Cooperative Extension • Monterey County

Crop Notes

September/October 2010

In This Issue:

University of California, U.S. Department of Agriculture, and County of Monterey cooperating

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CURLY TOP DISEASE OF VEGETABLE CROPS

Steven Koike, Li-Fang Chen, and Bob Gilbertson
University of California

Curly top is a virus disease that historically is an important concern on a number of crops grown in the western US. The problem also occurs in the Middle East and Mediterranean regions, where the virus is thought to have originated. Curly top has a long history in the western US, including California. The disease was described from the early 1900s and for many years caused significant crop loss in sugarbeet, tomatoes and other crops. In recent years the disease has not been as devastating on either sugarbeet or vegetable crops; however, curly top still occurs in the western United States and can still cause significant yield losses, although this tends to be sporadic and localized. In 2010, curly top was confirmed in a number of tomato and pepper fields in Monterey and San Benito counties, reminding us that this disease still occurs sporadically in our coastal region.

Symptoms of curly top vary greatly depending on the host plant infected, stage of growth when infections occurred, strain or species of virus involved, feeding preference of the insect vector, and amount of virus (titer) in the vector and plant host. In general, symptoms of curly top include chlorosis (yellowing), stunting, distorted growth, leaf curling and crumpling, thickening of leaf tissue, swelling and purpling of leaf veins, and necrosis (brown, dead tissue).

In tomato, curly top symptoms begin with leaves showing light green coloration, up-curling, and vein purpling on the underside of leaves. Plants become stunted with twisted, distorted, and yellow leaves. Plants infected at an early stage of development stop growing and die, often standing out among nearby healthy plants. Plants infected at later stages of development show distorted growth and light green-yellow leaves with vein purpling; these symptoms will develop on newly emerging growth in the upper part of the plant or on entire shoots, but plants generally do not die. Any fruits produced will be stunted and ripen prematurely. For photographs of symptoms see http://ucanr.org/blogs/SalinasValleyAgriculture/.

In peppers, plants are stunted with shortened internodes. Leaves are light green or yellow in color, show strong up-curling and crumpling, and are thick and brittle. Plants infected at a young stage may die, whereas older plants are stunted and leaves again curl upwards and are light green to yellow. Fruits that might develop will be small, wrinkled, and unmarketable. For photographs of symptoms see http://ucanr.org/blogs/SalinasValleyAgriculture/.

Cucurbits infected with curly top virus exhibit stunting, chlorosis, and curling and crumpling of leaves. Cantaloupe, honeydew, pumpkin, and squash have been confirmed as hosts. It is notable, however, that most reports of curly top on cucurbits originate from outside of California. In California where disease pressure tends to be relatively low, cucurbits with curly top symptoms are infrequently reported. These results indicate that cucurbits are less susceptible to curly top viruses than other plant families.

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As for all diseases caused by viruses, confirmation of curly top requires laboratory testing because other pathogens and factors can cause symptoms that are similar to those caused by the curly top viruses. Such symptoms can also be caused by Tomato spotted wilt virus, nutrient deficiencies, and herbicide damage. For tomato in particular, phosphorous deficiency results in a purple vein symptom that can closely resemble curly top disease.

Curly top disease occurs sporadically on California's central coast.

In California, three closely related viruses have been found to cause curly top disease. The naming and organizing of viruses follows a taxonomic system that is similar to the ones used for other organisms. The curly top viruses belong to the geminivirus family (*Geminiviridae*); the geminiviruses are named for their distinctive virus particles, which are shaped like twin multi-faceted spheres (icosahedrals) (figure 1), and their circular single-strand DNA genetic material (genome). The *Geminiviridae* family is further divided up into several sub-groups called genera (singular: genus). Curly top viruses belong in the genus *Curtovirus* (derived from the name "curly top"). By definition, *Curtovirus* members have a single single-stranded DNA molecule (monopartite genome), infect only dicot plants, and are vectored by the beet leafhopper (*Circulifer tenellus*) (figure 2). The three curly top virus pathogens in California are: *Beet curly top virus* (BCTV), *Beet mild curly top virus* (BMCTV), and *Beet severe curly top virus* (BSCTV) (Table 1). More than one curly top species can infect the same plant, so mixed infections can occur. For coastal California, both BMCTV and BSCTV have been confirmed in tomato and pepper samples sent to UC Davis for analysis. This is consistent with results from the Central Valley showing that BMCTV and BSCTV are the main viruses involved in curly top outbreaks, as well as the main viruses detected in leafhoppers and weeds. The first curly top virus to be described, BCTV (known as the type strain), is now infrequently found in California. Other species of curly top viruses have been described by virologists but, thus far, these have not been reported from California (Table 1).

Tomato and pepper crops in our region are sometimes damaged by curly top viruses.

Curly top viruses have a very wide host range and cause curly top disease in over 300 plant species in 44 families of agronomic crops, ornamental plants, and weeds. Some of the susceptible crops in California include bean, melon, pepper, pumpkin, spinach, squash, sugarbeet, and tomato. Commonly found weed hosts of curly top viruses include black mustard, lambsquarters, London rocket, nettleleaf goosefoot, perennial pepperweed, Russian thistle, and redstem filaree.

