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| **GRANT NUMBER:** | 20080408 | **Progress Report** | Final Report |
| | | **Reporting Period:** | July 30, 2008 to April 30, 2010 |
| | | **Submittal Date** | April 30, 2010 |

**Agency Name:** University of California Cooperative Extension, Monterey County

**Project Title:** Optimizing irrigation and nitrogen management in lettuce for improving farm water quality, Northern Monterey County

**Contractor Name:** Michael Cahn

**Project Director:** Michael Cahn (Printed Name) — Michael Cahn (Signature)

## Table of Deliverables

*(Place your Table of Deliverables here for both your midterm and final reports. It should be the same Table of Deliverables that was sent to Foundation along with your signed award letter. See sample below.)*

### Table 1. Deliverables Schedule

| Tasks | Description of Deliverables | Due Date | % of work completed | Date Submitted |
|---|---|---|---|---|
| **1.0** | **Conduct 3 trials demonstrating optimal irrigation and N management of lettuce** | **11/1/08** | 100% | April 2009 |
| 1.1 | Establish field trials | 8/30/08 | 100% | April 2009 |
| 1.2 | Develop fertilizer and irrigation plans for best managed treatment | 9/30/08 | 100% | April 2009 |
| 1.3 | Evaluate management treatment effects on crop yield and quality | 11/1/08 | 100% | April 2009 |
| **1.4** | **50% Preliminary report on management treatment effects** | **12/30/08** | 100% | April 2009 |
| | | | | |
| **2.0** | **Analyze, report, and extend trial results** | **4/30/10** | 100% | |
| 2.1 | Final report with analysis and summary of trial results | 4/30/10 | 100% | April 2010 |
| 2.2 | Grower educational meeting agenda and presentation | 3/1/10 | 100% | April 2010 |
| 2.3 | Guideline report, Newsletters and trade journal articles | 4/30/10 | 100% | April 2010 |
| | | | | |

**List of Deliverables Submitted For Final Report** *(by subtask number, please clearly mark the subtask number at the top left hand corner of each deliverable)*

- 1.1, 1.2, 1.3, 1.4
- 2.1,2.2,2.3

## Progress Report Narrative

*(Provide a brief introduction or summary of the report (e.g., "During the reporting period, project activities focused on completing design of the three sediment basins"…. Or "Activities were largely focused on organizing and hosting 4 tailgate meetings to discuss …" Or "Water Quality data was collected monthly at 6 sites, with data analysis indicating that…" etc.)*

**Introduction:**
The purpose of this project was to demonstrate potential water, fertilizer, and costs savings for producing lettuce by: 1. using weather and soil based information to accurately schedule irrigations, and 2. using the quick nitrate test (QNT) to customize the fertilization schedule to match the nitrogen needs of the crop. Together, these practices would minimize the over application of water and fertilizer and provide tools for optimizing yield and quality of lettuce. We conducted 5 demonstration trials in commercial fields to compare production costs, yield and quality of lettuce grown under best management practices (BMP) for water and nitrogen and under grower standard practices. The trials were conducted in the Salinas Valley between July and October of the 2008 season, and June and October of the 2009 season. Soil moisture and nitrogen status of the soil and crop were monitored from the first irrigation to harvest. Management practice effects on yield and quality were evaluated at harvest. Costs of water and fertilizer were compared between the BMP and grower standard practices.

**Summary of Activities**

**Task 1 – Conduct trials demonstrating best management of water and nitrogen for lettuce production in commercial fields**

. (Cumulative 100% complete)

(Describe by sub-task activities, problems, successes, milestones… If a deliverable is complete, please state that, and add a copy of the deliverable (listed above). If a deliverable is not complete, please state that, and describe progress towards completing the deliverable).

**Subtask 1.1. Establish irrigation and nutrient trials in lettuce (100% completed).** Meet with grower cooperators; determine appropriate field sites; interview growers for standard practices for management of water and nitrogen fertilizer.

We established field trials in commercial lettuce fields in King City, South Salinas, North Salinas, and San Ardo during the summers of 2008 and 2009 (Table 1). Growers and foremen were intially interviewed about irrigation and fertilizer practices. Trials conducted in South Salinas and San Ardo were planted with Romaine lettuce and the trials conducted in King City and North Salinas were planted with iceberg (head lettuce). Field sizes ranged from 15 to 27 acres in area, and were divided into 6 plots measuring160 feet in width × length of the field, an area ranging between 2.2 to 5 acres. The grower standard (grower) and best management practice (BMP) were assigned to the plots following a randomized complete block design with 3 replications. The irrigation system was set up with 2 main lines on separate valves. The grower standard was assigned to one of the mainlines and the best management treatment was assigned to the other main line. Flowmeters equipped with pulse outputs were installed on each mainline so that the applied water and irrigaiton schedule could be monitored from the first to last irrigation (Tables 3 and 4). Soil moisture tension was monitored using water mark sensors at 8 and 18 inch depths in each plot. Soil volumetric moisture was monitored to a depth of 3 feet at 2 locations within each plot using a neutron probe.

**Subtask 1.2. Develop an irrigation and nitrogen fertilizer plan for the best management treatment (100% completed).** For each of the 3 proposed field trial demonstrations, we will develop an irrigation and nitrogen fertilizer template for the best management treatment based on weather (evapotranspiration) data and soil nitrate quick test results.

A spreadsheet program was developed for determining the irrigation schedule in the BMP treatment using evapotranspiration data from the closest CIMIS weather station and crop coefficients based on the canopy cover and soil evaporation properties. Water holding capacity of the soil at each trial site was evaluated from undisturbed core samples from the 8 and 18 inch depths subjected to varying levels of tension using a ceramic pressure plate. Infra-red photos were taken with a digital camera at weekly intervals to record canopy cover in the BMP and grower standard treatments. The irrigation schedule was calculated for the BMP treatment twice per week and communicated to the irrigation foreman before each irrigation event. Soil moisture and flow meter data were analyzed weekly to adjust the irrigation schedule as needed.

