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IMPACT OF A MANAGEMENT STRATEGY ON SUSCEPTIBILITY OF WESTERN FLOWER THRIPS IN A SUSCEPTIBLE SITE TO RADIANT INSECTICIDE ON STRAWBERRIES

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Western flower thrips, *Frankliniella occidentalis*, are important insect pests of strawberries in California. They use their mouth parts to pierce plant cells and suck out their contents, resulting in decreased yield and quality. Control of this pest has been heavily dependent upon chemical insecticides. Spinosad has been the most effective insecticide class in management of the thrips on strawberries. In 2009, we surveyed their susceptibility from 6 distinct sites to Radiant insecticide in early season of strawberry production. Based on the results of these surveys, a susceptible site (the Holly Ranch, Watsonville) and a tolerant site (the Beach Road Ranch, Watsonville) were selected for further studies. Here we report the impact of a management strategy on susceptibility of the thrips from the susceptible site.

Materials and Methods

Strawberries at this susceptible site were treated with Success rotated with Dibrom. About half an acre of first year strawberries at the Holly Ranch was treated. A large area of wild hosts including trees and weeds were nearby the treatment field. Success was applied at the top label rate to the strawberries on May 29, June 8, August 8 and 15, respectively, while Dibrom at its top label rate was applied on June 16 and 29. Western flower thrips with strawberry flowers were collected on July 23, September 4 and October 21. Collected samples were immediately shipped to the lab for bioassay experiments.

Strawberry seedlings were planted in pots filled with soil mixture in a greenhouse/shadehouse as a source for leaflets on which to conduct the bioassays. Plants used in the experiments were at the three to six trifoliate stages when leaflets were removed for the bioassays, and were never treated. Radiant (spinetoram) was diluted in distilled water and at least 6 concentrations were used to produce a range of 5-90% mortality. The most-recently fully-expanded strawberry leaflets were dipped for 10 s into a solution containing specific amount of Radiant. Control leaflets were dipped into distilled water only. After the leaf surface was dried, 25-35 adult thrips were transferred from the field collected flowers with an aspirator to the upper surface of a treated leaflet encased in a Munger cell apparatus with a layer of wet paper facing the lower surface of the leaflet (Figure 1). After the initial exposure, adult mortality was determined at 24, 48 and 72 h, respectively. Thrips that were unable to walk at least a distance equivalent to their body length were considered dead.

The resulting data were corrected for control mortality and analyzed by the probit analysis. LC_{50} and LC_{90} for spinetoram were determined for each 24 h interval (24, 48 and 72 h) after the treatment. Differences in LC_{50s} and LC_{90s} were considered not significant if their respective 95% confidence limits overlapped.

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Results

After applications of Success on May 29 and June 8 and applications of Dibrom on June 16 and 29, LC_{50} and LC_{90} values of spinetoram to adult thrips (sampled on July 23) at 24, 48 and 72 h after the initial exposure were shown in Table 1. Two more Success treatments were applied on August 8 and 15. Compared to their respective LC_{50} and LC_{90} at 24, 48 and 72 h after the initial exposure from the July 23 sampling date, the LC_{50} and LC_{90} from the September 4 sampling date (twenty days after the final application) statistically remained the same (Table 1). The LC_{50} values for 24, 48 and 72 h post treatment from the October 21 sampling date (ten weeks after the final treatment) were 7.6, 17.0 and 141.9 times lower, respectively, while the LC_{90} values for the three post treatment intervals were still the same (Table 1).

Since the Holly ranch was treated with spinosad (Success) instead of spinetoram (Radiant), we tested susceptibility of adult western flower thrips to spinetoram compared to spinosad using the discriminating LC_{50} (26 µg ai/ml) and LC_{90} (115.2 µg ai/ml) concentrations of spinetoram (Table 2). At the LC_{50} concentration, spinetoram caused 20% greater mortality of the thrips at 24 h, 24% greater at 48 h, and 8% more at 72 h, whereas at the LC_{90} concentration, spinetoram killed 9-16% more of the thrips from 24 to 72 h after the exposure.

Conclusion

At the susceptible site of western flower thrips, two applications of spinosad did not affect the susceptibility. Ten weeks after 4 sequential applications of spinosad, the susceptibility increased dramatically. There was a large area of wild hosts existed nearby the treatment field and these wild hosts had never been treated for western flower thrips. Our results were likely attributed to the lack of treatments in the wild hosts.

Western flower thrips, *Frankliniella occidentalis*, are important insect pests of strawberries in California.

At the susceptible site of western flower thrips, two applications of spinosad did not affect the susceptibility.

Figure 1. Munger cell apparatus were used to determine the susceptibility of western flower thrips to Radiant insecticide.

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Table 1. Susceptibility of the western flower thrips population at the Holly Ranch to Radiant.

Sampling date	n	Exposure duration (h)	Slope ± SE	LC$_{50}$, µg ai/ml (95% CI)	LC$_{90}$, µg ai/ml (95% CI)
Jul. 23	899	24	0.81 ± 0.07	63.15 (47.86—81.85)	2417.16 (1405.26—5073.99)
		48	0.83 ± 0.07	23.01 (14.86—32.48)	815.18 (485.63—1710.21)
		72	0.91 ± 0.09	9.55 (5.72—13.98)	249.28 (172.61—406.88)
Sept. 4	2625	24	0.69 ± 0.03	48.23 (38.81—59.35)	3413.96 (2425.89—5060.25)
		48	0.81 ± 0.04	25.98 (20.53—32.21)	988.93 (761.75—1329.79)
		72	0.71 ± 0.03	7.57 (5.62—9.88)	492.48 (372.65—675.27)
Oct. 21	1321	24	0.53 ± 0.03	8.32 (4.55—14.39)	2164.59 (987.37—5926.91)
		48	0.47 ± 0.03	1.35 (0.66—2.47)	683.47 (328.47—1712.33)
		72	0.50 ± 0.03	0.34 (0.16—0.63)	126.14 (66.40—274.900)

Table 2. Susceptibility of western flower thrips to spinetoram in comparison with spinosad at the Holly Ranch.

	Concentration (µg ai/ml)	N	Mortality (%) 24 h	Mortality (%) 48 h	Mortality (%) 72 h
Radiant	26	222	51.80	63.51	76.58
Success	26	209	43.06	51.20	70.81
Radiant	115.2	218	59.63	74.31	84.86
Success	115.2	228	51.32	67.54	77.63
Control	0	227	3.96	7.05	13.66

Thrips were collected on September 24 from the Holly Ranch. Concentrations were based on the LC$_{50}$ and LC$_{90}$ of spinetoram.

VECTORS OF VIRUSES: A REVIEW

Steven Koike

Plant Pathology Farm Advisor

This article is a brief review of the vectors that transmit viruses to crops grown in our central coast region. As is evident from several on-going disease issues (*Apium virus Y* in celery, *Impatiens necrotic spot virus* of lettuce, *Tomato spotted wilt virus* of lettuce/pepper/tomato), viruses can be important and damaging pathogens. The biology and epidemiology of plant virus pathogens is a complicated one in that usually such systems involve the susceptible host plant, a virulent or infectious virus agent, and a vector organism that carries and transmits the virus. A "vector" can be defined as an organism that can acquire and subsequently transmit a pathogen (mostly viruses but also fungi and bacteria) to plants.

> In general, viruses do not exist and survive in nature without another organism. The plant host is the primary refuge of viruses.

In general, viruses do not exist and survive in nature without another organism. The plant host is the primary refuge of viruses. Once inside a host plant, viruses usually cannot spread to other plants without the help of external factors (exceptions are those viruses that are capable of being transmitted by pollen, carried by seed, or transmitted when roots of an infected plant touch and graft with roots from a healthy plant). One such external factor is commercial plant propagation practices. When plants are propagated commercially via cuttings or crown divisions (such as artichokes), viruses present in the mother stock will also be present in the propagated material.

The other major external factor that spreads viruses is a vector. Vectors feed on the infected plant, become contaminated or infested with the virus, then move to healthy plants and in-

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fect them by feeding. Arthropods (insects and mites) are the most common plant virus vectors, though nematodes and primitive soil microorganisms can also transmit these pathogens (Table 1).