The curly top viruses are vectored by the beet leafhopper. The biology of this vector has been extensively studied. The adult insects overwinter on perennial weeds growing along the foothills adjacent to the cultivated valleys. In the spring, the leafhoppers reproduce on these weeds and the resulting new generation obtains the virus by feeding on infected annual and perennial host plants. When the weed population dries up in the late spring, the new leafhoppers migrate to cultivated fields and spread the virus when they feed on the crops. On the valley floor, the leafhoppers go through multiple generations and continue to spread curly top to susceptible crops. In the fall, the leafhoppers return to the foothills to overwinter. This annual migration between foothill weeds and valley crops accounts for the annual occurrence of curly top disease in vegetable and sugarbeet crops. The leafhopper retains the virus in its body for a long period of time, and can continue to inject the virus into the phloem of plants for up to 1 month after initial acquisition (this mode of virus transmission is referred to as persistent circulative).

Disease incidence and distribution in tomato and pepper fields in a given year are dependent on the populations of the beet leafhopper and the migratory feeding patterns of this insect. Most infections tend to happen early in the growing season, but late season infections may also occur, as in 2010. In general, for coastal California, disease incidence is usually low and symptomatic plants occur randomly in a field, indicating where the fast moving leafhopper has stopped to feed. This random, scattered distribution of diseased plants reflects the fact that tomato and pep-

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per are not preferred hosts of the beet leafhopper and that the insects move on in search of preferred hosts, such as plants in the beet family (Chenopodiaceae). The virus is not carried in seeds nor is it mechanically transmitted (i.e., by touch or physical contact), so leafhopper transmission is the sole means of disease spread.

Management strategies for curly top disease vary by crop. Resistant cultivars are available for sugarbeet and common bean and help reduce the impact from the viruses. From 1943 through the present, the State of California has carried out a Curly Top Virus Control Program (CTVCP) that sprays insecticides in the foothill overwintering regions of the San Joaquin Valley; such applications are intended to reduce the leafhopper populations before they can migrate to the valley crops and spread curly top disease. There is some question, however, about the effectiveness and the future of this program. For coastal vegetable crops, control measures are not recommended due to the very sporadic nature of and limited damage from curly top disease.

The beet leafhopper is the only vector of curly top viruses.

The extensive research that has been conducted on curly top is a nice case study that shows the value of combining field studies and observations with the latest in molecular biology and DNA methods. Previously, all curly top diseases were thought to be caused by one virus, BCTV. However, researchers, breeders, and field personnel recognized for many years that significant differences existed between strains of BCTV based on differences in host range, symptoms induced in different hosts, and disease severity. With the advent of molecular techniques, researchers were able to confirm that the curly top disease is actually caused by three virus species (BCTV, BMCTV and BSCTV) and that their relative importance differs. Future research will possibly find yet more viruses that are involved in this complex disease system.

Table 1. Viruses that cause curly top disease in the USA

Virus pathogen	Role in California	Notes
Beet curly top virus (BCTV)	Less commonly found	Designated as "type strain" Formerly: Cal/Logan strain of BCTV
Beet mild curly top virus (BMCTV)	Predominant curly top virus in common bean, cucurbits, tomato, pepper, and spinach	Formerly: Worland strain of BCTV
Beet severe culy top virus (BSCTV)	Second most common curly top virus in tomato, pepper; most common found in sugarbeet	Formerly: CFH strain of BCTV
Horseradish curly top virus (HrCTV)	Not reported in CA	
Spinach curly top virus (SCTV)	Not reported in CA (TX only)	
Pepper yellow dwarf virus (PeYDV)	Not reported in CA (NM only)	

Control measures are usually not needed for coastal crops affected by curly top

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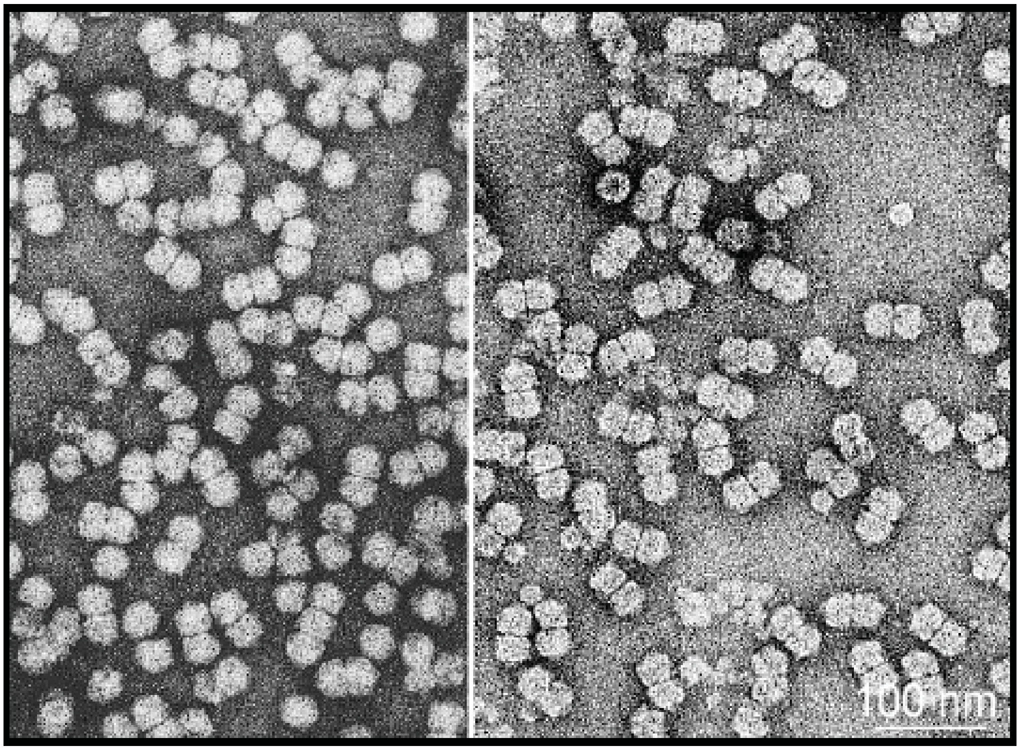

Figure 1: Electron micrograph showing characteristic twin particles of curly top viruses.
Photo credit: ICTVdB.

