



Prepared for: Performance Based Incentives for Conservation in Agriculture (PICA) Project

## **Performance based incentives metrics for N and water use efficiency in strawberries**

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The following methodologies are proposed as low cost procedures for estimating the efficiency of managing water and N fertilizer in strawberry. The protocols are designed to minimize data inputs but provide quantitative measures of the efficiency of N and water use. The procedures are also designed to allow N and water use efficiency to be compared at various stages of crop growth. Some of the required data will need to be collected by trained professionals at several stages during the crop cycle. Other data will need to be recorded by the grower throughout the season. To protect proprietary information, all input data will remain confidential and only the N and water use efficiency ratios will be reported.

CropManage, an online decision support tool for N and water management, is being adapted for strawberries, and will be available to participants for recording water and fertilizer applications, and for estimating N and water needs of their crops. Trainings will be available to participants interested in using CropManage.

Several assumptions are used in the calculations below that may not always be accurate, but allow us to consider factors that are difficult to measure. For example, we assume that the N contribution from the irrigation water is the concentration of nitrate-N in the water  $\times$  volume of water required for crop ET. We also assume that N in applied organic amendments should be recorded as applied N if the application was done 1 month prior to when the initial soil sample was collected for mineral N analysis since the amendments would generally mineralize over a 3 to 4 month period during the summer and fall. Estimates of fruit N content, cull rate, and leaf senescence, used in the crop N uptake calculation, are based on averages from data collected from commercial fields. The actual values likely vary 20 to 30% among individual fields. Crop coefficients used for estimated water use of strawberries are based on models of canopy growth that were developed from data collected in commercial fields. The canopy model can be adjusted based on the maximum cover measured for an individual field.

### **Procedures for estimating N efficiency:**

1. Measure mineral N (nitrate + ammonium) level in soil before bed listing in late summer or fall, early spring (March), and at the end of the season (October). At each sample date collect 10 to 15 subsamples from the field and composite for depths of 0 to 1, 1 to 2 ft.

UCCE/RCD responsibility

2. Measure concentration of nitrate-N in irrigation water once between April and June. Grower responsibility
3. Record seasonal fruit yield (lbs of fruit/acre) Grower responsibility
4. Record preplant and drip applied fertilize N applications (lbs N/acre) during the fall/winter period (~Oct - Feb ), and drip fertilizer N applications for the remainder of the season (~March – October). Application rates and N content of organic amendments (compost, rice bran, etc.) applied 4 weeks before or after the initial soil sample should be recorded. Grower responsibility
5. Sample plants for estimating vegetation biomass in August (mid/late season). Determine fresh weight of 20 plants randomly selected within a field and record plant population. Discard any significant fruit on plants before weighing. Determine water content of a 500 g (~ 1 lb) subsample of the plant vegetation by recording fresh weight and drying in an oven at 60 °C for at least 48 hours or until completely dry, and reweighing. Send sample to analytical laboratory for analysis of total N. UCCE/RCD responsibility
6. Estimate crop N-use ratio for the winter and full season periods:  $N \text{ ratio} = [N \text{ fertilizer applied} + \text{change in soil mineral N} + N \text{ water} * ETc] / [N \text{ in plant biomass (fruit and vegetation)}]$ . Note that preplant fertilizer N applied during the winter period will be weighted based on the release rate of the fertilizer (eg. approximately 50% of the applied preplant was released between Nov. – Feb.) Plant biomass N in March will be estimated using data from previous studies conducted by UC. UCCE/RCD responsibility

### **Procedures for estimating water use efficiency**

1. Record total applied water and rainfall during plant establishment (~Nov - Dec, post-establishment (~Jan – Feb), and production (~ Mar – Oct). Grower responsibility
2. Record irrigation dates or irrigation frequency by month. Grower responsibility
3. Determine maximum canopy cover in August. UCCE/RCD responsibility
4. Estimate crop ET using spatial CIMIS data and crop coefficient algorithm for strawberry. UCCE/RCD responsibility
5. Determine water use efficiency ratios for establishment, establishment + post-establishment, production periods:  $\text{Water use ratio} = \text{Applied water} / \text{Crop ET}$  UCCE/RCD responsibility