Nitrogen fertilizer applications were guided using soil nitrate data. Composite soil samples were collected from the upper 1 foot layer at weekly intervals and analyzed for nitrate using the quick nitrate test (QNT). Fertilizer applications were skipped or reduced if nitrate levels were above 20 ppm of $NO_3$-N in the top foot of soil. The accuracy of the QNT was evaluated by compared soil nitrate estimates with the UC ANR lab results for soil nitrate. In addition, soil samples were collected to a depth of 3 feet to determine the nitrate in the soil profile at planting and at harvest.

**Subtask 1.3 Evaluate the effect of weather based irrigation scheduling and improved N management on soil moisture, crop N status, crop yield and quality (100% completed).** Soil moisture levels will be compared between the grower standard and best managed treatments. Additionally, crop N status, yield, and quality of cut-product lettuce will be compared between treatments

Soil moisture tension and volumetric soil moisture were monitored in the grower standard and BMP plots at weekly intervals for all 5 trials. Soil moisture tension was monitored daily in both treatments using dataloggers after the crop was thinned. Whole plant samples were collected at weekly intervals to determine N uptake in the grower and BMP treatments. Cored product yield was evaluated in 2, 50 foot × 1 bed width sections within each plot. Evaluations included the final stand number, diseased plants, trimmed and untrimmed head weights, and dry matter content of the trimmed product. Marketable yield was calculated for each plot. In addition, 12 beds of each plot were harvested for cored product using commercial equipment. The cooperating company (Freshexpress-Chiquita) evaluated product quality.

**Task 2 – Analyze, report, and extend trial results to the lettuce industry and facilitate implementation of demonstrated practices.**

**Subtask 2.1 Analysis and summary of trial results (100% completed).** We will analyze data from the demonstration trials described in Task 1, including statistical analyses, summary tables and figures that will be used in reports and presentations. This subtask will be coordinated by Michael Cahn.

We have analyzed data from the 5 field trials, and the results are summarized in the section below with tables and figures. Data were analyzed using general linear means procedure in statistical analysis software (SAS).

**Subtask 2.2 Grower educational meetings (100% completed).** We will present the results from the demonstration trials described in Task 1 at the UC Irrigation and Nutrient Meeting that is hosted by UC Cooperative Extension. Additionally, we will present the trial results at Freshexpress grower meetings. This subtask will be coordinated by Michael Cahn.

Results of the field trials were presented by Michael Cahn and Richard Smith at 10 educational meetings (Table 1). Two of the meetings were organized by UC cooperative Extension as part of the annual irrigation and nutrient meeting on 2/24/09 and 2/23/10 (see included agendas). Other presentations were at the Dole grower meeting in Monterey on 1/7/09, at the FreshExpress Grower Meetings in Salinas on 3/25/09 and 3/24/10, and the CDFA Fertilizer Research and Education Program Conference (11/17/09) and the Plant health association meeting on 11/19/09. We estimate that almost 700 participants attended these meetings. We also conducted 3 consultation meetings with interested growers to explain how to implement weather based irrigation scheduling and the quick nitrate test for lettuce production.

Table 1. Summary of presentations given on lettuce irrigation and nitrogen management trials during 2009 – 2010.

| Date | Meeting name | Presentation Topic | Sponsors/Co-Sponsors | Location | Attendance |
|---|---|---|---|---|---|
| 1/7/09 | Dole Grower Meeting | Irrigation management of lettuce | Dole | Monterey CA | 20 |
| 2/24/09 | UC Irrigation and Nutrient Meeting | Lettuce irrigation and nitrogen management | UCCE/CAFF | Salinas CA | 100 |
| 3/25/2009 | Freshexpress grower kickoff meeting | Water and Nitrogen management of lettuce | FreshExpress | Salinas CA | 100 |
| 9/29/2009 | Freshexpress internal meeting | Water and nitrogen management of lettuce | FreshExpress-Chiquita | Salinas CA | 8 |
| 10/23/2009 | Water Quality Symposium | Irrigation and nutrient management | Monterey Bay National Marine Sanctuary | Moss Landing CA | 45 |
| 11/17/2009 | FREP CDFA meeting | Improving water and nitrogen management of lettuce | CDFA/FREP | Tulare, CA | 125 |
| 11/19/2009 | Plant Health Association Seminar | Improving water and nitrogen management of lettuce | Plant Health Association | San Luis Obispo CA | 75 |
| 2/23/2010 | UC Irrigation and Nutrient Meeting | Irrigation management to reduce nitrate leaching in lettuce | UCCE/CAFF | Salinas CA | 65 |
| 3/24/2010 | Freshexpress grower kickoff meeting | Water and Nitrogen management of lettuce | FreshExpress | Salinas CA | 125 |
| 4/22/2010 | Irrigation and nutrient management meeting | Irrigation Management and Impact on Nitrate Leaching and Fertilizer Use Efficiency | Cachuma RCD/CCAWQ | Santa Maria CA | 30 |
| | | | | Total | 693 |

**Subtask 2.3 Reports, newsletter and trade journal articles (100% complete).**
Results of the demonstration trials were reported in the mid and final reports, as well as summarized in a report to Freshexpress and in newsletter and trade journal articles.

A trade journal article and web interview were published summarizing preliminary results of the irrigation and N management trials in lettuce:

1. Cary Blake, Trials suggest less Nitrogen, water for head, romaine lettuce in the Salinas Valley. Western farm press, March 4, 2009. http://westernfarmpress.com/vegetables/romaine-lettuce-0304/index.html
2. Patrick Cavanaugh, Nitrate quick test, California Ag Net, March 5, 2009. http://www.californiaagnet.com/videos_patrick.html

We authored 3 newsletter articles and 1 trade journal article:

1. M. Cahn and R. Smith. 2009. Large scale irrigation and nitrogen fertilizer management trials in lettuce. Monterey County Crop Notes. May/June.