Figure 2: Beet leafhopper, vector of curly top viruses.
Photo credit: Jack Kelly Clark, UC ANR

LOW RESIDUE COVER CROPS MINIMIZE RUN-OFF, EROSION, AND NUTRIENT LOSS FROM FALLOW VEGETABLE FIELDS

Richard Smith, Michael Cahn, Aaron Heinrich and Barry Farrara

Managing run-off and water quality concerns from winter storms on sloped ground in the Salinas Valley is challenging. Storm events on the eastside of the Salinas Valley often result in flooding and significant soil erosion as run-off from rain events moves from agricultural lands onto roadways and into public water ways. Cover crops potentially reduce run-off and minimize erosion and sediment loss. Cover crops also provide many benefits for improving soil quality. However, due to the need to keep a large proportion of vegetable ground fallow to meet winter and spring planting schedules, cover crops are only used on a small percentage of acres in the Salinas Valley. Fields located on the east-side of the valley, which are sloped and have decomposed granite soils, prone to crusting, are especially susceptible to excessive run-off and erosion during storm events.

Nitrate leaching was estimated from the concentration of nitrate in leachate samples and by estimating the amount of percolation during storm events from rainfall, soil moisture storage, and evapo-transpiration data.

We have evaluated strategies of managing the biomass of winter cover crop in order to provide a cultural practice that can provide benefits of cover crops, but have minimal residue to impede ground preparation operations for subsequent vegetable crops. Over the past two years we have tested two cover crop species: cereal rye (AG104) and winter dormant triticale (Trios 102 and 888) in commercial vegetable fields. After listing, rye seed was broadcasted and incorporated on the beds and furrows, but the triticale was just planted on the furrow bottoms. These cover crops were then killed with an herbicide about 55 days after planting, allowing the cover crop biomass to decompose before spring planting. The objective was to provide ground cover, improve infiltration from rainfall, and reduce sediment loss. With this strategy, we hoped to demonstrate a cultural practice that can help growers reduce soil erosion and flooding, address water quality concerns, and maintain the productivity of their ground, while minimizing the problems caused by covercrops on planting schedules.

2009-2010 Trial: The trial was conducted with a cooperating grower east of Salinas. The site had slopes of approximately 3 to 4%. There were three replications of each treatment and plots measured eight 40-inch beds wide (26.6 ft) by 1,100 feet long. Cereal rye 'AG104' and winter dormant triticale '888' were seeded on November 13, lillistoned into the soil the next day and germinated by sprinkler irrigation on November 24, 2009. Cover crop were treated with 2% glyphosate on January 15, 2010 (52 days after germination) to assure manageable levels of residue. The untreated control was also treated for weeds at this time. Cover crop growth was measured by biomass sampling on seven dates.

Runoff from the plots was measured during rain events during the course of the trial. Run-off from each plot was channeled through flumes at the lower end of the plots. Flumes were instrumented to measure the flow rate and total volume of runoff. An automatic sampler collected composite samples of runoff during storm events. Run-off samples were analyzed for suspended sediments and nutrients at the DANR Analytical laboratory at UC Davis. A suction lysimeter was installed at a two foot depth in each plot to measure deep percolation of nitrate. A vacuum pump maintained 20-25 cbars of suction in the lysimeters to capture gravitational water during rainfall events. Nitrate leaching was estimated from the concentration of nitrate in leachate samples and by estimating the amount of percolation during storm events from rainfall, soil moisture storage, and evapotranspiration data. Mineral nitrogen was monitored on a bimonthly basis over the course of the trial. Nitrate in the soil profile was measured to a depth of 3 feet at the beginning and end of the trial.

RESULTS: The winter of 2009-10 was characterized by two intensive periods of rainfall in

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mid-January and late-February (Figure 1). As a result, we were able to measure differences in the quantity of runoff from the cover cropped and bare treatments. Forty-seven percent of the winter rainfall (about 120,000 gallons per acre) was lost as run-off from the bare plots. The low biomass cover crops reduced the volume of storm induced run-off by 95% for the rye treatment and by 80% for the triticale treatment (Figure 2). Cumulative erosion for the bare plots averaged 1199 lbs of sediment/acre for the winter season. Low residue cover crops greatly reduced sediment loss (Figure 3). The rye treatment reduced losses by greater than 99% (2.1 lbs of sediment/acre) and the triticale plots reduced losses by 94% (73 lbs of sediment/acre). Losses of sediment were highest during the first major rain events of the season when the fine particles in the soil were most susceptible to erosion (Figure 4).

Cover cropped treatments also reduce nutrient losses in the run-off.

Cover cropped treatments also reduce nutrient losses in the run-off. Total N and total P losses were reduced by 95% for the rye treatment and by 87% for the triticale treatment (Table 1) compared to the bare plots. Soluble nutrient losses were also reduced under the cover crop treatments. Reductions in nitrate-N losses were 92% and 93% for the rye and triticale treatments, respectively, compared to the bare plots. Reductions in soluble P (ortho-P) losses were 84% and 78% for rye and triticale treatments, respectively compared to the bare control. Also a significant reduction in ammonium and potassium losses was measured in the cover crop treatments relative to the bare plots (Table 1). Although the losses in nutrients may not have an agronomic impact on the subsequent vegetable crops, these losses can cause significant impairments to the quality of surface water. Both nitrogen and phosphorus spur algal growth in surface waters which can reduce dissolved oxygen levels.

