causes calcium

to move into the shoot apices of vegetative and indeterminate floral shoots and not into the fruit. Low calcium concentrations in the fruit can result in postharvest disorders. South Africa sprays calcium early in the season (up to 5 to 6 sprays). Boron is applied to the soil and to the foliage in spring. With proper *Phytophthora* management the tree can bear indefinitely.

Australia grows avocados over a wide range of environments, however, the major 'Hass' production area is in subtropical Queensland. The high rainfall and humidity in this region produces up to 1.5 meters of vegetative growth per year (up to 400 mm in spring and 1m in summer) and makes fungal and insect pest management a high priority. Leaching results in the need to fertilize regularly with nitrogen, potassium and boron. Nitrogen applications must be carefully managed to prevent excessive vegetative growth at the expense of fruiting in this climate. Boron is a common deficiency and multiple light applications are required throughout the year; on very sandy soils trees are fertigated weekly. A foliar boron application at flowering is recommended if leaf levels are very low. Zinc is also a common deficiency especially on heavier soils and the most effective way to apply it has been to apply zinc sulphate heptahydrate in a narrow band along the drip line. Calcium is starting to get more attention from researchers and growers as a possible avenue to improve fruit quality, especially to improve shelf life and reduce chilling injury. In some older orchards a build-up of copper in the soil as a result of residues from anthracnose fungicide sprays is causing some concern.

Due to high vigor, large tree size, and 2000 mm of rain per year in New Zealand, there is a need to replenish the nutrients, listed above, as well as potassium due to the light soils. Annual nitrogen application is approximately 40 kg/ha, excluding soil mineralization supply. Keep in mind that in New Zealand the climate is cool: the *maximum* summer day temperature is 26C (79F) and the *maximum* winter day temperature is 14C (63F). Frosts occur frequently.

California is unique among the avocado growing countries discussed in having an average rainfall of only 300 mm per year as winter rain. The coastal avocado growing regions have a mild Mediterranean climate with an average day temperature of 13C (56F) and an average summer day temperature of 21C (70F). Inland areas are colder in winter and warmer in the summer. Irrigation is required through most of the year. Soils are typically sandy-loam-clays with good drainage. Annually, 'Hass' orchards are fertilized with 56 to 161 kg N/ha applied in small doses over the growing season. Avocado trees suffer frost damage approximately once every 10-12 years in California.