Hemiptera insects: The Hemiptera order of insects contains the most important virus vectors and includes aphids, leafhoppers, whiteflies, and mealybugs. Taxonomically, these insects were formerly placed in the order Homoptera but now are reassigned to suborders within Hemiptera. Of these vectors, aphids transmit the greatest number of viruses affecting plants; for vegetables grown in coastal California, leafhoppers are the only other Hemipteran that vectors viruses, spreading *Beet curly top virus* (Table 1). Note that leafhoppers also vector bacterial pathogens such as the aster yellows and Pierce's disease bacteria.

The major means of virus spread is through the activity of vectors.

Thrips: In addition to being important plant pests in their own right, thrips insects also are vectors of viruses. Worldwide there may be a dozen or so viruses (called Tosporviruses) that are vectored by only a few species of thrips. In our region, *Impatiens necrotic spot virus* and *Tomato spotted wilt virus* are damaging pathogens that affect many of vegetable and ornamental crops (Table 1). While not yet documented in coastal California, the Tospovirus *Iris yellow spot virus* is a concern for onion and related crops.

Nematodes: Soilborne nematodes in the Longidoridae family (genera are *Trichodorus, Paratrichodorus, Longidorus, Paralongidorus,* and *Xiphinema*) transmit viruses. It is notable that such viruses have evolved this complex relationship solely with the nematode carriers and are not vectored by aphids or other organisms. In California, for example, *Trichodorus* and P*aratrichodorus* nematodes vector Tobacco rattle virus to spinach. For grapes, *Xiphinema americanum* vectors *Tomato ringspot virus* and *X. index* vectors *Grapevine fanleaf virus*.

Soil microbes: Soil microorganisms such as *Olpidium* and *Polymyxa* are free-living soil inhabitants that can also infect and colonize the roots of plants. Some isolates of these organisms carry and vector plant viruses. *Olpidium brassicae* is a primitive fungus (called a chytrid) that vectors *Mirafiori lettuce virus*, causal pathogen of lettuce big vein disease. *Polymyxa betae* is a primitive organism (called a plasmodiophorid protist) that is closely related to the pathogen that causes clubroot disease of crucifers; *P. betae* vectors *Beet necrotic yellow vein virus* to spinach and sugar beets.

Insects, nematodes, and even soil microbes vector viruses to central coast crops.

Management of virus diseases relies on typical integrated pest management strategies that include the following: plant resistant cultivars if available; plant seed or other propagative materials that are virus free; remove and control reservoir hosts such as overwintering weeds and crop volunteer plants; plow down and destroy old, harvested crops; avoid planting susceptible crops in areas that have a history of persistent virus problems; practice crop rotation so that the same crop is not continually present; manage the virus vector.

Controlling insect vectors by using insecticides and other measures is an important consideration in managing virus diseases. However, researchers have clearly shown that while vector control is an appropriate step, managing the insects will not necessarily prevent infection. Insects need only a few minutes to feed on plants and transmit the virus; therefore, spray applications and other steps do not operate rapidly enough to prevent this transmission. Direct management of soilborne nematode and microbe vectors is likewise of limited effectiveness. Soil-applied fumigants can reduce but not completely eliminate soil populations of these vector organisms.

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Table 1. Some coastal California crops, virus pathogens, and vectors

Crop	Virus pathogen	Vector
Artichoke	Artichoke curly dwarf virus	unknown
Basil	Impatiens necrotic spot virus	thrips
	Tomato spotted wilt virus	thrips
Beet	Beet curly top virus	leafhopper
Carrot	Carrot motley dwarf virus complex	aphid
Celery	Apium virus Y	aphid
	Celery mosaic virus	aphid
	Cucumber mosaic virus	aphid
	Tomato spotted wilt virus	thrips
Cilantro	Apium virus Y	aphid
	Carrot motley dwarf virus complex	aphid
	(Cilantro yellow blotch virus)*	(aphid)
	*pathogen not fully characterized	
Broccoli, bok choy, cauliflower	Cauliflower mosaic virus	aphid
cauliflower	Turnip mosaic virus	aphid
Escarole/Endive	Beet western yellows virus	aphid
	Tomato spotted wilt virus	thrips
Fava bean	Impatiens necrotic spot virus	thrips
Lettuce	Beet western yellows virus	aphid
	Lettuce mosaic virus	aphid
	Impatiens necrotic spot virus	thrips
	Lettuce necrotic stunt virus	no vector; soilborne
	Mirafiori lettuce virus	chytrid fungus
	Tomato bushy stunt virus	no vector; soilborne
	Tomato spotted wilt virus	thrips
	Turnip mosaic virus	aphid
Parsley	Apium virus Y	aphid
Pepper	Beet curly top virus	leafhopper
	Cucumber mosaic virus	aphid

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Table 1. Some coastal California crops, virus pathogens, and vectors		
	Pepper mottle virus	aphid
	Potato virus Y	aphid
	Tobacco etch virus	aphid
	Tomato spotted wilt virus	thrips
Radicchio	Impatiens necrotic spot virus	thrips
	Tomato spotted wilt virus	thrips
Raspberry	Raspberry busy dwarf virus	no vector (pollen spread)
Spinach	Beet necrotic yellow vein virus	soil protist
	Beet western yellows virus	aphid
	Cucumber mosaic virus	aphid
	Impatiens necrotic spot virus	thrips
	Tobacco rattle virus	nematode
	Tomato spotted wilt virus	thrips
Swiss chard	Beet curly top virus	leafhopper
Tomatillo	Turnip mosaic virus	aphid
Tomato	Beet curly top virus	leafhopper
	Tomato spotted wilt virus	thrips

Insect vector: aphids (photo by Jack Kelly Clark).

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Insect vector: leafhopper (photo by Jack Kelly Clark).

Insect vector: thrips (photo by Jack Kelly Clark).

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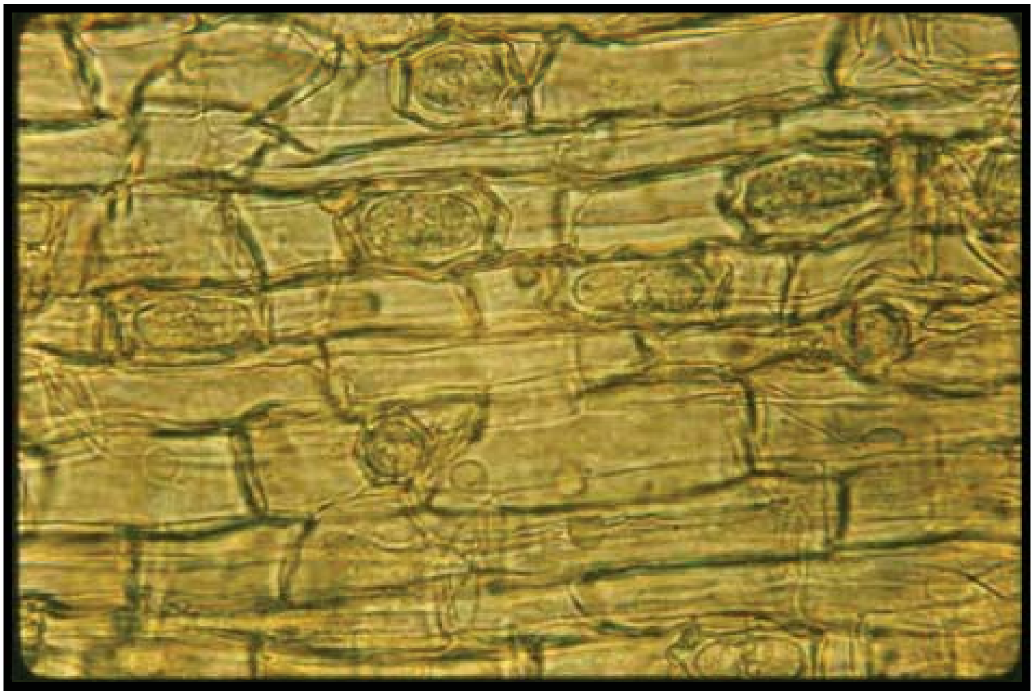
Soil microbe vector: *Polymyxa betae* (photo by John Sears).