The difference in levels of runoff between the cover crops was due to their biomass production and planting configuration. Rye was planted on the entire beds and triticale was planted only in the furrow. Rye 'AG104' grew faster than triticale '888' and had significantly greater dry matter throughout the evaluation (Figure 5). Both cover crops were sprayed with glyphosate at 52 days after germination, however, rye dry matter peaked at 0.83 tons/A, 65 days after germination. After reaching their peak of dry matter, the dry matter levels of both varieties declined as the cover crops began to decompose. Even when dead the cover crop biomass was still effective in reducing sediment loss, presumably because it still provided cover to the soil and reduced sediment from being dislodged by raindrop impact. Nitrogen accumulation roughly followed the same pattern as the dry matter accumulation. Rye 'AG104' accumulated 72 lbs N/A and triticale '888' accumulated 22 lbs N/A in the tops at 65days after germination (Figure 6). The amount of nitrogen that was accumulated by rye could be useful in sequestering nitrate that might otherwise be lost due to nitrate leaching.

The difference in levels of runoff between the cover crops was due to their biomass production and planting configuration.

There were no differences between total mineral nitrogen in the top foot of soil over the winter and all treatments experienced a significant reduction in mineral nitrogen following the mid-January storms (Figure 7). Nitrogen accumulated in the 1-2 foot depth January through early-March (Figure 7). The rye treatment had lower levels of nitrate at the lower soil depths indicating that it may have reduced nitrate leaching.

We followed the preparation of the field for planting broccoli. The cover crop residue did not cause a disruption of soil preparation operations (lillistoning and bed shaping – see youtube video: http://www.youtube.com/watch?v=k0oVVJ_BA7s).

CONCLUSIONS: Low residue cover crops are able to significantly reduce sediment and nutrient loss during winter storm events. Cover crops must be killed before they produce too much biomass and in this trial they decomposed sufficiently that their residue did not hamper land preparation and planting for the subsequent vegetable crop. Rye accumulated 72 pounds of nitrogen and there is evidence that less nitrate moved to the 2 foot depth in the soil.

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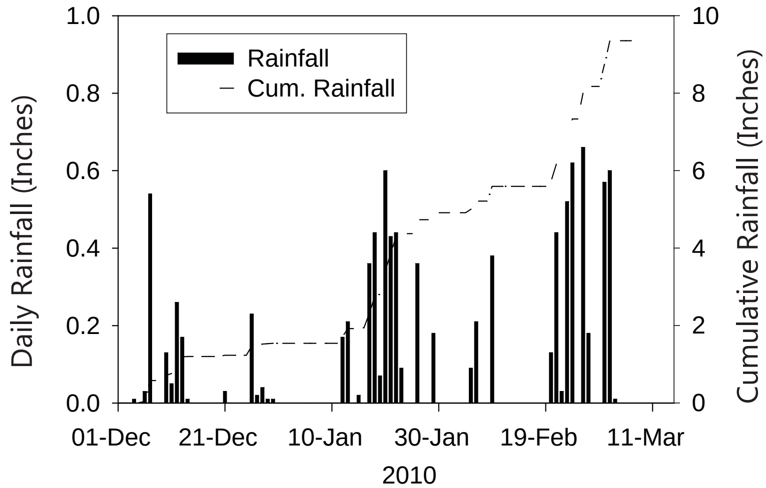

Figure 1. Rainfall during the winter of 2009 to 2010 measured at the trial site.

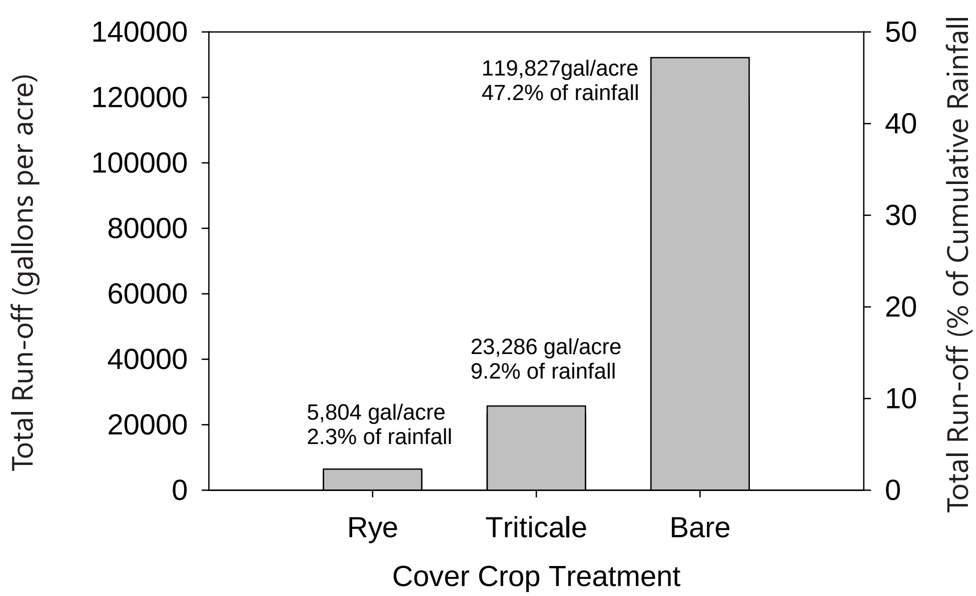

Figure 2. Total runoff from cover crop and bare treatments between mid January and March 7, 2010.