2. R. Smith, M. Cahn, and T. Hartz. 2009. Farming closer to the edge. Monterey County Crop Notes. July/August.

3. M. Cahn, and R.Smith. 2010. Summary of 2008-09 Large scale irrigation and nitrogen fertilizer management trials in lettuce. Monterey County Crop Notes. March/April

4. M. Cahn. Ag Alert. April 22, 2009. Irrigation management boosts yields. http://www.cfbf.com/agalert/AgAlertStory.cfm?ID=1299&ck=A0833C8A1817526AC555F8D67727CAF6

## Summary of project and results

In 2008 and 2009 five large scale trials were conducted to demonstrate practices to improve irrigation and nitrogen fertilizer management in romaine and iceberg lettuce in the Salinas Valley. Managements evaluated included 1) scheduling irrigations based on weather and soil information, and 2) using the nitrate quick test to match fertilizer rates with the nitrogen needs of the crop at different growth stages. These practices may improve the efficiency of water and fertilizer application, reduce losses and provide tools for optimizing yield and quality of lettuce. The combined nitrogen and water management practices were referred to as the BMP (best management practices).

***Procedures*** Trials were designed to compare the BMP and standard grower practices on large replicated strips in commercial fields located in the northern and southern parts of the Salinas Valley (Table 2). The management strips were 160 feet wide by the length of the field. Trials ranged from 15 to 27 acres in size. Soil textures ranged from silty clay to sandy loam at the trial sites. Trial No. 1 was irrigated with overhead sprinklers throughout the crop cycle; all other crops were irrigated with sprinklers for approximately the first 30 days of the crop followed by surface drip until harvest. All trials were planted on 80 inch wide beds. Iceberg lettuce was grown in trials 1 and 4 and romaine was grown at the other trials. Irrigations were scheduled using an irrigation spreadsheet program developed specifically for lettuce. The irrigation program estimated consumptive water use for lettuce using CIMIS reference evapotranspiration (ET) data multiplied by a crop coefficient. The program estimated the irrigation interval from the water holding capacity of the soil, estimates of crop rooting depth, and estimated crop ET. Applied water of the different management treatments was monitored using flow meters. Nitrogen fertilizer recommendations were based on weekly determinations of soil nitrate in the top foot of soil using the nitrate quick test. Soil moisture data and plant biomass was compared weekly between management treatments. Leachate during irrigation events was sampled using a suction lysimeters. Yield was evaluated in small plots (2, 100 feet × 13.3 ft areas) and in large plots (2, 300 ft × 80 ft areas) using commercial equipment in each of the management strips. The commercial harvest provided estimates of the yield of cored product and the small plots harvests estimated marketable and biomass yields Commercial yield data was not available for trial 3.

***Summary of Results*** Water and nitrogen fertilizer applications were significantly reduced in the BMP treatment (Tables 3 and 4), averaging 121 lbs of N/acre and 11.2 inches of water for the BMP treatment and 176 lbs of N/acre and 13.7 inches of water in the grower standard treatment for all trial sites. The greatest reduction in nitrogen fertilizer was in Trial 1 (reduction of 139 lb of N/acre) and the greatest reduction in water was in Trial 3 (reduction of 7.5 inches of applied water). Trial 2 had the least reduction in water and fertilizer because the grower standard practice was similar to the BMP treatment.

Monetary savings for applied fertilizer and water (Tables 3 and 4) were highest at the Trial 1 site ($99/acre) and least for Trial 2 ($15/acre). Average savings in water and fertilizer for the 5 trials was $41/acre. Although average water savings were less than fertilizer savings ($9/acre for water and $33/acre for nitrogen fertilizer), careful water management was needed to prevent nitrogen fertilizer losses through leaching.

Despite applying an average of 55 lbs of N per acre less than the grower standard treatment, average soil nitrate levels during the season in the BMP treatment equaled the average soil nitrate level of 26 ppm nitrate-N in the grower standard treatment (Table 3). A soil nitrate-N concentration above 20 ppm would correspond to more than 70 lb/acre of mineral nitrogen available to the crop in the top foot of soil, and is considered a benchmark of sufficient mineral N for lettuce. The extra nitrogen fertilizer applied in the grower standard treatment did not increase the average uptake of N in the crop (Table 3), and therefore was presumably lost by leaching.

Nitrate leaching was estimated for the BMP and standard treatments by monitoring water use, soil moisture, and nitrate concentration of leachate. Nitrate-nitrogen concentrations in leachate sampled with a suction lysimeter 2 feet below the soil surface ranged from 105 to 178 ppm (Tables 5 & 6) reflecting that nitrate is concentrated in the water held in the soil pores.

Scheduling irrigations to match the evapotranspiration demand of the crop in the BMP treatment minimized nitrate leaching and reduced the economic loss of applied nitrogen to the crop. In trial 2, less nitrate leached in the BMP treatment during germination by reducing the applied amount of water during the first 2 weeks of the crop (Table 5), but the magnitude of savings were less at trial 4 where extra water was applied during germination to compensate for hot weather conditions (Figure 1). After thinning and the installation of the drip system at trial 4 and 5, minimal losses of nitrate occurred in both the BMP and standard treatments because the applied water amounts were close to the crop evapotranspiration requirements (Figures 1 and 2). In contrast, following thinning and a sidedress application, higher leaching was observed in the standard treatment during a single sprinkler irrigation application at trial 1 (Table 6) because substantially more water was applied than the crop requirement.

