Cooperative Extension • Monterey County

Crop Notes

July/August, 2008

In This Issue:

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ENTOMOLOGY FARM ADVISOR – IMPORTANT UPDATE

Hugh Smith, the incoming entomology farm advisor for Monterey, Santa Cruz, and San Benito Counties, has advised Regional Director Peggy Mauk and County Director Sonya Hammond that, for family reasons, he is moving to Connecticut and will not be assuming the entomology position as planned.

After careful consideration of the important local entomology needs, Cooperative Extension is re-recruiting the position. The deadline for applications is August 15. Local individuals, organizations and companies are encouraged to advise potential candidates to apply. Particulars about the position are available at http://cemonterey.ucdavis.edu/

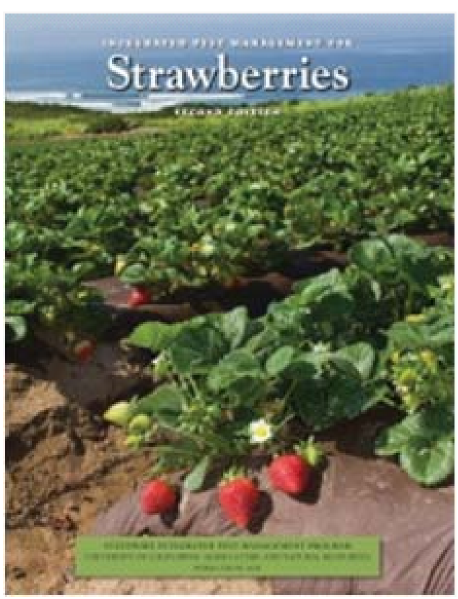
UC DAVIS SURVEY

Dear Clientele: We are asking that you take about 10 minutes to help academic colleagues at UC Davis with a survey they are conducting about how people handle and use nuts grown in California.
"Do you enjoy almonds, pistachios, and walnuts? Please help us learn more about who eats these nuts grown in California and how the nuts are used by completing an on-line survey at

http://ucce.ucdavis.edu/survey/survey.cfm?surveynumber=2655

The survey only takes about 10 minutes. This link will be available until August 1.

Integrated Pest Management for Strawberries 2nd Edition is now available at your Monterey County Cooperative Extension



This newly revised manual is the ultimate guide to pest management for strawberries. Whether you're a commercial grower or a home gardener, this manual is for you.

Using this manual you'll learn how to prevent and diagnose causes of damage; identify pests and key natural enemies; establish an IPM program for your field; manage problems related to irrigation, nutrition, and the growing environment; and determine when direct control actions are necessary. This revised manual also includes chapters on strawberry transplant production and managing pests in home garden strawberries.

MACROPHOMINA CROWN ROT: POSSIBLE NEW PRODUCTION ISSUE FOR STRAWBERRY IN CALIFORNIA.

Steven T. Koike, Plant Pathology Farm Advisor
University of California Cooperative Extension

Beginning at least as early as 2005 and continuing through 2008, our diagnostic lab in Salinas confirmed that collapsing strawberry plants from throughout California have been infected with the fungus Macrophomina phaseolina. Limited outbreaks have been observed in a number of coastal and inland strawberry producing counties. Symptoms consist of wilting of foliage, plant stunting, and drying and death of older leaves, though the central youngest leaves often remain green and alive. Plants can eventually collapse and die. When plant crowns are cut open, internal vascular and cortex tissues are dark brown to orange brown. We do not see fungus fruiting bodies or other structures directly on plant tissues. Thus far, affected fields generally have small, limited patches with this problem. However, for some locations where the disease has developed for more than one season, the patches can be quite large and appear to have spread from the initial problem area. Such patterns are consistent with the spread of a soilborne pathogen.

The soilborne fungus Macrophomina phaseolina has consistently been isolated from these symptomatic crown tissues. It is noteworthy that in these cases we have never isolated other important pathogens such as Colletotrichum, Phytophthora, or Verticillium. In culture, all Macrophomina isolates produce numerous tiny, black, irregularly shaped sclerotia. These sclerotia are survival structures that allow the fungus to persist for extended periods in the soil. The spore producing stage (pycnidia) of the fungus can be induced in culture, though we have yet to find these fruiting bodies on field grown plants. This disease is referred to as charcoal rot or crown rot.