Soil microbe vector: *Olpidium brassicae* (photo by R. Campbell).

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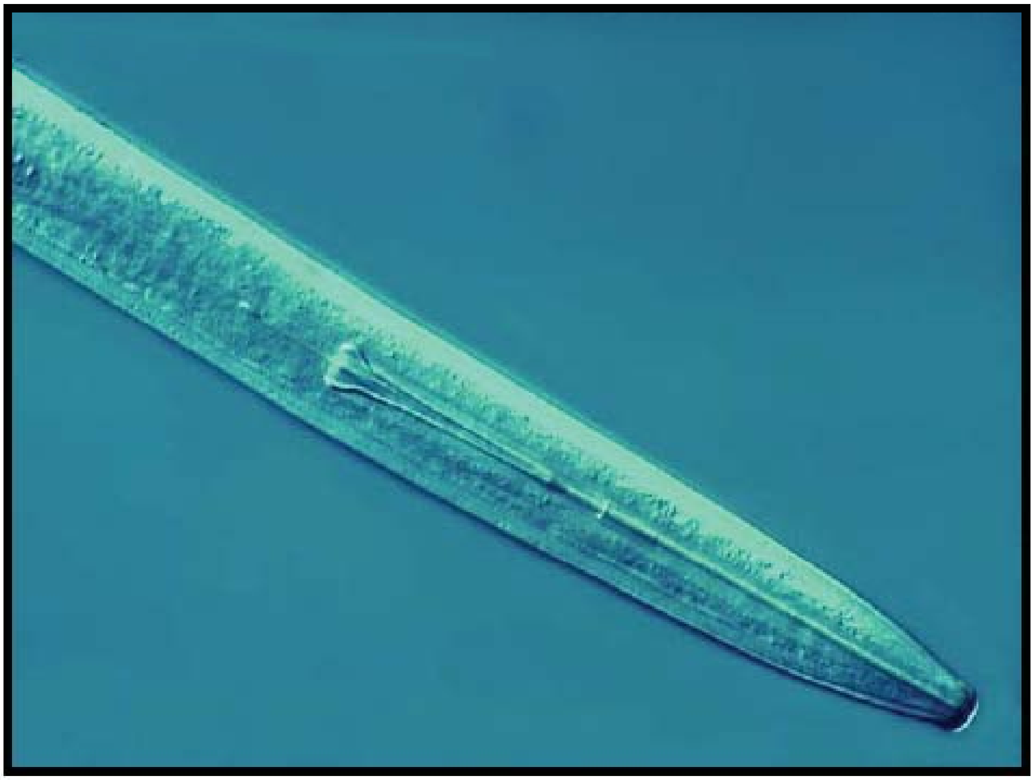

Nematode vector: *Xiphinema* (photo from Eisenback and Zunke).

Nematode vector: *Paratrichodorus* (photo from Eisenback and Zunke).

Steve Koike thanks John Chitambar and Bryce Falk for assistance with this article.

RESULTS OF TRIAL TESTING THE EFFICACY OF SEVERAL ORGANICALLY REGISTERED PESTICIDES FOR CONTROL OF SPOTTED WING DROSOPHILA (SWD) IN RASPBERRY

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Organic raspberries and blackberries continue to find management of spotted wing drosophila quite difficult since the number of effective insecticides tools is quite low. The trial described in this article is a description of an attempt to maximize efficacy of pyrethrin (Pyganic) and neem oil based (Aza-Direct) insecticides by closely spaced multiple applications, as well as a re-test of the organically registered spinosyn Entrust.

The following is a brief summary this trial in a local organically managed raspberry field:

Treatments were Pyganic 5.0 applied at 9 fl oz and 18 fl oz per acre, Pyganic 5.0 applied at 18 fl oz per acre + Aza-Direct applied at 2 pt per acre and Entrust applied at 2 oz per acre. Each treatment was replicated 3 times.

Two applications of all Pyganic materials and mixes were made; one on 6/29 and the other on 7/2. As per recommendations from the distributor, carrier pH's were modified to below 6.5 with Mix-Well.

Entrust was applied once on 7/2. As per label recommendations, pH was not modified and checked out at 7.0.

Applications made with 75 gal water per acre.

Vacuum evaluations using the bug vacuum pictured with this article took place before the first application and last vacuum evaluation was on July 6. Evaluation of fruit, consisting of harvest and subsequent evaluation for SWD larval infestation of 25 marketable ripe raspberries was made before application and then again on July 7.

Results were encouraging. Level of fruit infestation as evaluated on July 7 was significantly lower than the untreated control in the 18 oz per acre Pyganic treatments (both alone and mixed with Aza-Direct) and the single application of Entrust. This trend corresponded as well with the numbers of flies caught by vacuum up to that date.

It appears that a single application of Entrust or two applications of a high rate of Pyganic can offer organic growers up to five days of SWD control.

There are pesticides mentioned for management of spotted wing drosophila in this article. Before using any of these products, check with your local Agricultural Commissioner's Office and consult product labels for current status of product registration, restrictions, and use information.

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SUSCEPTIBILITY OF THE TWO-SPOTTED SPIDER MITE TO SELECTED ACARICIDES

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The two-spotted spider mite *Tetranychus urticae* (Koch) is an important pest of strawberries.

The two-spotted spider mite *Tetranychus urticae* (Koch) is an important pest of strawberries. Feeding by mites reduces plant vigor, resulting in decreased fruit size and yield or plant death. Acaricides have been frequently applied for the mite control, leading to acariticide resistance. Failures in chemical control of spider mites caused by the resistance have been reported for various compounds, such as organophosphates, dicofol, organotins, hexythiazox, clofentezine and abamectin. The rapid development of resistance in these mites is favored by their high reproductive potential, extremely short life cycle and arrhenotokous mating system. Resistance monitoring can be an effective component of a resistance management program and detection of changes in resistance/susceptibility can facilitate use of alternate control measures. Here we report susceptibility of the two-spotted spider mite to some acaricides.

Material and Methods

Adult two-spotted spider mites were collected from commercial strawberry fields in Oxnard area (Ventura County, CA) in September 2006 and maintained in colonies on strawberry plants in growth chambers. The following acaricides were obtained from their respective manufacturers: Agri-mek 0.15EC (Syngenta Inc., Greensboro, NC), Oberon 2S (Bayer Crop Protection, Kansas City, MO), Zeal Miticide (Valent U.S.A. Corporation, Walnut Creek, CA), Savey 50DF (Gowan Company, Yuma, AZ), and Acramite 50WS (Crompton Manufacturing Company, Inc. Middlebury, CT). Each of these acaricides was diluted in deionized water and at least 6 concentrations were used to produce a range of 5-90% mortality. Nonionic wetter/spreader (Kinetic-1, Bayer Crop Protection, Kansas City, MO) was added to each solution of acaricides at a concentration of 0.1% (v/v). Top label rates of acaricides mentioned in this study are the manufacturer-recommended highest application rates (in 200 gallons per acre) to control the mites on strawberries in California. Strawberry leaflets were dipped for 8 s into a solution containing specific amount of the selected acaricides and Kinetic-1. Control leaflets were dipped into kinetic water solution only. Four to eight replicates were used for each treatment rate and the control. After the leaf surface was dried, 30 spider mite adults were transferred from a colony with a fine brush to the abaxial surface of a treated leaflet in a Munger cell apparatus with a layer of wet paper facing the upper surface of the leaflet. Adult mortality was determined at 72 h after the initial exposure. Mites that were unable to walk at least a distance equivalent to their body length were considered dead. For the mite egg bioassay, 20 female adults were transferred to the abaxial surface of a leaflet hold in a Munger cell. After an oviposition period of 24 h, the adults were removed. The infested leaflets were dipped for 8 s into the above described acaricide solutions. After the leaf surface was dried, the leaflets were returned into the Munger cell apparatus. Egg mortality was determined at 7 days after the initial treatment. For the immature bioassay, the eggs were allowed to hatch. When the immatures reached the deutonymphal stage, they were transferred to the abaxial surface of the treated leaflets in Munger cells. The immature mortality was determined at 6 days post-treatment when the nymphs failed to develop into adults. Bioassay Munger cells were hold at 23 C and the papers were moistened when needed. The mite mortality data were corrected for control mortality and analyzed with probit analysis. LC_{50} and LC_{90} for each acaricide were determined.