Soil mineral nitrogen levels were generally equal or higher in the BMP treatment compared to the standard management over the course of the growing season despite lower amounts of applied nitrogen (Appendix 1 Figures 3-7). For example, in trial 1, soil mineral nitrogen levels in the upper foot of soil were generally highest in the BMP treatment until the end of the crop cycle though fertilizer N was reduced by 139 lb of N/acre in the BMP treatment (Figure 3). Also, trials 2 and 3 had the highest mineral N in the upper foot of soil in the BMP managed treatment (Figures 4 and 5). Only in trial 5, where a small amount of water was applied during the drip phase of the crop for both the BMP and standard management treatments did the extra nitrogen fertilizer result in higher soil nitrate levels in the upper foot of soil for the standard treatment. These results indicated that by applying irrigation water at rates equal to the consumptive water use of the crop, nitrate can be effectively maintained in the root zone and leaching losses can be minimized.

On average, cored product yields for small and large plots were not statistically significantly different among the BMP and grower standard management treatments for the 5 field trials. Small plot estimates of yield in the BMP treatment were statistically lower than the grower standard at trial 2. However, yields of large plots harvested with commercial equipment at trial 2 were not statistically different among management treatments. Overall, large scale commercial yields in four of the trials indicated that the BMP treatment yielded from 98% to 104% of the standard treatment (Table 7).

**Conclusions**

Large scale field trials demonstrated that careful water management and nitrogen fertilizer management can result in equivalent yields and save money on fertilizer and water inputs. In addition, reducing nitrate leaching could minimize nitrogen loading to ground water supplies. The main tool for improving irrigation scheduling for lettuce is was using CIMIS evapotranspiration data to estimate a reasonable irrigation schedule that will maintain yields and minimizes the leaching of nitrate. The nitrate quick test can provide guidance for management of fertilizer nitrogen. Taken together, these tools may help growers improve the efficiency of lettuce production and improve water quality protection.

Table 2. Planting date, lettuce type, varieties, irrigation method and soil types at trial sites.

| Trial | 1st irrigation | harvest date | days to harvest | lettuce type | variety | soil type |
|---|---|---|---|---|---|---|
| Trial 1 | 6/28/2008 | 9/3/2008 | 68 | iceberg | Gabilan | Rincon clay loam |
| Trial 2 | 7/14/2008 | 9/16/2008 | 65 | romaine | Sun valley/Platinum | Chualar sandy loam |
| Trial 3 | 8/23/2008 | 10/31/2008 | 70 | romaine | Altura | Cropley silty clay /Salinas clay loam |
| Trial 4 | 5/14/2009 | 7/23/2009 | 71 | iceberg | steamboat | Chualar Loam |
| Trial 5 | 8/3/2009 | 10/9/2009 | 68 | romaine | green towers | Chualar Loam |

Table 3. Applied nitrogen fertilizer and soil nitrate levels in BMP and grower standard treatments, and fertilzer cost savings at trial sites.

| Trial | Standard | BMP | N Fertilizer | Fertilizer | Standard | BMP | Standard | BMP |
|---|---|---|---|---|---|---|---|---|
| | Total Applied Nitrogen (lbs N/acre) | | Reduction (lbs N/acre) | Cost Reduction ($/acre)[1] | Mean Soil Nitrate (over season) (ppm NO3-N) | | Total N Uptake at Harvest (lbs N/acre) | |
| Trial 1 | 248 | 110 | 139 | 83 | 33.3 | 47.0 | 134 | 142 |
| Trial 2 | 77 | 65 | 12 | 7 | 18.3 | 19.5 | 149 | 133 |
| Trial 3 | 200 | 154 | 46 | 28 | 19.5 | 20.4 | 86 | 93 |
| Trial 4 | 180 | 134 | 47 | 28 | 18.7 | 17.7 | 165 | 173 |
| Trial 5 | 175 | 144 | 31 | 18 | 41.3 | 26.9 | 120 | 119 |
| Average | 176 | 121 | 55 | 33 | 26.2 | 26.3 | 131 | 132 |

[1] nitrogen fertilizer valued at $0.60/lb

Table 4. Applied water in BMP and grower standard treatments during germination and post germination.

| Trial | Standard | BMP | Estimated Crop ETc (inches) | Irrigation requirement [1] (inches) | Water use reduction (%) | Energy Savings[2] ($/acre) |
|---|---|---|---|---|---|---|
| | Total Applied Water (inches) | | | | | |
| Trial 1 | 17.7 | 14.7 | 10.1 | 13.4 | 17 | 15.5 |
| Trial 2 | 9.9 | 8.7 | 7.6 | 8.9 | 12 | 7.6 |
| Trial 3 | 19.4 | 11.9 | 6.7 | 8.7 | 39 | 18.1 |
| Trial 4 | 10.7 | 10.4 | 7.0 | 8.4 | 3 | 1.2 |
| Trial 5 | 10.9 | 10.1 | 6.1 | 7.6 | 7 | 3.2 |
| Average | 13.7 | 11.2 | 7.5 | 9.4 | 16 | 9 |

[1.] irrigation requirement = ETc/DU; DU = distribution uniformity of the irrigation system

[2.] assumes energy costs of $0.15/kWhr, operating well depths of 75 feet for south county trials, and 150 feet for north county trials

Table 5. Estimated nitrate nitrogen losses due to leaching during germination of lettuce: Trial 2, July 10 to July 24, 2008

| Management Treatment | Applied Water[1] | Crop ET | Soil Moisture Storage | Percolation | NO3-N concentration in leachate | Nitrogen loss by leaching | Value of Fertilizer lost [2] |
|---|---|---|---|---|---|---|---|
| | ---------------- | inches | ---------------- | | ppm | lb/acre | $/acre |
| BMP | 2.4 | 1.2 | 0.0 | 1.2 | 116.4 | 31.4 | 18.85 |
| Standard | 3.5 | 1.2 | 0.3 | 2.1 | 104.9 | 49.5 | 29.67 |