The particular biology and ecology of M. phaseolina in the strawberry production environment is not yet defined for California. However, the fungus has been extensively studied in other systems. We know that Macrophomina, due to the production of microsclerotia, can survive for extended periods in the soil. The fungus probably is spread within and between fields mostly by the movement of soil during soil tillage and preparation operations. Disease is often most severe if the infected plant is subject to stresses such as weather extremes, water stress, poor soil conditions, and other factors. If fumigation treatments fail to significantly reduce soil inoculum, possible disease management steps could include applying post-plant fungicides (if effective, registered materials are available), rotating to non-host crops, and planting resistant or tolerant strawberry cultivars.

In preliminary tests, it appears that some strawberry cultivars differ in their susceptibility to this pathogen. In replicated shadehouse experiments, cultivars such as Albion, Camarosa, Diamante, and Ventana were quite susceptible; inoculated plants showed wilting symptoms two weeks after exposure to the fungus, and by four weeks the plants had collapsed. In contrast, cv. Seascape was very tolerant and showed only minor dieback of the oldest leaves by the end of the experiment.

While in years past M. phaseolina has been periodically associated with strawberry in California, it appears that only recently has charcoal rot disease become a production concern for the commercially grown crop. Charcoal rot of strawberry also has been reported in Egypt, France, India, Israel, and other parts of the US (Florida and Illinois). In California there is circumstantial evidence that the fields most seriously affected by Macrophomina have all been treated with pre-plant alternatives to the methyl bromide + chloropicrin fumigation standard. This crown rot problem may therefore be triggered by this change in production practices. Our UC Cooperative Extension group will be continuing our examination of this disease and plans to study disease epidemiology, strawberry cultivar resistance, fungicide treatments, and other aspects. Koike wishes to thank the California Strawberry Commission for its support of our diagnostic lab in Salinas.

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Dieback symptoms of strawberry infected with Macrophomina.

In strawberry, Macrophomina causes distinct browning of crown tissue.

UNDERSTANDING WHITE DRUPLET IN CANEBERRIES

Mark Bolda
Strawberry and Caneberry Farm Advisor
UC Cooperative Extension

Introduction: Growers of caneberries report that berry druplets, the juice filled sacs that compose blackberry and raspberry fruit, will sometimes turn white for no apparent reason. The following article is a discussion of the probable causes of this problem, called white druplet, and what growers can do to minimize it.

White druplet is a tan to white discoloration of one to many druplets on the fruit (Figures 1 and 2 below).

White druplet is a tan to white discoloration of one to many druplets on the fruit (Figures 1 and 2 below). Most often, white druplets will appear when there has been an abrupt increase in temperature accompanied by a drop in humidity, and this will be especially pronounced when there is wind. Commonly, in the Monterey Bay area, this would mean fairly steady temperatures of 70°F suddenly going to above 90°F with an absence of fog.

While white druplets may seem to be directly caused by weather, they are actually caused by ultra-violet (UV) radiation.

While white druplets may seem to be directly caused by weather, they are actually caused by ultra-violet (UV) radiation. Weather conditions modulate this by the effect they have on penetration of UV radiation into the fruit. Cool, humid air scatters and absorbs UV radiation, while hot dry air has the opposite effect and allows more direct UV rays to reach the fruit. The movement of humidity away from the canopy by wind only heightens the effect of hot dry air. Additionally, as humidity is moved away from the plant canopy more UV rays penetrate the canopy and damage the fruit that may not even have been exposed to the sun. Fruit inside of the canopy have not been acclimatized to UV radiation, and are subsequently more susceptible to it when in finally reaches them.