Results

Adult two-spotted spider mites were very susceptible to Agri-Mek (Table 1). LD_{50s} of Agri-mek for adult two-spotted spider mites was 0.46 µg ai/ml, while the LD_{90s} was 2.66 µg ai/ml (Table 1). The LD90 for adult two-spotted spider mites was over 4-fold lower compared to the top label rate (16 oz product/acre or 11.25 µg ai/ml). Susceptibility of two-spotted

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spider mite eggs and nymphs to the selected acaricides is shown in Tables 2 and 3. LC_{90} of Oberon for the eggs was 6.9 µg ai/ml, which is over 21-fold lower than the top label rate. The LC_{90} of Zeal was 9.0 µg ai/ml and was 9-fold lower than its top label rate. The LC_{90} of Savey was 363.4 µg ai/ml, an over 3-fold higher than the top label rate. The LC_{90} of Acromite was 1.6-fold lower than the top label rate (Table 2). LC_{50s} of Oberon, Zeal and Acramite for the two-spotted spider mite nymphs were 93.7-, 25.3- and 27.0-fold lower while the LC_{90s} were 34.1-, 7.4- and 6.6-fold lower than their respective top label rates. However, LC_{50} and LC_{90} of Savey to the nymphs were 141.0- and 4322.1-fold higher than the top label rate (Table 3).

Conclusion

Agri-mek, Oberon, Zeal, Savey and Acramite are commonly-used acaricides on strawberries in California. This research indicated that Agri-mek was very effective in controlling adults of the two-spotted spider mite. Obron, Zeal and Acramite were effective in controlling eggs and immatures of the two-spotted spider mite. Savey failed to control eggs and immatures of the two-spotted spider mite.

Agri-mek, Oberon, Zeal, Savey and Acramite are commonly-used acaricides on strawberries in California.

Table 1 Susceptibility of adult two-spotted spider mites to Agri-mek on strawberries

n	X^2	Slope ± SE	LC_{50}, µg ai/ml (95% CI)	LC_{90}, µg ai/ml (95% CI)	Top Label Rate (µg ai/ml)
927	45.02	1.68 ± 0.13	0.46 (0.39 – 0.54)	2.66 (1.97 – 3.99)	11.25

Table 2 Susceptibility of the two-spotted spider mite (Tetranychus urticae) eggs to selected acaricides on strawberries

Acaricide	n	X^2	Slope ± SE	LC_{50}, µg ai/ml (95% CI)	LC_{90}, µg ai/ml (95% CI)	Top Label Rate (µg ai/ml)
Oberon	2405	36.8	3.7 ± 0.24	3.1 (2.8 – 3.4)	6.9 (5.9 – 8.5)	150.0
Zeal	3755	159.9	2.6 ± 0.11	2.9 (2.2 – 3.7)	9.0 (6.8 – 14.1)	81.0
Savey	3287	169.1	2.07 ± 0.11	87.04 (67.75 – 107.91)	363.43 (262.38 – 614.69)	117.3
Acramite	3966	475.7	2.6 ± 0.11	59.0 (34.3 – 84.0)	185.4 (126.0 – 390.9)	299.9

Table 3 Susceptibility of the two-spotted spider mite (Tetranychus urticae) immatures to selected acaricides on strawberries

Acaricide	n	X^2	Slope ± SE	$LC_{50,}$ µg ai/ml (95% CI)	$LC_{90,}$ µg ai/ml (95% CI)	Top Label Rate (µg ai/ml)
Oberon	465	18.4	3.1 ± 0.26	1.6 (1.5 – 1.9)	4.4 (3.7 – 5.5)	150.0
Zeal	280	20.7	2.4 ± 0.36	3.2 (1.8 – 4.4)	10.9 (7.6 – 21.6)	81.0
Savey	383	32.6	0.8 ± 0.18	16,535.6 (7955 – 102,625)	506,986.6 (886,03.7 – 445,676,104.6)	117.3
Acramite	282	39.2	2.1 ± 0.38	11.1 (2.3 – 17.6)	45.1 (29.2 – 173.7)	299.9

NEW REGULATIONS PROPOSED WILL AFFECT NUTRIENT MANAGEMENT OF LEAFY GREEN VEGETABLES

Richard Smith, Vegetable Crop and Weed Science Farm Advisor

The draft Agricultural Order issued by the Central Coast Regional Water Quality Control Board (CCRWQCB) on November 19 increased the regulation of discharges of nitrate-nitrogen to surface and ground water from agriculture. As written, all vegetable operations that produce over 1000 acres of lettuce, cole and several other ‘high risk’ crops and that use chlorpyrifos or diazinon are placed into Tier 3 compliance category which has specified regulations concerning the movement of nitrates to surface and ground waters. The new regulations may require growers to implement a certified Irrigation and Nutrient Management Plan (INMP) to document information on nitrogen applied to crops vs nitrogen removed by crops. This information would be used to calculate a nitrogen balance ratio and growers are given three years to demonstrate nitrogen balance ratios of 1.0 for annual rotations that are double cropped. In other words, if double cropped lettuce annually removes 240 lbs of N/A (120 lbs N/A/crop), the annual amount allowed to grow two crops of lettuce in order to comply with the nitrogen balance ratio would be 240 lbs N/A/year. Given current production practices and traditional fertilization programs, complying with these new restrictions will require many growers and their fertility consultants to make a shift in their approach to fertilization of leafy green vegetables.

The new regulations may require growers to implement a certified Irrigation and Nutrient Management Plan (INMP) to document information on nitrogen applied to crops vs nitrogen removed by crops.

The ultimate goal of the regulations issued by the CCRWQCB is to reduce the load of nitrate that is added to agricultural operations in the hope to improve the quality of ground and surface waters in the valley. It is therefore important for us to explore ways that we can be more efficient with applied nitrogen fertilizer. It is important to keep in mind that there are tools that can help growers to deal with this new regulatory era and which safeguard yield.

There are a variety of approaches that can be taken to improve nitrogen use efficiency, but I will just discuss two simple first steps that can be taken to achieve better nitrogen use efficiency. The first is the much discussed nitrate quick test. It is particularly useful in double cropped leafy green vegetable production for the following reasons. Nitrate levels in Salinas Valley soils typically follow a predictable pattern over the course of the growing season (Figure 1). Soil nitrate levels at the beginning of the growing season are typically low in the soil due to loss of nitrate from the prior season from leaching by rain that occurs during the winter. Once the first crop has been planted and the growing season progresses, soils begin to warm and nitrogen from applied fertilizer and from mineralization of nitrate from soil organic matter begin to increase the pool of nitrate in the soil. Typically, higher amounts of nitrogen need to be applied to the first crop because of lower initial soil nitrate levels. As we get to the second crop however, there are higher levels of soil nitrate which can be accounted for with the nitrate quick test. For example, a value of 20 ppm nitrate-N is equivalent to 80 pounds of nitrogen in the soil. This amount of residual soil nitrate can be used to for growth of the second crop and fertilizer rates can be reduced accordingly. This is the reason that we often grow the second crop of lettuce with substantially less nitrogen than the first crop. The nitrate quick test gives you the information that you need to make an informed decision on the nitrogen needs of the crop without jeopardizing yield.

It is important to keep in mind that there are tools that can help growers to deal with this new regulatory era and which safeguard yield.

