

little difference to its chances of groundwater transport. However, volatile forms of nitrogen, such as anhydrous ammonia, may be lost to the atmosphere before conversion to nitrate if improperly injected. Urea nitrogen may also be volatilized if improperly applied. In addition, fertilizer in slow-release form affects the rate of fertilization and in this sense influences plant uptake and nutrient loss.

Rate of application is probably the single most complex and controversial aspect of efficient fertilizer management, as illustrated by Figure 4. This figure is a general representation of several studies conducted at the UF and elsewhere. It compares single applications of soluble and slow-release fertilizer to multiple applications of soluble nitrogen. Effects of fertilizer placement are not shown in Figure 4, but the general response to nitrogen it shows would apply to either broadcasting or banding.

Figure 4 shows the estimated amounts of fertilizer needed for each application method. The dashed line shows the theoretical amount of applied nitrogen needed to meet optimal crop requirements, 90 kilograms per hectare, and is included for comparison purposes. This curve drops after harvest due to the release of nitrogen from plant decomposition. From Figure 4 it is evident that a single application of soluble nitrogen requires the largest amount of fertilizer to assure growth (200 kg/ha) while a multiple application of soluble nitrogen required the least (120 kg/ha).

Figure 4 also shows that the effectiveness of multiple applications of fertilizer depends on both knowledge of optimal plant uptake of nutrients and scheduling of application. Multiple applications will usually give better control of nutrient releases but will also increase costs, forcing a compromise. Fertigation — applying fertilizer through an irrigation system — enables frequent applications with minimal management and costs, as long as irrigation is also needed. Trickle irrigation and under-tree, low-volume sprinkler systems are well-suited to fertigation of tree crops because these systems do not wet foliage and fallow areas between rows. In some cases, overhead irrigation systems are just as satisfactory.

Two release curves are shown in Figure 4 for slow-release fertilizer, one matched to plant uptake and the other mismatched. According to Figure 4, both slow-release curves were somewhat in-between single and multiple application in their effectiveness. Rates depended upon how fast fertilizer granules dissolved and released nitrogen. When slow-release fertilizer is matched with a crop's uptake requirement, fertilizer requirements are sharply reduced. Often, however, release rates of