Some growers of caneberries in the Willamette Valley of Oregon, where rapid changes from a normally mild climate to temperatures up to and above 100° F occur through the summer, use overhead irrigation to minimize fruit loss to white druplet. This is not merely misting the fruit; large amounts of water are applied and thoroughly wet the canopy. This is done to maintain cool temperatures and high canopy humidity for as long as possible. Sprinkling is not done too late in the evening to allow fruit to dry before nightfall.

While some varieties, such as Apache blackberry, Kiowa blackberry and Caroline red raspberry, tend to get white druplets more frequently than others, almost all caneberry varieties are susceptible to at least to some degree.

Conclusion: The above has been a summary of the causes and approaches growers can take to minimize white druplet in raspberries and blackberries.   Growers are encouraged to contact Mark Bolda with UC Cooperative Extension regarding the management of this and other problems in strawberries and caneberries.

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Figure 1: White druplet on Apache blackberry

Figure 2: White druplet on Heritage red raspberry

FOOD SAFETY AND SALINAS VALLEY CROPS: 4. THE QUESTION OF SEEDBORNE *E. COLI* O157:H7

Steven Koike and Trevor Suslow
UC Cooperative Extension; UC Davis

This is the fourth of a series of articles dealing with the pathogenic bacterium Escherichia coli (abbreviated *E. coli*) within the context of leafy vegetable crops in California. The purpose of this article is to provide an introduction and perspective on the questions surrounding the potential for *E. coli* O157:H7 to be a contaminant of vegetable seed.

Currently, human pathogenic *E. coli* has not been documented on any commercial lettuce or spinach seed.

Recent food safety events involving fresh leafy green vegetables (consumed without cooking), especially the strong evidence linking a multistate outbreak to consumption of packaged spinach in September 2006, have heightened interest in identifying how human pathogens such as *E. coli* O157:H7, *Salmonella*, and others reach and contaminate these commodities. Along with this interest there is an urgent desire, on the part of industry and regulatory groups, to identify and implement effective prevention measures. While research and prevalence surveys clearly identify cattle as a primary reservoir and source of shedding of *E. coli* O157:H7, it remains far less definitive which of the many potential hosts, routes, and vectors actually result in contamination of crops. Because of such uncertainty, diverse elements within production environments are being considered as possible vehicles for introducing or moving *E. coli* O157:H7 into field plantings. Examples of such factors are irrigation water, surface runoff water, workers and handlers, equipment, wild mammals such as deer and feral pigs, wild birds, windborne dust and particles, and vegetable seed.

Discussions have been held as to whether the vegetable seed used to plant leafy green vegetables can be contaminated with pathogens such as *E. coli* O157:H7 and *Salmonella* in a manner that would result in persistent populations on the harvested crop. In an effort to account for all possible routes of contamination, some groups have recommended or required that growers test spinach and lettuce seed for human pathogens and certify that planted lots are free of such contaminants. A rationale for requiring seed testing is the documentation of *Salmonella* and *E. coli* O157:H7 on seeds used to grow sprouted seed commodi-

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ties. However, before human pathogen testing is broadly implemented for leafy green vegetable seed that will be planted in open field, mineral based soils, a more considered evaluation of the available information should be made. Below is a brief summary of this information.

No contaminated seed lots found: Currently, we are unaware of documentation that human pathogenic bacteria have been detected and isolated from spinach or lettuce seed. Seed lots that are naturally contaminated with *E. coli* O157:H7 or *Salmonella* have not been publically identified. While food safety journal articles concerning leafy greens proposed that contaminated seed could pose a potential risk for crop contamination, these authors acknowledge that this hypothetical scenario is highly speculative and lacks the support of science-based evidence.

The outdoor soil and weather environment would not favor survival and growth of human pathogenic bacteria even if found on vegetable seed.

No association with specific seed lots: In addition to the lack of evidence for contaminated seed (presently limited by the low level of experience in testing), the patterns derived from "epidemiological evidence" would not seem to support a seed-borne source. If a given seed lot, often planted by one or more growers in a region, was contaminated with *E. coli* O157:H7 or *Salmonella*, one might expect that food poisoning events would be a recurring problem associated with different blocks or widely separated fields that were planted with this particular seed and exposed to similar climatic conditions and practices. Recognizing that other factors would play a role, it would be logical to assume that contaminated spinach or lettuce would be a more frequent problem where this specific seed lot was used. In contrast, our experience has been that the very rare occurrences of *E. coli* O157:H7 on spinach or lettuce have been associated with a specific harvest date, processing date, processor, and other aspects of field location. These outbreaks were not broadly linked to a particular vegetable cultivar or seed lot.

