

Evaluation of N Uptake and Fertilization Strategies of High Density Plantings of Leafy Green Vegetables

Location: Commercial Farms in the Salinas Valley

Duration: Two years

Project leaders:

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Summary

Nitrate leaching from vegetable production in the Salinas Valley is a continuing and serious problem. New regulations included in the renewal of the Irrigated Lands Discharge Waiver by the Regional Water Quality Control Board, Region 3 have given this problem a sense of urgency. Proposed regulations will require growers to implement a certified Irrigation and Nutrient Management Plan to document the amount of nitrogen (N) applied to the crop vs the amount taken up and removed at harvest. This information would be used to calculate an N balance ratio. Grower will have three years to demonstrate an N balance ratio of 1.0 for annual rotations that are double cropped. Strategies to improve N use efficiency such as reducing fertilization rates and improving the efficiency of applied irrigation water can provide improvements in losses of nitrate from leafy green vegetable production systems. However, anxiety regarding the use of reduced levels of N on the profitability of leafy vegetable production has slowed adoption of reduced-N application practices.

The use of 80-inch beds for the high density production of spinach, baby lettuce, spring mix and cilantro is a relatively new production system in the Salinas Valley and other areas of the coastal production district. Crops grown on these beds mature rapidly (25-35 days), and are subjected to demanding quality standards such as dark green color of the harvested product. These crops are also shallow rooted and are sprinkler irrigated, making it difficult to achieve a high level of N-use efficiency. These crops are potentially “at risk” because they may have difficulty complying with the 1.0 N balance ratio.

Currently, little information on the N uptake of leafy green vegetables produced in high density plantings except for preliminary data collected in 2011 on spinach; in addition, there is little understanding of typical N fertilizer application rates to these crops. Understanding the quantity of N taken up by these crops is basic to understanding the efficiency of current fertilizer practices and devising ways to improve N use efficiency. Fertilizer practices include the application of pre or at-planting N applications and are followed by one or more top dress applications at 2 weeks after planting and before harvest (4-5 weeks after planting). Preliminary indications are that pre/at-planting

applications are often 2.0 to 4.0 times higher than crop uptake, prior to the first topdress application. A partial reason for these high pre/at-planting applications may be due to inefficiency in the use of N due to leaching that occurs with the germination water. The use of a fertilizer technology (e.g. urease and nitrification inhibitors) to help reduce N loss during the germination phase of the growth cycle may help reduce N losses.

Target Audience

Commercial growers and fertilizer industry representatives in the Salinas Valley and surrounding growing areas (Santa Cruz and San Benito Counties)

Objectives

- Document the quantity and pattern of N uptake pattern over the life cycle of spinach, baby lettuce, a representative salad mix vegetable (e.g. mizuna) and cilantro
- Evaluate fertilizer additives such as urease and nitrification inhibitors with pre/at-planting fertilizer applications to improve N use efficiency
- Evaluate quantities of irrigation water applied to these crops over the course of the growth cycle

Methods

A survey of five well-managed, high-yielding fields of baby lettuce, a representative salad mix (Mizuna) and cilantro fields in Monterey County will be conducted (spinach will not be included in this phase of the study because this evaluation is currently being carried out by funding by the California Leafy Greens Research Board). Fields will be selected that have typical production practices for this region. Fields will be selected that encompass the range of microclimatic factors close to the coast and inland. These evaluations will be conducted on 15 commercial fields (five of each commodity) in 2013 and 2014 production seasons (30 total fields). Crop biomass, biomass N and soil nitrate-N will be measured three times during the growing season to measure the N uptake pattern and total N uptake. Biomass samples will be collected by collecting 0.5 m² areas from the beds. At harvest, total biomass and commercially harvested biomass and biomass N will both be measured. Fertilizer application rates and timing in each field will also be documented. Biomass samples at harvest will also be analyzed for phosphorus and potassium to provide information on the uptake of these key nutrients. A flow meter with data logger will be installed in the irrigation system to monitor the quantity of irrigation applied to each crop monitored.

Two fertilizer trials each year will be conducted – on baby lettuce and on spinach to evaluate pre/at planting fertilizer applications with fertilizer additives including urease and nitrification inhibitors in comparison with ammonium fertilizers to determine if these products can improve N use efficiency of the fertilizer applications.