[1] July 10 - July 24, 2008

[2] N fertilizer value = $0.60/lb

Table 6. Estimated nitrate-nitrogen loss due to leaching during one sprinkler irrigation, post thinning: Trial 1, July 25 to July 29, 2008

| Management Treatment | Applied Water[1] | Crop ET | Soil Moisture Storage | Percolation | $NO_3$-N concentration in leachate | Nitrogen loss by leaching | Value of Fertilizer lost [2] |
|---|---|---|---|---|---|---|---|
| | ---------------- | inches | ---------------- | | ppm | lb/acre | $/acre |
| BMP | 0.8 | 0.6 | 0.0 | 0.3 | 174 | 11.2 | 6.74 |
| Standard | 1.4 | 0.6 | -0.1 | 0.9 | 178 | 37.3 | 22.40 |

[1] July 25 - July 29, 2008

[2] N fertilizer value = $0.60/lb

Table 7. Commerical and small plot yields of BMP and grower standard treatments.

| Trial | small plot harvest: Grower | small plot harvest: BMP | | BMP relative to Standard | commercial harvest: Grower | commercial harvest: BMP | | BMP relative to Standard |
|---|---|---|---|---|---|---|---|---|
| | Total CFR[1] Yield | | | | Total CFR[1] Yield | | | |
| | ----- tons/acre | ------ | | % | ----- tons/acre | ------ | | % |
| Trial 1 | 27.3 | 27.8 | NS[2] | 102 | 20.9 | 20.7 | NS | 99 |
| Trial 2 | 25.7 | 23.0 | ** [3] | 90 | 13.6 | 14.2 | NS | 104 |
| Trial 3 | 12.1 | 10.5 | NS | 87 | -- | -- | | -- |
| Trial 4 | 38.6 | 40.2 | NS | 104 | 30.0 | 29.5 | NS | 98 |
| Trial 5 | 14.4 | 14.8 | NS | 103 | 9.0 | 9.0 | NS | 101 |
| Average | 23.6 | 23.3 | NS | 97 | 18.4 | 18.3 | NS | 100 |

[1] CFR = Cored for region

[2.] not statistically signficant at $p < 0.05$ level

[3.] statistically signficant at the $p < 0.05$ level

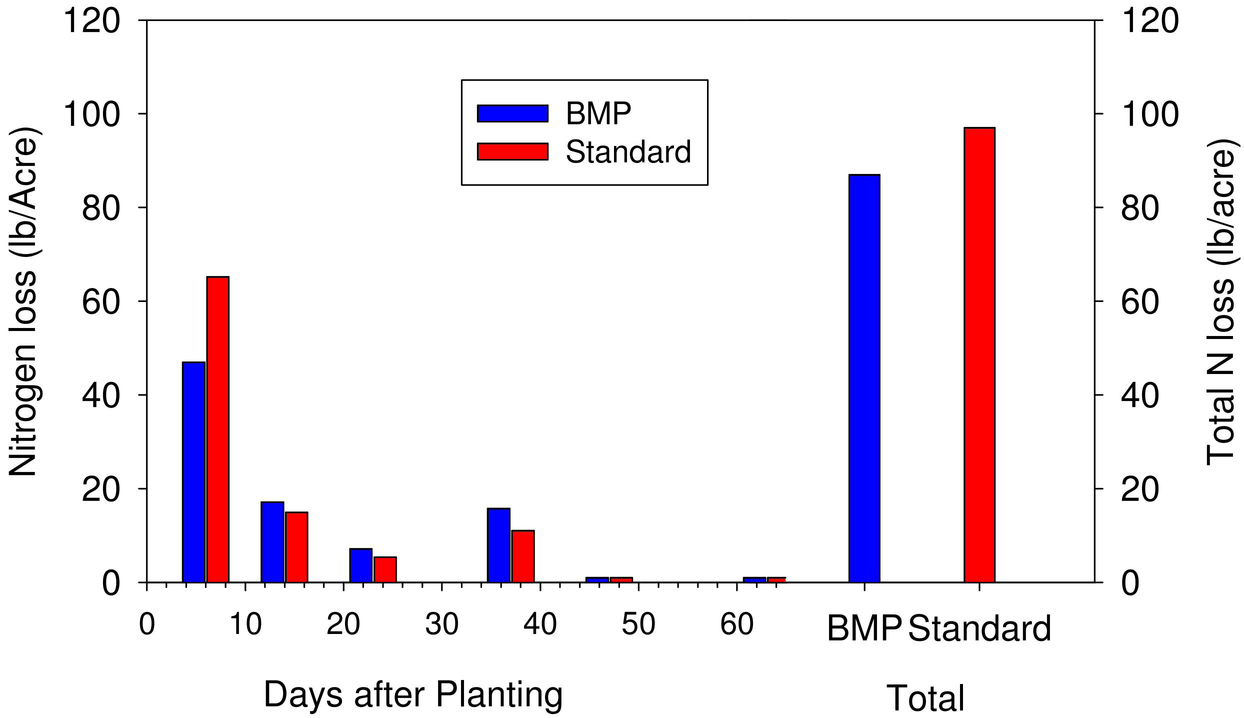


Figure 1. Estimated nitrate leaching losses for BMP and Grower standard treatments at field trial 4.