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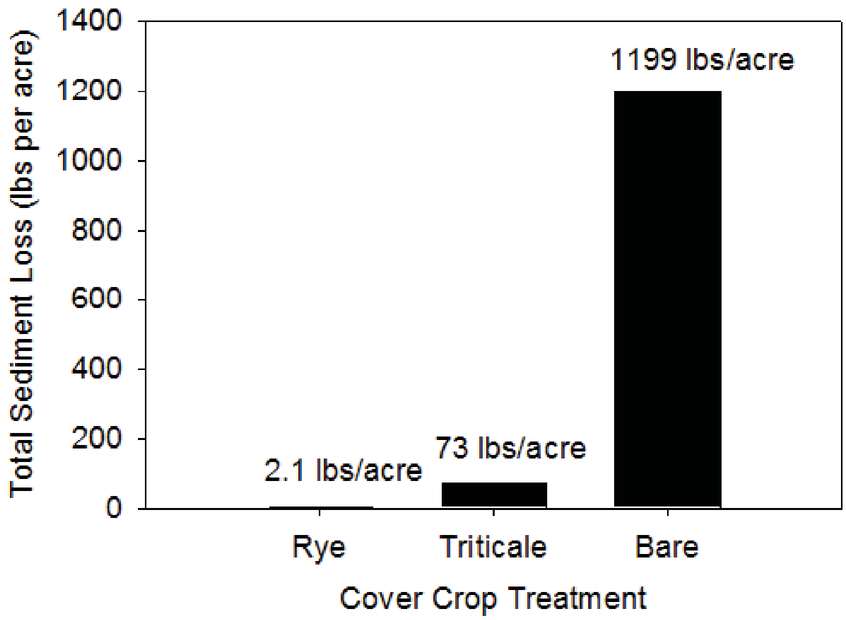

Figure 3. Total sediment loss in run-off from cover crop and bare treatments between mid January and March 7, 2010.

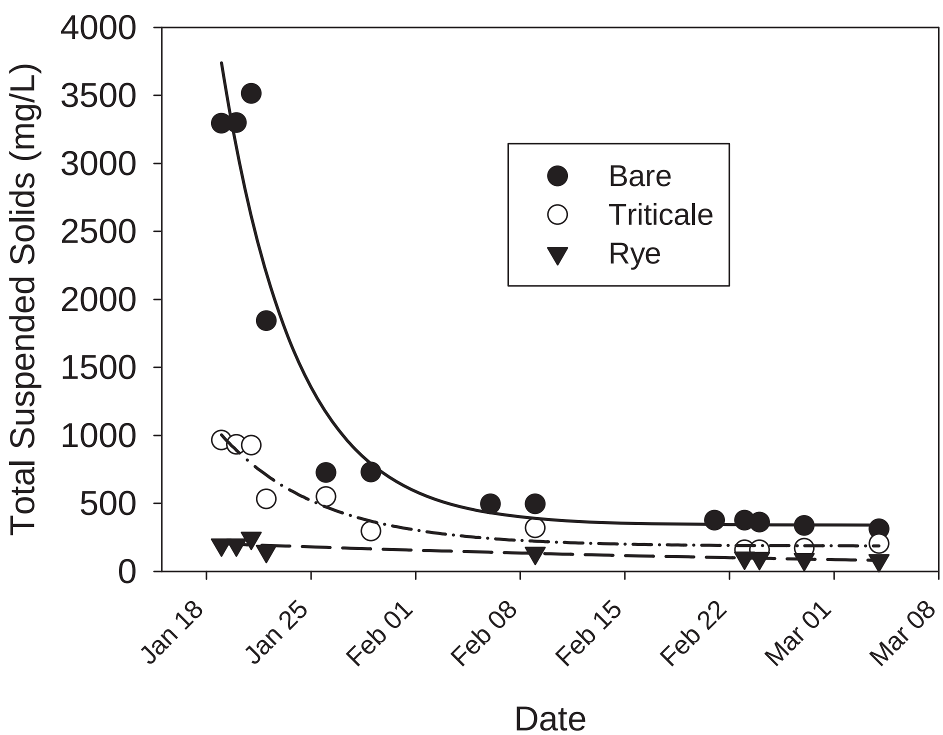

Figure 4. Concentration of suspended solids in run-off from cover crop treatments between mid January and March 7, 2010.

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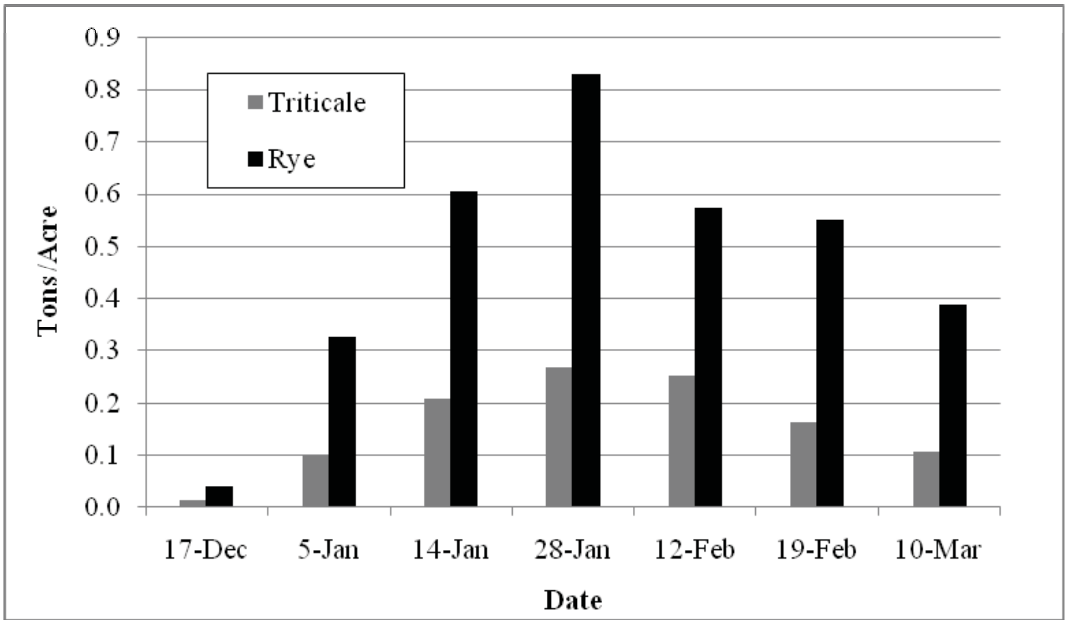