Field environment not favorable: Research clearly documents that suitable environmental conditions are required for bacterial survival and growth on plants and other objects. The sprouts commodities (alfalfa, clover, mung bean, mustard cress, radish) well illustrate this. These fresh commodity items are generally produced by soaking seed in water, placing this seed into rotating drums or plastic trays, and frequently spraying or misting them with water. In tray culture, trays are moved into indoor growing chambers, watered with modified hydroponic systems, and plants maintained under incubator-like conditions with high humidity, continuous free moisture, and temperatures ranging from 70 to 85 °F (22 to 30 °C). *Salmonella* and *E. coli* O157:H7 have been found at very low levels on a very small percentage of sprouts seed lots. When such seed is grown under these conditions, the environment favors explosive bacterial growth; within 48 hours, pathogens can grow from very difficult-to-detect to easily detectable and recoverable levels. This production system therefore allows for the occasional occurrence of food poisoning associated with contaminated sprouts products grown from even marginally infested seed.

However, for leafy green vegetables produced in outdoor fields, planted in mineral based soils, and subject to fluctuating outdoor weather conditions, the environment is not favorable for human bacterial pathogens to survive and grow from low to high levels that could result in crop contamination. In addition, field soils are complex microbial settings where a myriad of microorganisms would compete with and feed on bacteria present on spinach or lettuce seed. The combination of a less than favorable environment and competitive microbial community suggests that even if human pathogens were present on vegetable seed, such pathogens would not experience significant growth as seen in the sprouts system. Without further study, the risks associated with seedborne pathogens for sprouts commodities should not be used directly as a model or rationale for testing policies involving field-planted vegetable seed.

Even though seed-borne *E. coli* does not likely play a role in contaminated leafy greens, seed producers should implement appropriate practices to guard against contamination.

Other considerations: At present, it appears unlikely that seedborne *E. coli* O157:H7 plays a significant, if any, role in the periodic outbreaks on leafy green vegetables. Following are some other considerations regarding this topic. 1. Research should be conducted to further explore the microbial community ecology influenced by germinating vegetable seed. Such research should include developing improved and standardized methods to look for various pathogens on seed and other plant materials. 2. Regardless of the expected low risk for *E. coli* O157:H7 on vegetable seed, producers of vegetable seed should adopt appropriate practices to ensure that seed do not become contaminated. Such steps include careful site selection to avoid direct contact with cattle wastes, irrigating with water that has not been exposed to manure or animals, appropriate timing of fertilizer applications if such fertilizers contain manure, and devising seed handling and equipment sanitizing protocols.

COMPARISON OF DRIP AND SPRINKLER IRRIGATION IN BRUSSELS SPROUTS: WATER USE, NITROGEN, AND CROP YIELD.

Michael Cahn, Irrigation and Water Resources Advisor, UC. Cooperative Extension, Monterey Co.
Marc Buchanan, Agronomist, Buchanan and Assoc.

Introduction

Brussels sprouts are typically irrigated using hand-move sprinkler lines on the central coast of California. After establishing transplants, as many as 10 to 14 days may pass between sprinkler irrigations. The long irrigation interval is possible because the evapotranspiration rate is lower on the coast compared to a few miles inland and because Brussels sprouts have a rooting depth of 2 to 3 feet. Nitrogen fertilizer is typically applied to Brussels sprouts by a combination of preplant fertilizer incorporated in the beds followed by 1 or 2 sidedressings of fertilizer in bands in the beds, and finally by fertigating through the sprinkler water after the canopy is too dense for tractor traffic.