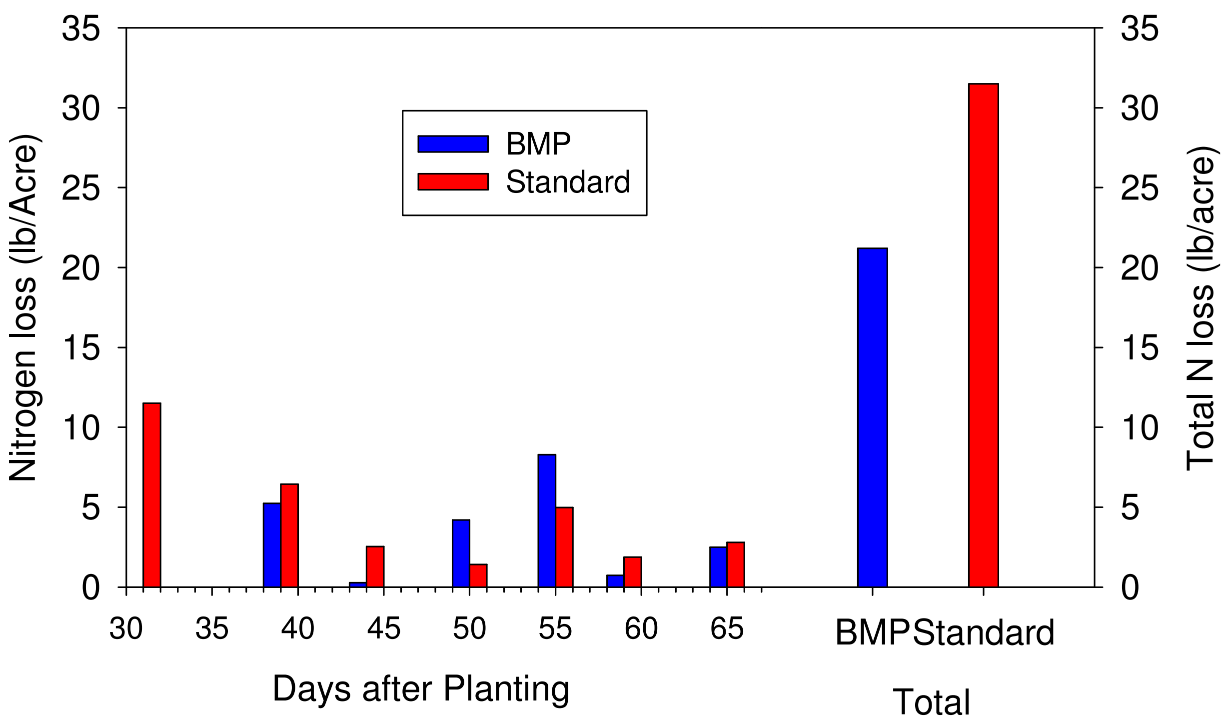


Figure 2. Estimated nitrate leaching losses for BMP and Grower standard treatments at trial 5.

Appendix 1. Soil mineral nitrogen and cumulative N fertilizer applications for Trials 1 – 5.

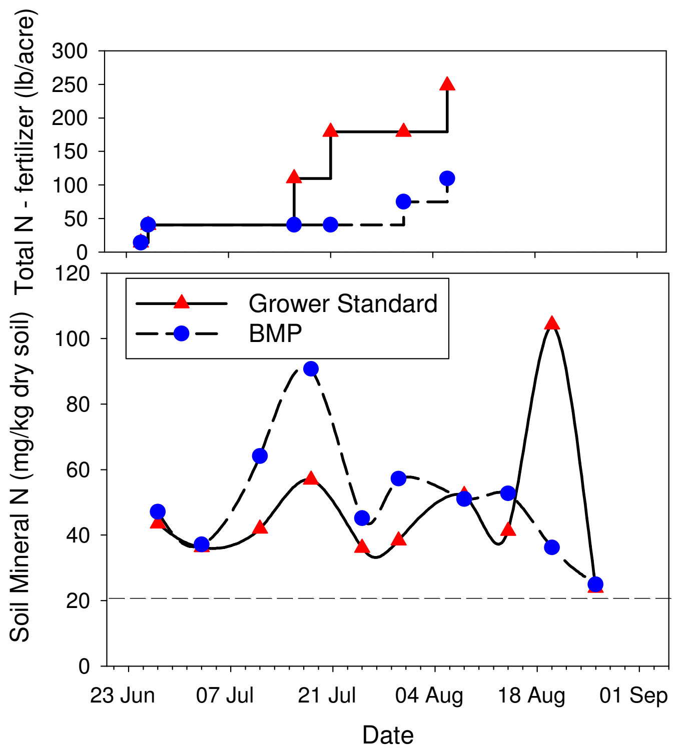


Figure 3. Average mineral nitrogen concentration in the 0-1 foot soil layer of the BMP and Standard treatments and applied N fertilizer at Trial 1.

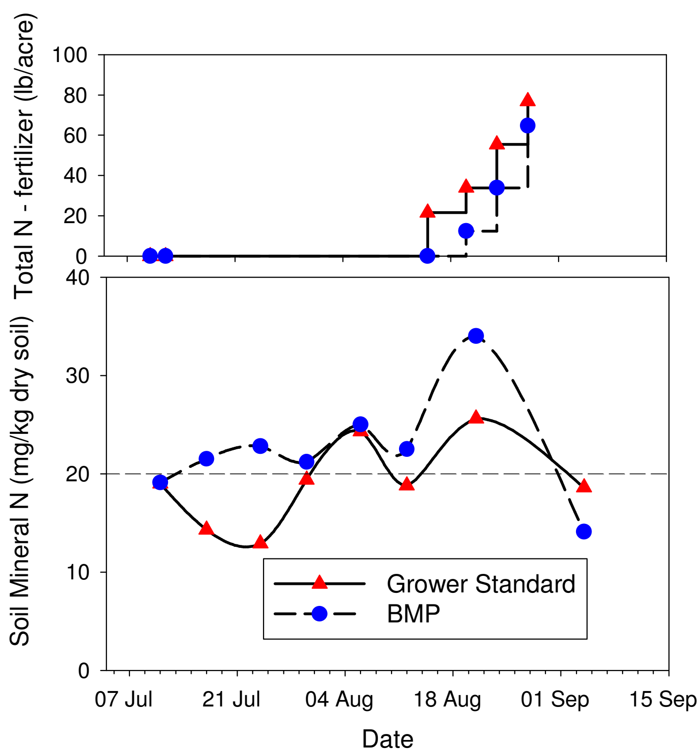


Figure 4. Average mineral nitrogen concentration in the 0-1 foot soil layer of the BMP and Standard treatments and applied N fertilizer at Trial 2.