The second practice to reduce the load of nitrate added to vegetable operations is whether to use fall applied preplant nitrogen. We had an opportunity to follow the fate of an application last winter and observed a dramatic loss of nitrogen during a series of storms in 2010 (Figure 2). The data indicates that the money spent on this application of nitrogen fertilizer was rapidly and nearly completely lost in one series of storms. This is clearly “low hanging fruit” in terms of nitrogen savings that can be achieved for lettuce production and a cost savings to the production budget. I realize that fall nitrogen applications are often mixed

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with decision regarding phosphorus and potassium applications; for more information on phosphorus applications to cool season vegetables check out the following publication: http://cemonterey.ucdavis.edu/newsletterfiles/Monterey_County_Crop_Notes8723.pdf

The draft rules issues by the CCRWQCB are yet to be finalized by the full board in March 2011. Whatever shape the final rules take, it appears that we have to begin the process of rethinking our approach to fertilizing lettuce and other leafy greens. The good news is that there are solid tools that can help the industry cope with this new regulatory era.

Figure 1. Typical pattern of nitrate-N (ppm) in soil over the course of the growing season

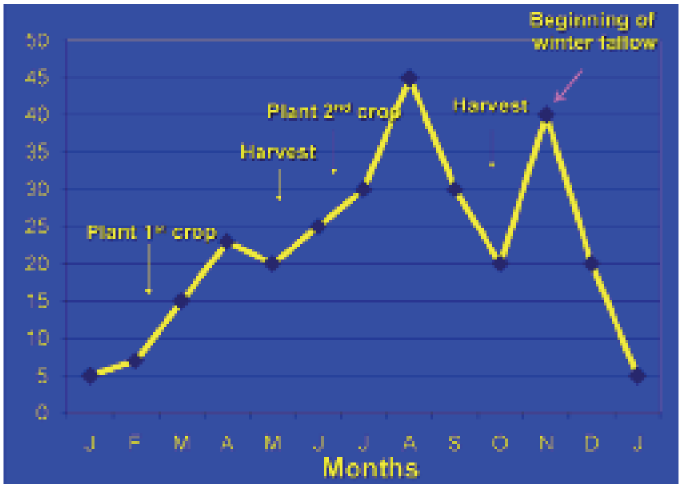
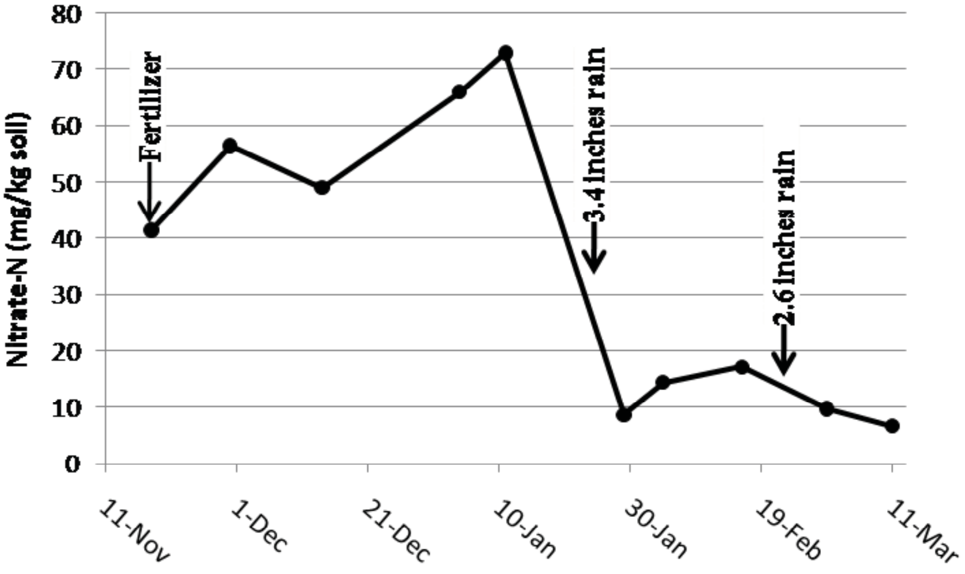


Figure 2. Fate of fall applied nitrogen in one storm even in January, 2010



The second crop and fertilizer rates can be reduced accordingly. This is the reason that we often grow the second crop of lettuce with substantially less nitrogen than the first crop. The nitrate quick test gives you the information that you need to make an informed decision on the nitrogen needs of the crop without jeopardizing yield.

VEGETATED TREATMENT DITCHES: INEFFECTIVE IN REDUCING NUTRIENT, SEDIMENT, AND E. COLI BACTERIA CONCENTRATIONS IN IRRIGATION RUN-OFF ON THE CENTRAL COAST

Michael Cahn, Irrigation and Water Resources Advisor
Trevor Suslow, Food Safety Specialist, Plant Sciences Dept. UCD.
Adrian Sbodio, Staff Research Associate, Plant Sciences Dept. UCD.

Irrigation run-off from cool season vegetable fields on the central coast of California can carry significant loads of sediment, nutrients, and bacteria. Planting vegetation in permanent ditches on farms can stabilize banks thereby preventing erosion, and potentially provide a biological treatment that could improve water quality. Due to food safety concerns, many vegetable growers have been reluctant to increase plantings of vegetated ditches because the plant cover may harbor small animals that could transport microbial contaminants to an adjacent crop of leafy greens. Research reports from other regions of the United States suggest that vegetation in these ditches could reduce bacterial loads in run-off, thereby reducing the risk of microbial contamination to downstream fields as well as reducing loads of nutrients and sediments. Another obstacle to vegetating ditches, especially for maximizing water treatment benefits, is cost. The ditches may need to be graded, hand planted, and frequently watered to establish vegetation, and then maintained to prevent infestation of weedy species.

Polymers are another management tool that can improve farm water quality. Our past studies have shown that adding polyacrylamide (PAM) to irrigation water at concentrations of 5 ppm significantly reduced concentrations of sediment and associated nutrients in tail water run-off. However, we have not examined the effect of PAM on bacterial loads in irrigation run-off. If the bacteria are associated with sediment in the run-off, PAM could greatly reduce the migration of E. coli and other bacteria that pose food safety risks to leafy green crops. Furthermore the combination of polyacrylamide and vegetation treatment may improve water quality more than either practice alone.

Because of lack of information on the efficacy of vegetation and polymers to reduce bacterial loads in run-off under central coast conditions, we undertook a 2 year field study that simulated E. coli contamination in a lettuce field. The field trials evaluated the effectiveness of vegetated treatment ditches, polyacrylamide polymer, and the combination of these two practices to reduce bacteria, sediment, and nutrient concentrations in irrigation run-off.

Procedures

Field trial design Field trials were conducted at the USDA-ARS Spence Research Farm, near Salinas CA. The soil type was a Chualar sandy loam. The water source was ground water. Run-off treatments included: 1. untreated irrigation water and run-off water treated through a bare (non-vegetated) ditch (control treatment), 2. untreated irrigation water and run-off water treated through a vegetated ditch (vegetated treatment); 3. irrigation water treated with 5 ppm of polyacrylamide polymer and run-off water treated through a bare ditch (PAM treatment). 4. irrigation water treated with polyacrylamide polymer (2.5 ppm in 2007 and 5 ppm in 2008) and run-off water treated through a vegetated ditch (vegetated PAM treatment). Treatments were randomly assigned to the field plots so that each treatment was evaluated on each plot during 4 consecutive irrigation events. The soil was cultivated between irrigation events to remove residual effects of the polymer in the soil. Run-off collected at the lower end of the plots was diverted through either a vegetated or bare ditch.

Treatment ditches. A tractor implement was used to scrape V-shaped ditches for treating irrigation run-off at the lower end of each of the 4 plots beginning in August of 2007. The ditches measured 170 ft long, 10 ft wide, and 3 ft deep. Creeping wild rye (*Leymus*

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triticoides) seedlings were transplanted on the bottom and lower sides of the ditch at a density of 1 plant/ft2. Red fescue (*Festuca rubra*) seedlings were planted on the upper sides of the ditch. The ditches were irrigated twice per week to establish the vegetation (Fig. 1). Volunteer grain rye and barley from a previous cover crop also germinated and contributed to the vegetation during the 2007 season (Fig. 1). However, creeping wild rye and red fescue dominated the vegetation during 2008 season (Fig. 1). Non-vegetated ditches were established next to the vegetated ditches before the start of each field trial. The bare ditches had the same dimensions as the vegetated ditches.