Drip irrigation may offer several advantages over sprinklers for Brussels sprouts production. Windy conditions which are common adjacent to the coast can greatly reduce the uniformity of sprinklers, but do not affect the uniformity of drip systems. For situations where pumping capacity is limited, drip systems can be designed to apply water at low rates so that they can irrigate more acreage during a single irrigation than sprinklers. Irrigation run-off is also minimized using drip irrigation. Finally, fertilizer can be applied to the crop through the drip system so that nutrient applications can be matched to the uptake rate of the crop.

Demonstration trial comparing drip and sprinklers

We divided an 8 acre Brussels sprout field located near Ano Nuevo, California into 2 management zones to compare the benefits of using drip and fertigating nitrogen to the standard grower practice of using hand move sprinklers and sidedress applications of nitrogen fertilizer. Transplants in the Grower Standard (GS) zone were established and grown with hand move sprinklers. Transplants in the best management practice (BMP) zone were also established with sprinklers, but after establishment, shallowing buried drip tape (3-4 inches deep), was used to irrigate the crop until harvest. The crop was transplanted on June 28th, 2006 and harvested December 5th, 2006. Surface water was used to irrigate the crop. A total of 247 lb of N/acre were applied to the GS zone and 228 lb of N/acre were applied to the BMP zone. All nitrogen fertilizer was applied through the drip system for the BMP zone at weekly intervals of 7 to 24 lbs of N per acre until the end of September. A majority of the N fertilizer (189 lbs of N/acre) was sidedressed in the GS zone, and the remaining fertilizer was applied by injection through the sprinklers.

Windy conditions which are common adjacent to the coast can greatly reduce the uniformity of sprinklers, but do not affect the uniformity of drip systems.

Results

Crop water use

The seasonal evapotranspiration of the crop was estimated using canopy cover measurements and reference ET data averaged from the nearest CIMIS stations (Santa Cruz, Pajaro). Cumulative crop ET was estimated to be 13.7 inches between transplanting and harvest for both zones (Table 1). Irrigation was scheduled in the BMP zone using crop ET and soil moisture monitoring data after the drip system was installed, between July 12 and December 5th. A total of 12.3 inches of water were applied to the BMP zone by overhead sprinklers and drip and 12.7 inches were applied to the grower standard (GS) zone using overhead sprinklers. Rain events added an additional 2 inches of water to the crop during October and November. Irrigation efficiency was 96% for the BMP and GS zones. No run-off was measured from either management zone. Soil moisture at the 8 inch and 18 inch depths of the GS zone was drier than measured in the BMP zone (Fig. 1). Soil moisture tensions at the 8 inch depth was generally maintained between 20 and 60 centibars in the BMP zone and between 40 and 100 centibars in the GS zone (note that high moisture tensions indicate drier soil conditions). Soil moisture tensions at the 18-inch depth were also lowest in the BMP zone. Soil moisture declined in both zones during October, but rain events raised moisture levels in November.

The seasonal evapotranspiration of the crop was estimated using canopy cover measurements and reference ET data averaged from the nearest CIMIS stations (Santa Cruz, Pajaro).

Soil nitrate leaching

Estimated drainage was approximately 0.6 and 0.5 inches for the BMP and GS zones, respectively, assuming soil moisture storage was 0 (Table 1). The low amount of drainage in both

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zones would not be expected to cause large losses of N through nitrate leaching during the cropping cycle. Nevertheless, soil nitrate levels in the GS zone were much higher than levels measured in the BMP zone during the season; and therefore nitrate was more likely to leach below the root zone in the GS zone if subsequent winter rains were heavy. Highest soil nitrate-N levels were 240 ppm at the 1 foot depth in the GS zone during August (Fig. 2). Subsequent samples demonstrated that nitrate levels at the 2 and 3 foot depths reached 49 and 23 ppm, respectively, in the GS zone during September.

Crop yield

Bulk (biomass) and marketable yields were highest in the BMP zone. Yield increases in the BMP area were presumably due to less culled sprouts and greater small-sized sprouts than harvested in the GS zone (Table 2). The crop appeared more uniform in height and taller in the BMP zone compared with the grower standard zone.