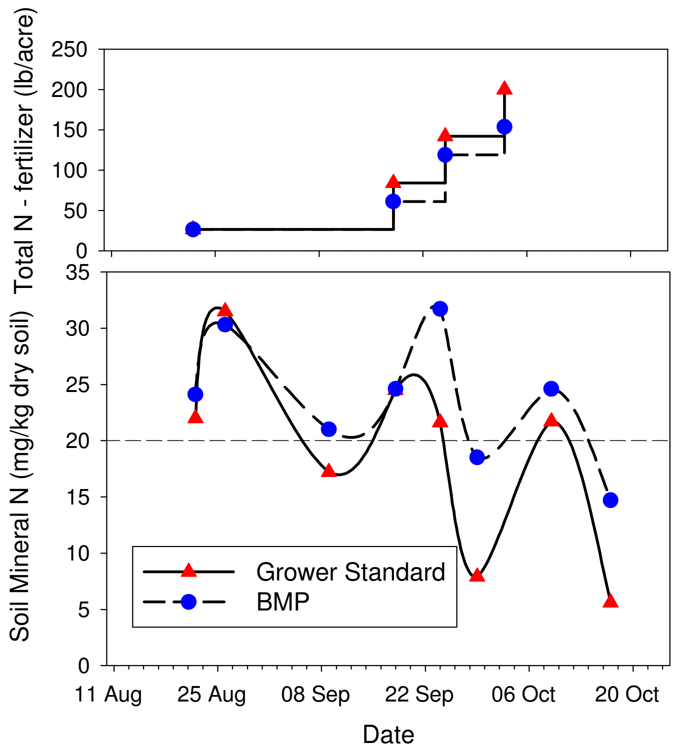


Figure 5. Average mineral nitrogen concentration in the 0-1 foot soil layer of the BMP and Standard treatments and applied N fertilizer at Trial 3.

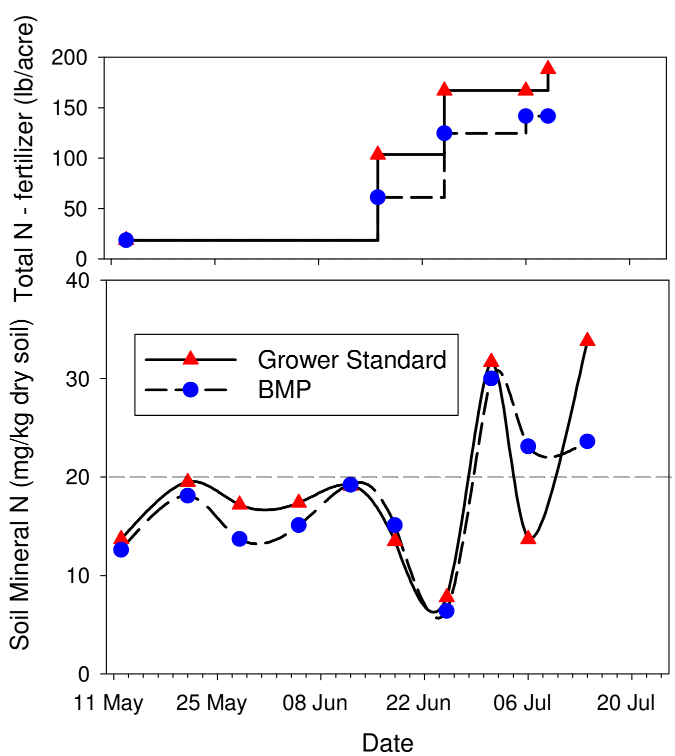


Figure 6. Average mineral nitrogen concentration in the 0-1 foot soil layer of the BMP and Standard treatments and applied N fertilizer at Trial 4.

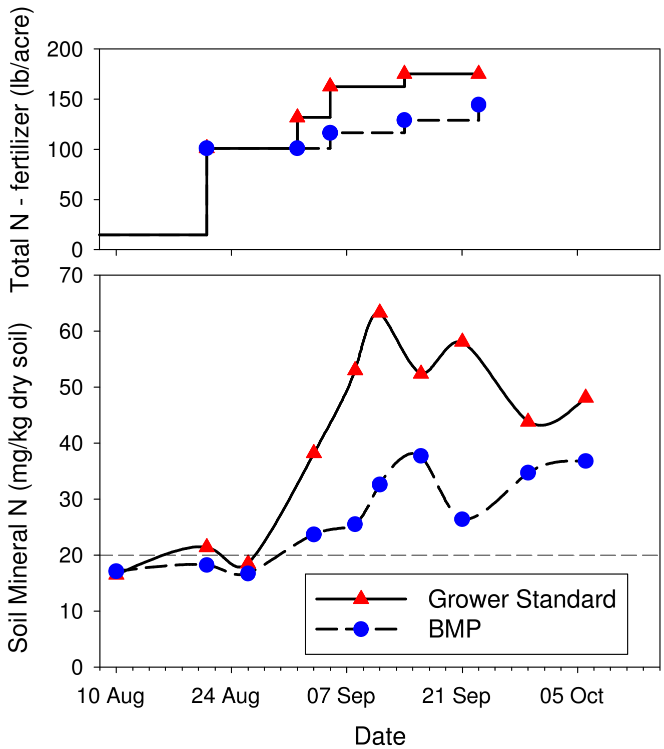


Figure 7. Average mineral nitrogen concentration in the 0-1 foot soil layer of the BMP and Standard treatments and applied N fertilizer at Trial 5.