Polymer treatment Emulsified liquid PAM (Hydrosorb Soilfloc 300E, 37% ai wt/wt) was prediluted into 100 gal tanks of water for the 2007 trial. A high pressure centrifugal pump was used to inject tank mixed PAM into the main line to achieve a 5 ppm concentration in the irrigation water during the 2007 trial. A second tank containing 1500 ppm PAM was used to achieve a 2.5 ppm concentration of PAM in the irrigation water during the 2007 field trial. A chemical metering pump (Seepex MD) was used to directly inject the concentrated liquid PAM into the irrigation system to achieve 5 ppm concentration in the irrigation water during the 2008 trial. Separate mainlines were used for different water treatments.

E. coli field inoculation The experimental field was inoculated with a mixture of 3 marked strains of generic *E. coli* isolated from water samples that had been previously collected in Salinas. These *E. coli* isolates could be quickly identified due to their natural resistance to the antibiotic, rifampicin. A suspension of the strains was mixed with sand and placed in small porous bags. The satchels of sand-E. coli mixture were positioned 100 ft from the upper end of the field in 20 furrows within each plot, immediately before the first irrigation event. The bags were removed after the first irrigation and the field was not inoculated again during subsequent irrigation events.

The experimental field was inoculated with a mixture of 3 marked strains of generic *E. coli* isolated from water samples that had been previously collected in Salinas

Water sampling Flumes were positioned at the lower end of the ditches to measure run-off volumes and collect composite samples during the irrigation events. Composite water samples were collected at the upper and lower ends of the treatment ditches. Water samples were analyzed for pH, EC, and temperature immediately after irrigation events and then frozen until they could be analyzed for nutrients, salts, and sediment concentrations at the UC DANR analytical laboratory. Sub-samples of the composite run-off samples were also analyzed for coliform, generic E. coli, and inoculated E. coli.

Results

Sediment in run-off

Run-off water treated with PAM had a significantly lower concentration of suspended sediments and lower turbidity compared to untreated water sampled above the ditches in 2007 and 2008 (Fig. 2). Suspended sediments concentration measured at the outlet of the ditches was less than the concentration at the inlet for all treatments during the 2007 and 2008 trials but not statistically significant (Fig. 2). Although the average concentration of suspended sediments (total suspended solids) and turbidity in the untreated run-off (no addition of PAM) entering the vegetated ditch treatment was lower than the concentration entering the control bare ditch treatment in 2007, the differences between treatments were also not statistically significant, and was probably an artifact of the sampling method used during this year. After adjusting the sampling method in 2008, the average suspended sediment concentration and turbidity of the untreated run-off entering the vegetated and bare ditches were similar (not statistically different).

In contrast to the suspended solids, turbidity levels generally remained the same or increased slightly between the inlet and outlet of the ditches in 2007 and 2008 (data not presented). The difference in turbidity levels of the run-off measured at the inlet and outlet of the ditches were also not statistically different among treatments.

Suspended sediment concentration and turbidity levels in the outflow from the ditches

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was lowest from PAM treated plots (Table 1). Sediment concentrations were reduced by 89% and 90% for the PAM and PAM+veg treatments, respectively in 2007 and by 93% and 92%, for the PAM and PAM+veg treatments, respectively in 2008. Average load of sediment loss was 167 and 76 lb/acre/irrigation from the control treatment in 2007 and 2008, respectively. Treatments with PAM also reduced sediment loads by an average of 88% in 2007 and 92% in 2008.

Treatments with PAM also reduced sediment loads by an average of 88% in 2007 and 92% in 2008.

The vegetation treatment did not consistently reduce sediment concentration and turbidity in the run-off from plots that did not receive PAM treated water. The concentration of suspended sediments in the outflow from the vegetated ditch was 35% less than the control treatment (bare ditch) in 2007. Although the difference between these treatments was statistically significant, the inflow concentration of sediments was lowest for the vegetated treatment (Fig. 2) and probably an artifact of the sampling method used during this trial. This result was not repeated in the 2008 trial. Both suspended sediment concentration and turbidity measured at the outlet of the control bare and vegetated ditch treatment were statistically similar in 2008 and actual averages were highest for the vegetated treatment (Fig. 2). Also the combined treatment of PAM and the vegetated ditch did not reduce suspended sediment, turbidity, and sediment load significantly more than the PAM and bare ditch treatment for either year (Table 1).

Nutrients in run-off

Treatments with PAM had significantly lower concentrations of total N and total P in run-off than the untreated control at the inlet of the treatment ditches in 2007 and 2008 (data not shown). The addition of PAM reduced total N in run-off at the inlet of the ditches between 38% and 64% relative to the untreated control in 2007 and by more than 67% relative to the untreated control in 2008. At the outlet of the treatment ditches, PAM treatments had more than 64% less total N in run-off compared to the untreated control (Table 2). Run-off from PAM treated plots also had 65% to 73% less total P than the untreated control at the outlet of the treatment ditches (Table 6).

Vegetation in the ditches minimally affected the total N and P concentrations in sprinkler run-off. Total N concentration at the outlet of the vegetated ditch was significantly less than the untreated non-vegetated ditch in 2007 (Table 2); however, the concentration of total N in run-off entering the inlet to the vegetated ditch was also less than the concentration at the inlet of the untreated control ditch (data not presented). Furthermore, the difference in total N concentration between the inlet and outlet of the vegetated ditch was not statically different from the other treatments. Total N concentration at the inlet and outlet of the vegetated ditch was statistically similar to the untreated control ditch in 2008. Finally, the concentration of total N at the outlet of the ditches was statistically similar for the PAM and PAM+vegetation treatments in 2007 and 2008, demonstrating that the concentration of total N in run-off from PAM treated plots was not further reduced by flowing through the vegetated ditch (Table 2).

Similar to total N results, vegetation only had minimal effects on total P concentration at the outlet of the ditches. Total P concentration in the run-off exiting the ditches was statistically similar between the bare control ditch and the vegetated ditch in the 2007 and 2008 trials (Table 3). Also, the difference in total P concentration in the run-off between the inlet and outlet of the ditches was similar among all treatments. The concentration of total P at the outlet of the ditches was statistically similar for the PAM and PAM+vegetation treatments in 2007 and 2008, also demonstrating that the vegetation did not further reduce the total P concentration in the sprinkler run-off.

Soluble P concentration was statistically similar among treatments at the inlet and outlet of the ditches in 2007. Soluble P concentration of run-off from the outlet of the vegetated ditch was higher than the concentration measured at the outlet of the control treatment in 2008. Also, soluble P concentration in the run-off significantly increased between the inlet and outlet of the vegetated ditch. In comparison the control treatment had similar

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concentrations of soluble P between the inlet and outlet of the ditch

The addition of PAM to the irrigation water had no significant affect on the concentration of soluble P in the run-off during the 2007 trial; however, the addition of PAM significantly reduced soluble P concentration in the run-off at the inlet and outlet of the non-vegetated ditch relative to the control treatment in 2008 (Table 3). The reduction in soluble P concentration in the run-off of the PAM treatment was 32% less than the concentration in the untreated control (Table 3).

The addition of PAM to the irrigation water also had no significant affect on the concentration of nitrate-N in the run-off during the 2007 trial relative to the control treatment. The PAM treatment had significantly lower NO_3 concentration in the run-off entering the treatment ditch than the concentration measured at the inlet of the control ditch in 2008. The average reduction in NO_3 concentration due to the addition of PAM was 31% less the concentration measured in the control treatment in 2008.

Ammonium (NH_4) concentration of run-off was not significantly different among treatments during the 2007 trial. The addition of PAM to the irrigation water significantly reduced NH_4-N concentration in the run-off relative to the control treatment during the 2008 trial. The concentration of NH_4-N at the outflow of the PAM treatment ditch was 44% to 66% lower than the concentration of NH_4-N in the out flowing runoff from the control treatment in 2008 (Table 2).

<u>Coliform and *E.coli* bacteria in run-off</u>
Introduced strains of rifampicin resistant *E.coli* generally composed a majority of the E. coli measured in the run-off. Total coliform concentrations averaged 153 and 544 times greater than the concentration of generic E. coli in the run-off in the 2007 and 2008 trials, respectively.