Water use efficiency (biomass/applied water) was slightly higher in the BMP zone (1.0 tons/inch for the BMP treatment and 0.9 tons/inch for the GS treatment, Table 1).

Conclusions

Drip irrigation provided a more uniform moisture and nitrate level in the soil during the season than hand-move sprinklers and increased yields using less nitrogen fertilizer than side-dressing. This was a preliminary trial that was not replicated, but shows that drip may offer some significant benefits for Brussels sprouts production on the central coast while also addressing regulations to improve water quality by minimizing run-off and nitrate leaching.

Acknowledgements: The authors would like to thank the Central Coast Regional Water Quality Control Board and Santa Clara Valley Water District for the opportunity to participate in this project and for funding.

Drip irrigation provided a more uniform moisture and nitrate level in the soil during the season than hand-move sprinklers and increased yields using less nitrogen fertilizer than side-dressing.

Table 1. Water use summary for Brussels sprouts in BMP and grower standard zones, 2006.

Treatment	Applied Water[x]	Crop ET	Runoff	Δ Soil Moisture [y]	Drainage	Irrigation Efficiency
	------------------------------ inches -----------------------------					%
BMP	14.3	13.7	0.0	--	0.6	96.0
Grower Standard	14.2	13.7	0.0	--	0.5	96.2

[x] includes 1.97 inches of rainfall

[y] not estimated

Table 2. Brussels sprout biomass and marketable yield in BMP and grower standard zones, 2006.

Treatment	Bulk Yield	Marketable Yield	Large size	Small Size	Culls	Water Use Efficiency[x]
	---- tons/acre ----		--------- % ----------			tons/inch
BMP	14.8	10.7	28.7	43.6	28.5	1.0
Grower Standard	13.0	8.8	31.7	34.7	37.7	0.9

[x] water use efficiency = bulk yield/applied water

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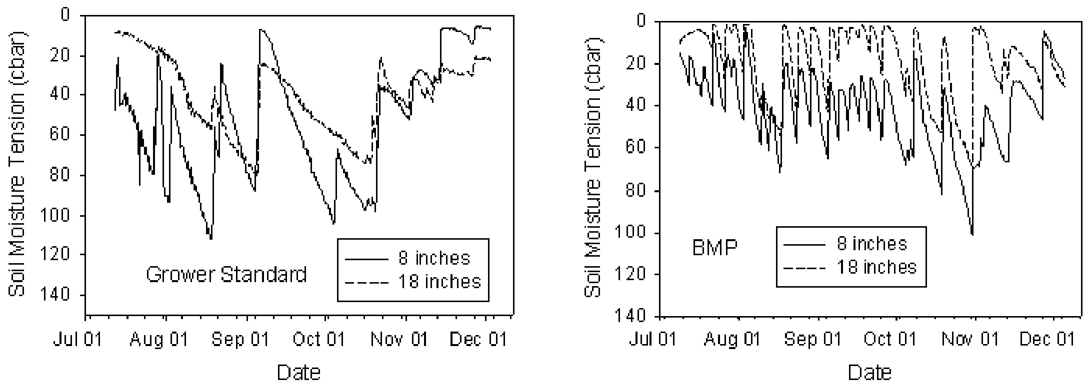


Figure 1. Soil moisture tension in best management practice and grower standard zones. High moisture

