Research Article

# Field trials show the fertilizer value of nitrogen in irrigation water

*by* Michael Cahn, Richard Smith, Laura Murphy *and* Tim Hartz

***Increased regulatory activity designed to protect groundwater from degradation by nitrate-nitrogen ($NO_3$-N) is focusing attention on the efficiency of agricultural use of nitrogen (N). One area drawing scrutiny is the way in which growers consider the $NO_3$-N concentration of irrigation water when determining N fertilizer rates. Four drip-irrigated field studies were conducted in the Salinas Valley evaluating the impact of irrigation water $NO_3$-N concentration and irrigation efficiency on the N uptake efficiency of lettuce and broccoli crops. Irrigation with water $NO_3$-N concentrations from 2 to 45 milligrams per liter were compared with periodic fertigation of N fertilizer. The effect of irrigation efficiency was determined by comparing an efficient (110% to 120% of crop evapotranspiration, $ET_c$) and an inefficient (160% to 200% of $ET_c$) irrigation treatment. Across these trials, $NO_3$-N from irrigation water was at least as efficiently used as fertilizer N; the uptake efficiency of irrigation water $NO_3$-N averaged approximately 80%, and it was not affected by $NO_3$-N concentration or irrigation efficiency.***

California agriculture faces increasing regulatory pressure to improve nitrogen (N) management to protect groundwater quality. Groundwater in agricultural regions, such as the Salinas Valley and the Tulare Lake Basin, has been adversely impacted by agricultural practices, with nitrate-N ($NO_3$-N) in many wells exceeding the federal drinking water standard of 10 mg/L (Harter et al. 2012). The threat to groundwater is particularly acute in the Salinas Valley, where the intensive production of vegetable crops has resulted in an estimated net loading (fertilizer N application − N removal with crop harvest) of > 100 lb/ac (> 112 kg/ha) of N annually (Rosenstock et al. 2014).

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Levels of $NO_3$-N in irrigation wells in the Salinas Valley commonly range from 10 to 40 mg/L. Given the typical volume of irrigation water applied to vegetable fields, $NO_3$-N in irrigation water could represent a substantial fraction of crop N requirements, provided that crops can efficiently use this N source. Indeed, the concept of "pump and fertilize" (substituting irrigation water $NO_3$-N for fertilizer N) has been suggested as a remediation technique to improve groundwater quality in agricultural regions (Harter et al. 2012).

Cooperative Extension publications from around the country (Bauder et al. 2011; DeLaune and Trostle 2012; Hopkins et al. 2007) agree that the fertilizer value of irrigation water $NO_3$-N can be significant, but they differ as to what fraction of water $NO_3$-N should be credited against the fertilizer N recommendation. There is a paucity of field data documenting the efficiency of crop utilization of irrigation water N. Francis and Schepers (1994) documented that corn could use irrigation water $NO_3$-N, but in their study N uptake efficiency from irrigation water was low, which they attributed to the timing of irrigation relative to crop N demand and the availability of N from other sources. Martin et al. (1982) suggested that uptake efficiency of irrigation water $NO_3$-N could actually be higher than from fertilizer N, but their conclusion was based on a computer simulation, not on field trials.

With this near total lack of relevant field data, California growers have legitimate concerns about the degree to


Inexpensive nitrate test strips allow on-farm estimation of irrigation water $NO_3$-N concentration. In Salinas Valley irrigation wells, levels of $NO_3$-N commonly range from 10 to 40 mg/L, which could supply a substantial portion of crop N requirements.

Mike Cahn