Concentration of *E. coli*$_{rif}$, generic E. coli, and coliform bacteria were not statistically different among treatments at the inlet and outlet of the ditches for the 2007 and 2008 trials (Table 4). Similarly, the difference in concentration between the inlet and outlet of the ditches was not statistically different among treatments for both years of the trial (data not presented). One exception was that less coliform bacteria were measured in run-off at the inlet of treatments with PAM in the irrigation water in 2008 (Table 4). Although the PAM treatment reduced the concentration of coliform bacteria in the run-off 2.5 times less than the untreated control, the concentration in the PAM run-off remained higher than most food safety and regulatory water quality targets.

Discussion and Conclusions

The lack of effectiveness of the vegetated treatment to reduce the concentration of suspended sediment and nutrients in run-off may be explained by a combination of factors. Flow rates of the run-off were high relative to the length of the vegetated ditch such that the residence time was less than 45 min. A majority of the biomass of the wild rye that was planted on the bottom of the ditches was 6 inches above the soil surface and would have been unlikely to interact with the run-off flowing in the ditches. Finally, the concentration of suspended sediment in the run-off was significantly higher than concentrations found in run-off of other vegetative ditch studies due to the use of impact sprinklers and that the trial was conducted on a highly erodible soil. Despite these limitations we expected to measure at least a small reduction in sediment concentration between the inflowing and out-flowing run-off from the vegetated ditch. These results suggest that it may be challenging to design vegetated treatment systems that are effective for run-off with high volumes and high sediment loads.

The addition of polyacrylamide polymer to irrigation water at concentrations of 5 ppm and less reduced suspended sediments in sprinkler run-off by an average of 90% and total N and P by approximately 70% for both years of the trials. Because PAM presumably flocculated suspended sediment in run-off water, insoluble

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forms of N and P associated with the sediments would have also been retained in the field rather than carried in the run-off. More surprising was the result that the addition of PAM significantly, albeit modestly, reduced the concentration of soluble P and NO3-N in run-off during the 2008 trial. The reduction in soluble P and NO_3-N concentration of about 30% under the PAM treatment was relatively small compared to the effect of PAM on total nutrient and sediment concentration; and therefore it was not surprising that no significant reduction in these soluble nutrients was measured for the PAM treatment during the 2007 trial.

None of the management practices evaluated reduced *E. coli* and coliform bacteria concentrations less than the concentrations measured in the bare control treatment.

None of the management practices evaluated reduced *E. coli* and coliform bacteria concentrations less than the concentrations measured in the bare control treatment. This result might be expected for the vegetated treatment since vegetation was ineffective in reducing sediment concentration. Despite consistently reducing sediment concentration in the run-off, PAM was ineffective in reducing bacteria concentration. The results of these trials suggested that the majority of the E. coli and coliform bacteria resided in the water and were not associated with suspended sediments. Other studies that have reported that vegetation reduced the load of *E. coli* in irrigation run-off may have lessened the volume of run-off or dropped out bacteria associated with suspended fecal particles. For example, the vegetated buffers in the study of Tate et al. (2006) minimized the bacterial load by enhancing infiltration into the soil and minimizing the movement of cattle feces. In our study, soil was inoculated with E. coli from a point source (sachels of E. coli) and was allowed to migrate in the run-off along the length of the furrows. Because we removed the source of *E. coli* after the first irrigation event, all bacterial collected during subsequent irrigations would have persisted in the soil, presumably in a state that could be readily transported in run-off during irrigation events. Another difference from previous studies was that the reaction time of the vegetated treatment was limited to less than 45 min, which is probably an insufficient time for potential degradation processes to affect bacterial populations. Studies of large constructed wetlands have shown a degradation of E. coli populations during the course of several days. Unfortunately, large vegetated treatment systems designed to handle large run-off volumes associated with overhead sprinklers would be an impractical solution for most of the high valued vegetable production areas on the central coast.

Fig. 1. Vegetated treatment ditches planted with creeping wild rye and red fescue in October 2007 (left) and October 2008 (right). Volunteer grain rye and barley dominated the vegetation during the 2007 trial.

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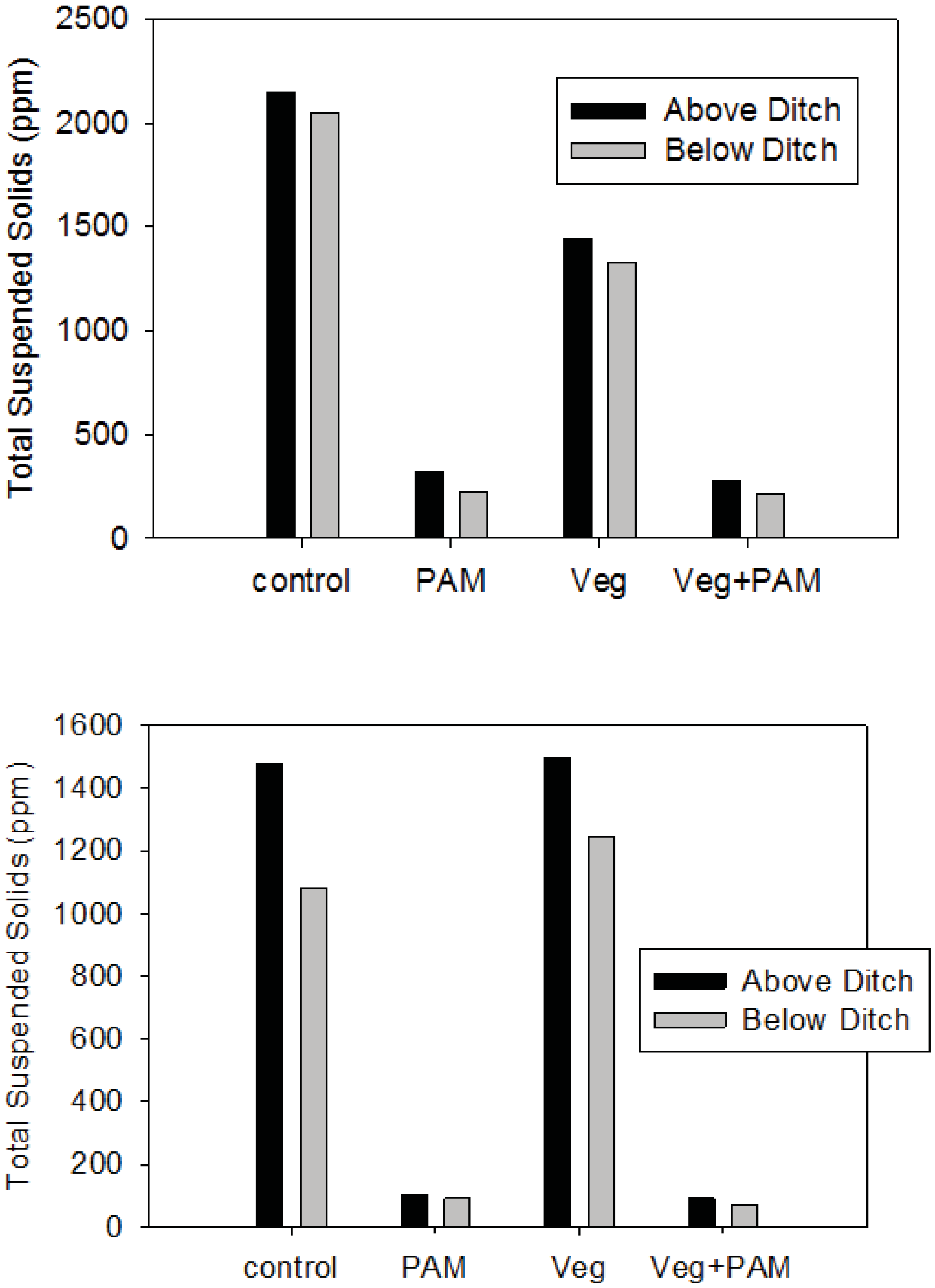

Fig. 2. Average suspended solids concentration in run-off measure at the inlet and outlet of treatment ditches for the 2007 (top) and 2008 (bottom) trials.