Figure 5. Cover crop biomass 2009 to 2010 (glyphosate applied January 15, 2010)

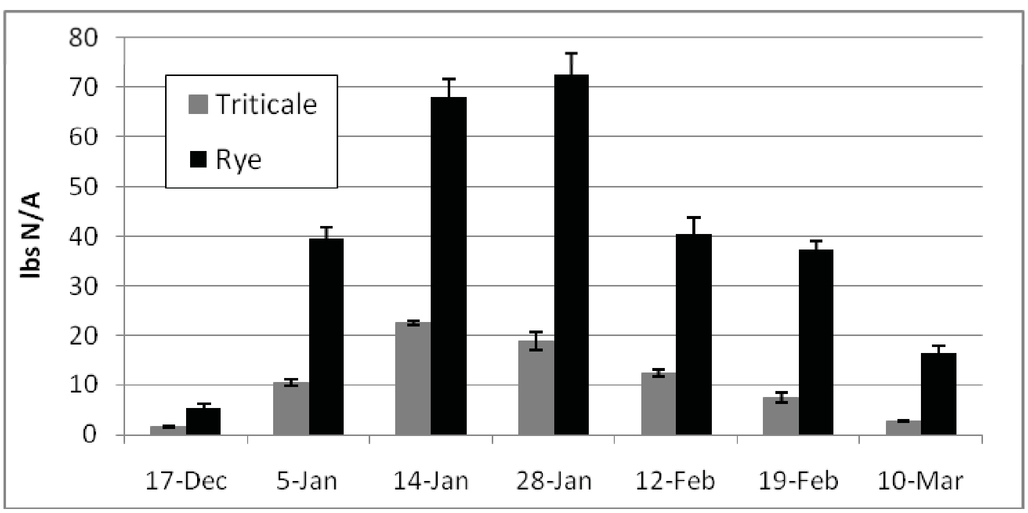

Figure 6. Nitrogen in cover crop biomass

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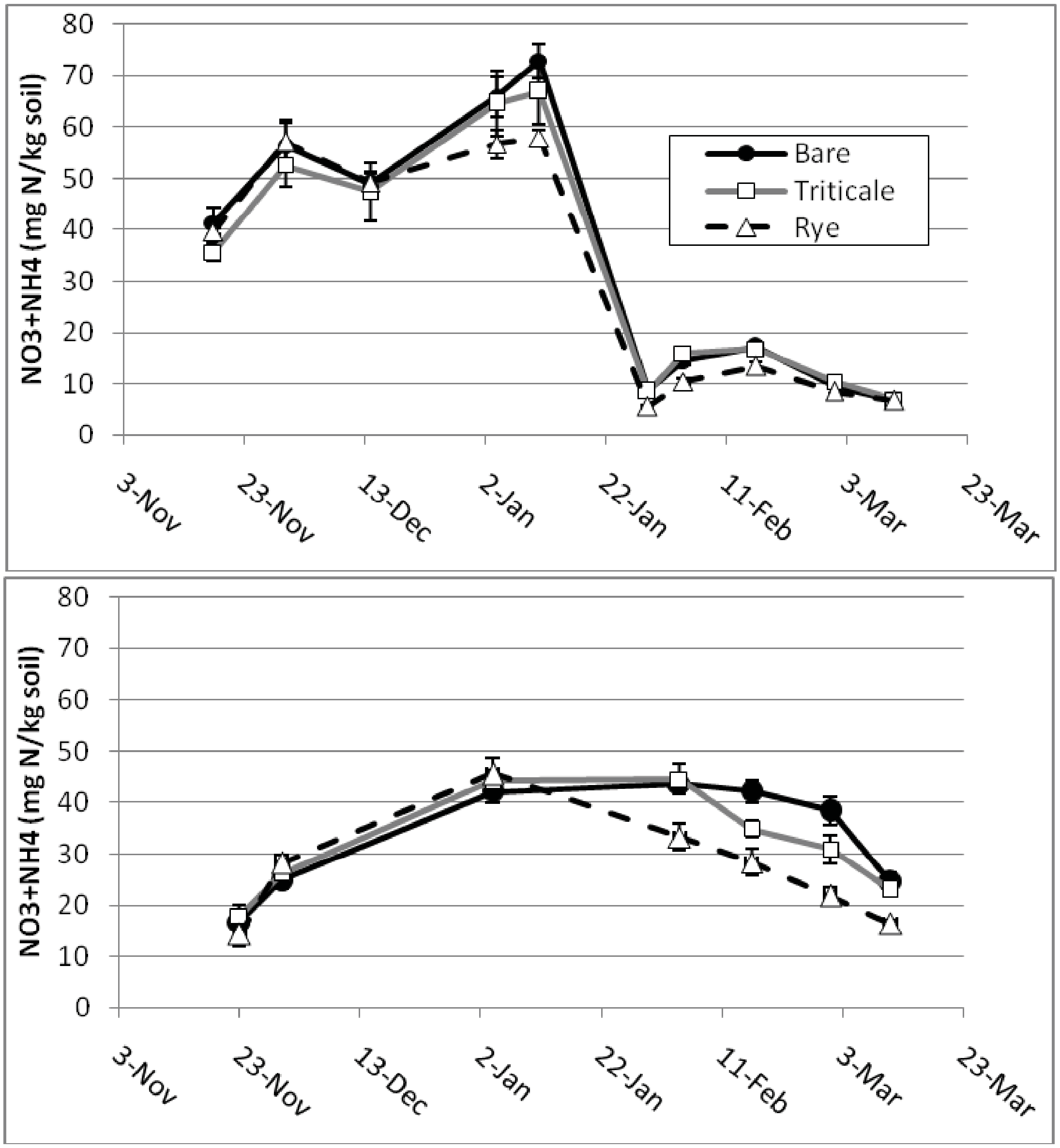