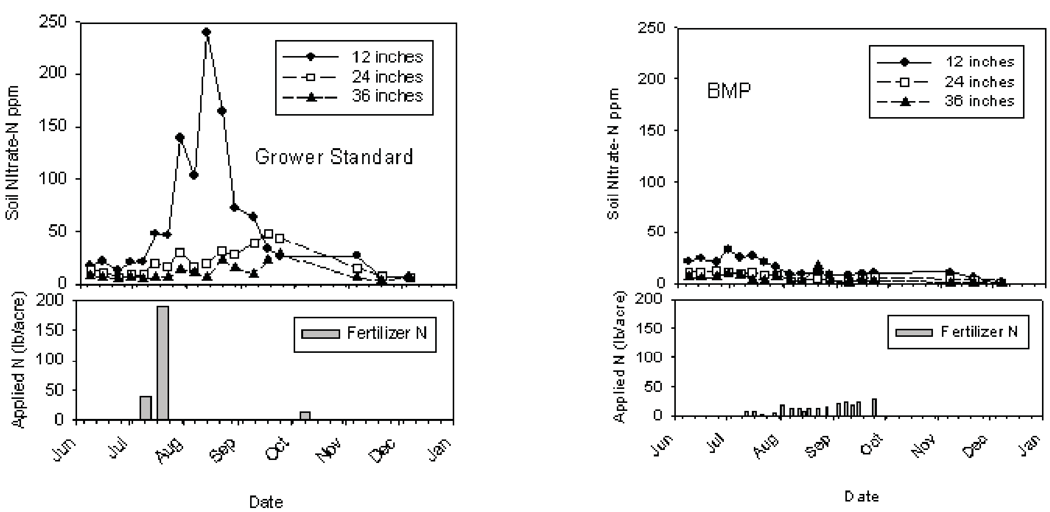


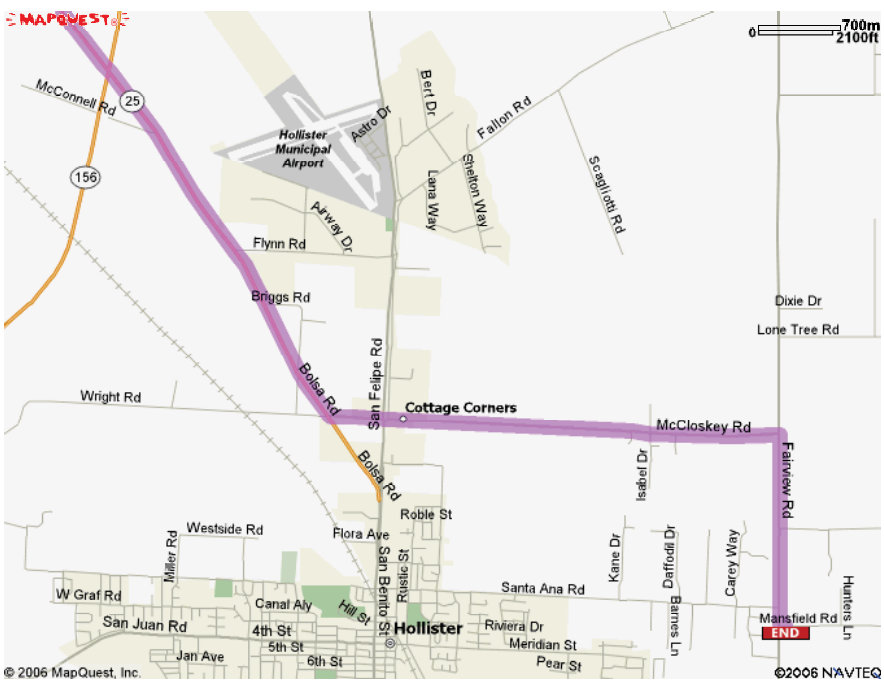
Figure 2. Soil nitrate levels in BMP and GS blocks and corresponding nitrogen fertilizer applications.

UC COOPERATIVE EXTENSION, SAN BENITO COUNTY WATER DISTRICT AND THE SANTA CLARA VALLEY WATER DISTRICT

Fertigation Workshop
Hands-on Field Instruction for Irrigators and Growers
July 30, 2008, 8:30 a.m. – 1:30 p.m.
30 Mansfield Road, Hollister 95023

- Balancing the irrigation system: Is my system is running properly?
- Principles of fertilizer injection: How, when and how much fertilizer to inject?
- Calibration of the injection system: Is my injector working properly? Did I fertigate correctly?
- Post injection operations

The class is free, but space is limited to 20 participants. A BBQ lunch will follow, so reservations are needed. Please call Shawn Novack at (831) 637-4378 or Bob Siegfried at (408) 265-2607, ext. 2969 to reserve your place by July 10.



The Regional Water Quality Control Board has approved 4.0 water quality credits for this workshop.