Prospects for manipulating the vegetative-reproductive balance in horticultural crops through nitrogen nutrition: a review

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Abstract
This review examines the prospects for manipulating the vegetative-reproductive balance in horticultural crops through nitrogen (N) nutrition. It also examines whether incorrect timing or excessive applications of N stimulate vegetative growth at the expense of reproductive growth. Productivity of horticultural crops is dependent on an adequate N status because photosynthetic capacity is dependent on leaf N content per unit area. Efficient N uptake occurs during periods of active growth and depends on active photosynthesis. Most N in exposed leaves is accumulated as protein and the uptake and conversion to protein requires a carbohydrate (CHO) supply. A feedback mechanism has been proposed from shoots to roots in the control of N uptake, because ammonium and nitrate uptake do not increase at supraoptimal concentrations. Stored CHO and nutrients support actively growing shoots and inflorescences and while vegetative and reproductive meristems compete as sinks, fruit growth depends principally on current photosynthesis. Most of the season's N uptake by deciduous trees occurs during the post-fruit maturity period in late summer and autumn in vegetative growth which is remobilized prior to leaf fall in late autumn into storage. The N is redistributed the following spring to support new season leaf and fruit growth. In sand culture studies conducted with 2-year-old peach and apple trees, an N deficiency which led to inadequate tree N reserves in winter inhibited flowering, fruit set and vegetative growth the following spring. N applied during spring is poorly assimilated. For Prunus spp., 90% of the N contained in the spring vegetative flush is derived from storage, indicating that exogenous N applications at that time are unlikely to influence that season's growth. Vegetable crops which have high growth and N uptake rates compared with tree fruit crops (maximum N uptake rate for tomato 66 kg/ha.week v. peach 1.3 kg/ha.week) rely on exogenous N and current photosynthesis to support growth. In studies where very high N rates were applied to horticultural crops, tree crops were unaffected except in citrus where yield was depressed and tree size was unaffected. The growth and yield of most vegetable crops were depressed at high N rates while at these high N rates, tomato yields were increased while vegetative growth was unaffected. Where a depression in tomato growth occurred at high N rates, it was caused by a salt effect, although chloride at the same osmotic potential depresses growth much more than nitrate. In subtropical fruit and nut crops such as lychee, macadamia and avocado, timing and rate of N were not detrimental to yield. Soil N, tree N and CHO reserves buffer against an external N supply and hence the ability of applied N to manipulate the vegetative-reproductive balance. More work is required to establish the extent and subsequent effect of competition between the vegetative flushes and inflorescence growth for subtropical fruit crops in particular.

Keywords: Nitrogen; vegetative-reproductive balance; horticultural crops

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