Figure 7. Soil nitrate and ammonium concentrations. Upper graph: 0-1 ft and lower graph: 1-2 ft. Large decline in soil nitrate coincided with heavy rain in mid- January. Error bars represent the SE n=6.

Table 1. Seasonal nutrient loss in run-off of cover crop treatments.

Treatment	Total N	Ammonium-N	Nitrate-N	Soluble-P	Total P	K
	------------	------------	lbs/acre	------------	------------	------------
Rye	0.21	0.05	0.04	0.17	0.20	0.80
Triticale	0.60	0.05	0.03	0.24	0.47	1.30
Control	4.78	0.12	0.49	1.06	3.71	4.12
	------------	% reduction in loss compared to control				------------
Rye	96	59	92	84	95	81
Triticale	87	58	93	78	87	69

LOAD VS. CONCENTRATION: IMPLICATIONS FOR REACHING WATER QUALITY GOALS

Michael Cahn and Tim Hartz

Among the controversies regarding water quality regulation in the Central Coast region are the issues of how to measure agriculture's contribution to water quality problems, and how to document the success of best management practices (BMPs) in improving water quality. Water quality can be measured in two ways - by pollutant concentration, or pollutant load. Concentration is the mass of a pollutant in a defined volume of water (for example, milligrams of nitrate-nitrogen per liter, or PPM). Load is the amount (mass) of a pollutant that is discharged into a water body during a period of time (i.e. tons of sediment per year). Both concentration and load provide information of environmental significance, but each has limitations.

Concentration is a useful parameter to assess water quality because it has biological significance to organisms of concern. A high concentration of nitrogen and phosphorus in surface water spurs the growth of phytoplankton, which lowers dissolved oxygen levels, resulting in harm to fish and other aquatic organisms which need oxygen to survive. In drinking water, nitrate-nitrogen levels above 10 PPM are harmful to the health of humans, especially infants. Water quality regulation on the basis of concentration has long been used for point sources of pollution such as factories and power plants. Since such point sources generally have defined wastewater release points, and utilize industrial processes that result in reasonably constant pollutant concentration in wastewater, monitoring concentration makes good sense. Additionally, since it is relatively simple to measure wastewater volume in discharge pipes, pollutant load can easily be calculated if the concentration is known.

Unlike industries that can reengineer processes to meet water quality concentration goals, agriculture has biological limitations that cannot be manipulated to meet water concentration targets.

Pollutant loading is also a useful measure of water quality; when evaluating an entire watershed or groundwater basin, one can calculate the load a given pollutant that can be accommodated from various sources (agriculture, industry, water treatment plants, etc.) without the watershed or basin exceeding the water quality standard. This allocation of permissible pollutant load by source is the foundation of the Federal Total Maximum Daily Load (TMDL) process used nationwide to regulate water quality issues arising from non-point sources like agriculture.

Unfortunately, in an agricultural context there are serious limitations to both approaches to water quality assessment. The first issue with using concentration is the continuity between agricultural land and the surrounding watershed. Unlike industrial sites that can confine processing facilities, few boundaries separate agricultural fields from the surrounding watershed. Fields may receive precipitation during storm events and run-off from adjacent land. Water applied by both irrigation and rainfall can freely percolate to ground water supplies, and surface run-off can exit into neighboring land at multiple locations. The lack of boundaries between cropped fields and the surrounding land means that growers have limited means to control discharge from their operations and accurately monitoring discharge from a ranch or farm can be difficult and expensive.

Also, unlike industries that can reengineer processes to meet water quality concentration goals, agriculture has biological limitations that cannot be manipulated to meet water concentration targets. For example, a goal of discharging agricultural water with a concentration of less than 10 PPM nitrate–N, is currently not feasible in the production of leafy green vegetable crops. Nitrogen is the main nutrient that plants use to manufacture proteins, and must be supplied at a rate to match the demand of the crop. A typical lettuce crop accumulates between 100 and 150 lbs of nitrogen per acre in 60 to 70 day period. Crops mainly take up the nitrate form of nitrogen from

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soil, and the majority of nitrate uptake occurs by the movement of nitrate to the root surface in the transpirational flow. Since lettuce typically transpires approximately 8 inches of water under coastal conditions, the average nitrate-N concentration of that water would have to average as much as 50-60 PPM to supply sufficient N for growth. In irrigated fields it is inevitable that some leaching will occur, and the nitrate concentration in that leachate will typically be similar to what is in the root zone soil water. Consequently, in leafy green fields, leachate discharged to ground water or to surface water by tile drains during the growing season will inevitably average more than 10 PPM nitrate-N.

