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Use of soil columns and field scale data to develop agricultural best management practices

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Decreasing groundwater and surface water quality relative to land use, poorly retentive sandy soils, frequent and intensive rainfalls, and shallow groundwater depths is a major concern in Florida. Excess nutrients are subject to runoff and leaching, which raises environmental concerns in Florida watersheds. Due to a state-wide effort to reduce pollution of Florida's waters, best management practices, or BMPs, are the future of agriculture in Florida. BMPs are guidelines advising producers how to manage the water, and nutrients they use in order to minimize agriculture's impact on the state's natural resources. Starting with the physiological processes and mechanisms controlling nutrient uptake of vegetable and citrus plants, and resource capture and utilization are critical considerations. BMPs are developed based on uptake processes scaled-up from a plant level to field scale linked to specific environmental, crop development, and management aspects and integrated into generic conceptual models with special reference to the interactive effects of irrigation and fertility management as related to crop nutrient interception capacity. One BMP is the use of controlled-release fertilizers (CRF) to reduce leaching of nutrients, especially nitrate-nitrogen (NO_3 $-$-N) to groundwater, caused mainly by application of soluble N fertilizers to sandy soils in Florida. A leaching column study was conducted to evaluate N release and transformation from selected CRF over a 16-week period when it was applied on the soil surface or incorporated into the soil. When one pore volume of water was applied to column weekly or biweekly, the CRF released urea-N slowly over time with three peaks of release on 3–4, 8, and 12 week after application. Both ammonium-nitrogen (NH4 +-N) and NO_3 $-$-N were leached in large amounts on week 2, likely from soluble forms of N. Cumulatively, the most leached N at the end of study was in the NH4 + form, followed by the NO_3 $-$ form. The sum of all N forms leached and volatilized from soluble fertilizers accounted for 53–69% of total N applied. On average for both application treatments throughout 16-week period, 5.8 h was required for ammonification and 4.7 d for nitrification to occur after N release from the fertilizer. Characterization of CRFs for specific soil type, leaching volume and cycle, and application manner as well as knowledge of N requirement of the crop will allow for the Best Management Practices of these fertilizers, thus obtaining optimum yields and minimizing nutrient losses from CRFs. In field scale studies of soluble fertilizer management, total inorganic soil N in the root zone decreased with time, reaching minimum concentrations at the end of growing seasons. Total Mehlich-1 soil P and K fluctuated but large concentrations remained in the soil at the end of both seasons. Nutrient use efficiency ranged from 59 to 62 for N, P, and K. Leaching loss during the season was likely for N and K, and there is a post-harvest leaching risk for P and K on removal of the plastic mulch.