**University of California Cooperative Extension, Monterey County**

# 2009 Irrigation and Nutrient Management Meeting and Cover Crop and Water Quality Field Day

## Tuesday, February 24

**7:45 a.m. to 3:00 p.m.**

**RAIN OR SHINE**

**Irrigation and Nutrient Management Meeting: Monterey County Agricultural Center, 1432 Abbott Street, Salinas**

| | |
|---|---|
| 7:45 | **Registration and Refreshments** |
| 8:00 | ***Water Management of Lettuce: Field Scale Studies***<br>Mike Cahn, Irrigation and water resources Farm Advisor, Monterey County |
| 8:30 | ***Nitrogen Management of Lettuce: Field Scale Studies***<br>Richard Smith, Vegetable Crop and Weed Science Farm Advisor, Monterey County |
| 9:00 | ***TBD***<br>Tim Hartz, Extension Vegetable Specialist, UC, Davis |
| 9:30 | ***Using Vegetation and Polymers for Controlling Nutrient, Sediment, and Bacteria in Irrigation Run-off***<br>Mike Cahn, Irrigation and water resources Farm Advisor, Monterey County |
| 10:00 | ***Break*** |
| 10:30 | ***Mineralization of Nitrate from Organic Fertilizers***<br>Tim Hartz, Extension Vegetable Specialist, UC, Davis |
| 11:00 | ***Field Evaluations of Liquid Organic Fertilizers on Strawberries***<br>Mark Gaskell, Farm Advisor, Santa Barbara County |
| 11:30 | ***Monterey County Water Concerns: Update on Groundwater status and Salinas Valley Water Project***<br>Curtis Weeks, Monterey County Water Management Agency |
| 12:00 | ***Conclusion and travel to lunch and field demonstration site*** |

**Vegetable Furrow Bottom Cover Crop Field Trial Demonstration**
**Sea Mist Farms – off Espinosa Road (Between Hwy 101 and Castroville)**

| | |
|---|---|
| 12:45 | ***Lunch – on Site***<br>Pizza lunch provided by CAFF |
| 1:30 | ***Field Demonstration and Discussion***<br>***Discussion of the Impact of Low-Residue Cover Crops on Winter Fallow Beds on Runoff and Water Quality***<br>Mike Cahn and Richard Smith, University of California Cooperative Extension; |
| 2:30 | ***Conclusion*** |

* **Sponsors:** University of California Cooperative Extension; Resource Conservation District (RCD); Community Alliance with Family Farmers (CAFF); and Agriculture and Land-Based Training Association (ALBA)
* **Continuing Education, Certified Crop Advisor and Water Quality Credits have been requested**
* **For more information call Richard Smith 759-7357 or Michael Cahn 759-7377**

1432 Abbott Street
Salinas, CA 93901

*phone* 831.759.7350
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**University of California Cooperative Extension, Monterey County**

# 2010 Irrigation and Nutrient Management Meeting and Cover Crop and Water Quality Field Day

## Tuesday, February 23

**7:45 a.m. to 3:00 p.m.**
**RAIN OR SHINE**

**Irrigation and Nutrient Management Meeting: Monterey County Agricultural Center, 1432 Abbott Street, Salinas**

| | |
|---|---|
| 7:45 | **Registration and Refreshments** |
| 8:00 | ***Nitrogen Management Studies: Field Scale Evaluations***<br>Tim Hartz, Extension Vegetable Specialist, UC, Davis |
| 8:30 | ***Nitrate Leaching Evaluations in Lettuce Production***<br>Aaron Heinrich, Staff Research Associate, Monterey County Cooperative Extension |
| 9:00 | ***Nutrient Movement from Production Fields – Results of Monitoring***<br>Sarah Green, Preservation Inc. |
| 9:30 | ***Irrigation Management and Impact on Nitrate Leaching and Fertilizer Use Efficiency***<br>Mike Cahn, Irrigation and water resources Farm Advisor, Monterey County |
| 10:00 | ***Break*** |
| 10:30 | ***Practical Soil Nitrate Testing and Fertilizer Management***<br>Richard Smith, Vegetable Crops and Weed Science Farm Advisor, Monterey County |
| 10:50 | ***Ag Water Enhancement Program (AWEP)***<br>Bob Fry, Natural Resources Conservation Service (NRCS), Davis |
| 11:10 | ***Polyacrylamide (PAM) Update: Formulations, Control of chlorpyrifos in runoff***<br>Mike Cahn, Irrigation and water resources Farm Advisor, Monterey County |
| 11:40 | ***Salinas Valley Water Project Update***<br>TBA, Monterey County Water Resources Agency |
| 12:00 | ***Conclusion and travel to lunch and field demonstration site*** |

**Vegetable Furrow Bottom Cover Crop Field Trial Demonstration**
**D'Arrigo Brothers Farms – off Old Stage Road**

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| 12:45 | ***Lunch – on Site***<br>Pizza lunch |
| 1:30 | ***Field Demonstration and Discussion***<br>***Discussion of the Impact of Low-Residue Cover Crops on Winter Fallow Beds on Runoff and Water Quality***<br>Mike Cahn and Richard Smith, University of California Cooperative Extension; |
| 2:30 | ***Conclusion*** |

* **Sponsors:** University of California Cooperative Extension; Resource Conservation District (RCD); Community Alliance with Family Farmers (CAFF)
* **Continuing Education, Certified Crop Advisor and Water Quality Credits have been requested**
* **For more information call Richard Smith 759-7357 or Michael Cahn 759-7377**

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