A further problem in using concentration targets to regulate individual agricultural producers is that the concentration of nutrients, pesticide, or sediment in discharge may vary significantly during a day, week, or month, depending on the constituent of interest, which fields are being irrigated, and which mix of crops are being raised. The concentration of a soluble nutrient in farm run-off could be far above a concentration goal in the morning, but later in the day, the concentration of the same nutrient could be much lower, and meet water quality targets because the grower is irrigating a different set of fields, or using a different well. Unless many repeated measurements of concentration are taken, assessing the water quality impacts of a particular ranch may be difficult, expensive and imprecise. Additionally, the volume of water discharged from an individual farm may vary greatly during a week or even a day, depending on factors such as how many fields are being irrigated, crop stage, composition of crop types, irrigation method, and time of year. This variation in discharge volume limits how effectively concentration data can be extrapolated to assess if an individual farmer is making progress in meeting water quality targets. A ranch having a low volume of discharge with a high concentration of a nutrient, may have less impact on a receiving water body than a ranch having a high discharge volume but a lower concentration of the same nutrient.

The volume of water discharged from an individual farm may vary greatly during a week or even a day, depending on factors such as how many fields are being irrigated, crop stage, composition of crop types, irrigation method, and time of year.

Assessing the load of a nutrient or a pesticide discharged during a defined period of time may be a more accurate assessment of an individual producer's contribution to water quality impairments than measuring the concentration of these pollutants. However, measuring load can be problematic because the volume of run-off or percolation must be accurately estimated. For pollutants such as pesticides, the risk to water quality may depend greatly on the amount of run-off leaving the ranch or farm, and a combination of compiling data on field applications and assessing run-off volume may be the most accurate way to estimate water quality impacts. For nitrate, assessing the amount nitrogen fertilizer applied to fields in excess of typical crop N uptake may provide a reasonable estimate of potential environmental loading, since the majority of applied N not taken up by the crop will eventually be lost to the environment.

In summary,

- Concentration is a measure of the amount of a pollutant in a defined volume of water, and load is the amount of a constituent discharged during a defined period of time.
- Concentration data may not accurately assess impacts of individual producers on water quality impairments due to a lack of boundaries between production fields and the surrounding watershed, biological limitations of agricultural production, and variability in volume of run-off and concentration of constituents discharged from agricultural lands.
- Assessing pollutant load would be a more accurate approach to evaluating the contribution of individual producers to regional water quality impairments, but actual measurement of loading can be complicated and expensive. Using an indirect measure of loading such as the rate of inputs applied to production fields, could provide a reasonable estimate of a growers' potential contribution to water quality impairment.

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New requirement from California DPR:
Bring your license or certificate card to the meeting for verification when signing in.

University of California Cooperative Extension—Monterey County

2010 Plant Disease Seminar

Tuesday, November 16, 2010
8:00 a.m. to 12:00 p.m.
County of Monterey Agricultural Center— Conference Room
1432 Abbott Street, Salinas, California

8:00 – 8:30	**Registration for morning session (no charge).**
8:30 – 9:00	2010 plant disease developments in coastal California Steven Koike. UC Cooperative Extension
9:00 – 9:30	Grapevine pathology: vine decline, fungicide research Larry Bettiga. UC Cooperative Extension
9:30 – 10:00	Viruses of strawberry and caneberry: symptoms, causes, biology Bill Wintermantel. USDA-ARS Salinas
10:00 – 10:30	Break: Sponsored by CAPCA, Monterey Bay Chapter
10:30 – 11:00	Strawberry plant collapse concerns in the central coast Steven Koike. UC Cooperative Extension
11:00 – 11:30	Biological control of *Sclerotinia minor* on lettuce Krishna Subbarao. UC Davis
11:30 – 12:00	Disease and insect research on strawberry Mark Bolda. UC Cooperative Extension

Continuing education credits are requested. Call ahead (at least 24 hrs.) for special needs arrangements; efforts will be made to accommodate full participation. For more information, contact Steven Koike (831-759-7350; 1432 Abbott Street, Salinas, CA 93901) or visit our website at http://cemonterey.ucdavis.edu.

An afternoon session, held in this same conference room, will be hosted by CAPCA, Monterey Bay Chapter.

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University of California Cooperative Extension, Monterey County

Salinas Valley Weed School 2010

Tuesday, November 9
8:00 a.m. to 12:00 noon
Agricultural Center Conference Room
(1432 Abbott Street, Salinas)

8:00 Registration (no fee required) and Refreshments. Herbicide Symptom Exhibit

8:30 Weed control strategy in peppers and implication for other crops
Richard Smith, Vegetable Crop and Weed Science Farm Advisor, Monterey County

9:00 Lettuce weed control – outside the box ideas
Steve Fennimore, Extension Vegetable Weed Specialist, U.C., Davis, Salinas

9:30 Herbicide and pharmaceutical relationships
Steve Fennimore, Extension Vegetable Weed Specialist, U.C., Davis, Salinas

10:00 Break and Herbicide Symptom Exhibit

10:30 Alternatives for roadside weed control in Santa Cruz County
Steve Tjosvold, Environmental Horticulture Farm Advisor, Santa Cruz County

11:00 Managing aquatic weeds in irrigation reservoirs and small ponds
John Roncoroni, Weed Science Farm Advisor, Napa County

11:30 Effects of soil, environment, and chemistry on herbicide persistence
Brad Hanson, Extension Weed Specialist, U.C., Davis

12:00 Conclusion

3.5 Continuing education credits applied for. Please call ahead for special accommodations. For more information call Richard Smith (831) 759-7357.

Afternoon session sponsored by the Monterey Bay Chapter of CAPCA