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Table 1. Concentration of total suspended solids (suspended sediments) and turbidity of run-off sampled at the outlet of the treatment ditches for the 2007 and 2008 field trials. NTU = Nephelometric turbidity units. Low values signify less turbidity.

2007 trial:

Treatment	Total Suspended Solids		Turbidity	
	ppm		NTU	
untreated control (bare ditch)	2044	a	1598	a
PAM 5 ppm (bare ditch)	228	b	135	b
vegetated ditch	1325	c	862	c
vegetated ditch + 2.5 ppm PAM	212	b	117	b

2008 trial

Treatment	Total Suspended Solids		Turbidity	
	ppm		NTU	
untreated control (bare ditch)	1082	a	950	a
PAM 5 ppm (bare ditch)	90	b	104	b
vegetated ditch	1244	a	1022	a
vegetated ditch + 5 ppm PAM	71	b	84	b

Table 2. Concentration of total, nitrate, and ammonium forms of nitrogen in run-off sampled at the outlet of the treatment ditches for the 2007 and 2008 field trials.

2007 trial:

Treatment	Total Kjeldahl N		Nitrate-N		Ammonium-N	
	------------------------		ppm		-----------------------	
untreated control (bare ditch)	9.7	a	4.1	a	1.04	a
PAM 5 ppm (bare ditch)	3.5	b	4.1	a	1.12	a
vegetated ditch	7.0	c	4.7	a	0.90	a
vegetated ditch + 2.5 ppm PAM	3.4	b	4.2	a	0.96	a

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2008 trial:

Treatment	Total Kjeldahl N		Nitrate-N		Ammonium-N	
	ppm					
untreated control (bare ditch)	8.4	a	5.6	a	0.7	a
PAM 5 ppm (bare ditch)	2.8	b	4.3	b	0.2	b
vegetated ditch	8.0	a	7.4	a	0.8	a
vegetated ditch + 5 ppm PAM	3.0	b	4.9	b	0.4	b

Table 3. Concentration of total and soluble forms of phosphorus in run-off sampled at the outlet of the treatment ditches for the 2007 and 2008 field trials.

2007 trial:

Treatment	Total P		Soluble P	
	ppm		ppm	
untreated control (bare ditch)	4.4	a	0.58	a
PAM 5 ppm (bare ditch)	1.6	b	0.58	a
vegetated ditch	3.7	a	0.69	a
vegetated ditch + 2.5 ppm PAM	1.2	b	0.57	a

2008 trial:

Treatment	Total P		Soluble P	
	ppm		ppm	
untreated control (bare ditch)	3.3	a	0.9	a
PAM 5 ppm (bare ditch)	1.0	b	0.6	b
vegetated ditch	3.5	a	1.1	a
vegetated ditch + 5 ppm PAM	1.1	b	0.8	b

Table 4. Concentration of marked generic E. coli (rifampicin resistant), total generic E. coli, and coliform bacteria in run-off sampled at the inlet and outlet of the treatment ditches for the 2007 and 2008 field trials. Data are expressed as the log of the number of colonies (MPN) per 100 ml of sample.

2007 trial:

	E. coli$_{rif}$			*E.coli*			Coliform		
Treatment Description	above	below	diff.	above	below	diff.	above	below	diff.
	Log(MPN/100 ml)								
untreated control (bare ditch)	3.5	3.5	0.0	3.3	3.5	-0.2	5.3	5.6	-0.3
PAM 5 ppm (bare ditch)	3.2	3.4	-0.2	3.4	3.7	-0.3	5.5	5.7	-0.2
vegetated ditch	3.3	3.2	0.1	3.5	3.5	0.0	5.3	5.5	-0.2
vegetated ditch + 2.5 ppm PAM	3.4	3.4	0.0	3.3	3.4	0.0	5.3	5.7	-0.4
LSD$_{0.05}$	NS[x]	NS	NS	NS	NS	NS	NS	NS	NS

[x] NS = treatment differences were not statistically signficant

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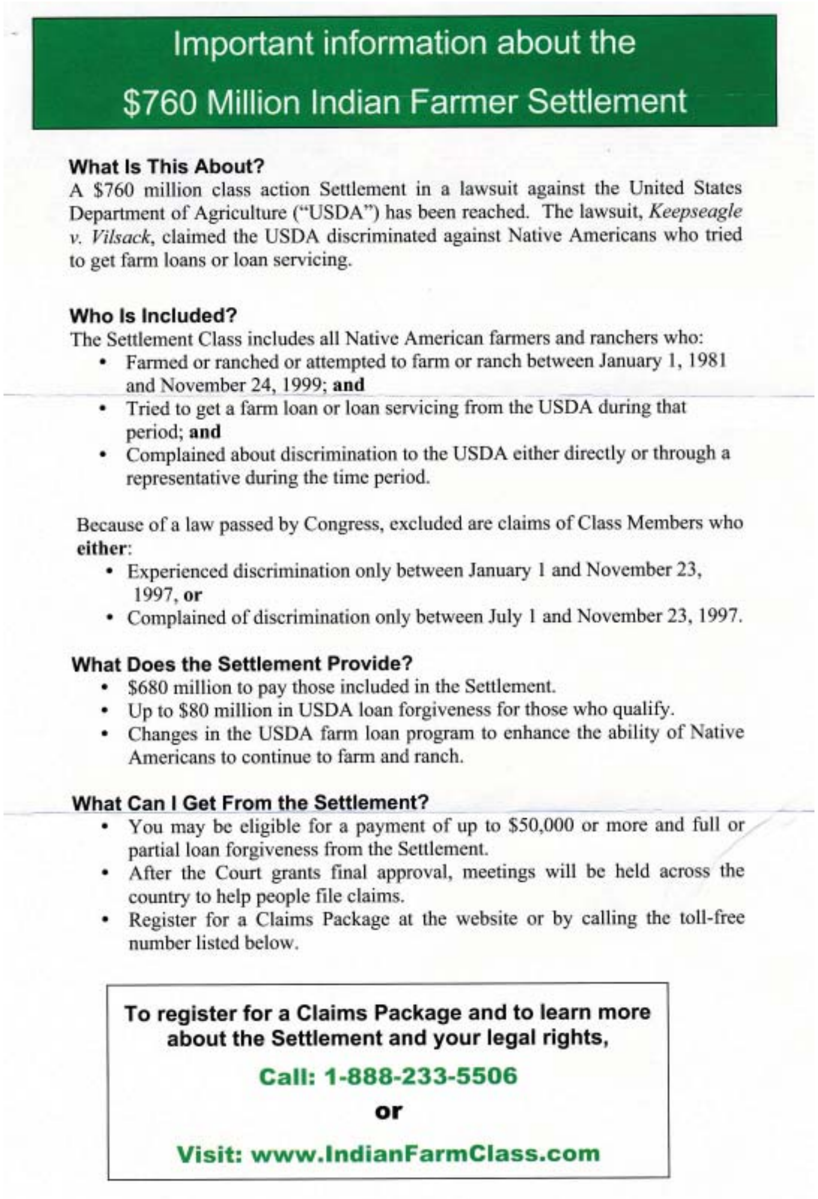
2008 trial:

Treatment Description	*E. coli*$_{rif}$ above	*E. coli*$_{rif}$ below	*E. coli*$_{rif}$ diff.	*E.coli* above	*E.coli* below	*E.coli* diff.	Coliform above	Coliform below	Coliform diff.
	----------	----------	----------	Log(MPN/100 ml)	----------	----------	----------	----------	----------
untreated control (bare ditch)	2.3	2.2	0.1	2.7	3.2	-0.5	5.3	5.5	-0.2
PAM 5 ppm (bare ditch)	2.1	2.0	0.0	2.4	2.5	0.0	4.9	5.1	-0.2
vegetated ditch	1.9	2.3	-0.4	2.5	3.5	-1.0	5.2	5.6	-0.5
vegetated ditch + 5 ppm PAM	2.2	2.1	0.0	2.3	3.0	-0.7	4.9	5.2	-0.3
LSD$_{0.05}$	NS^{x}	NS	NS	NS	NS	NS	NS	NS	NS

^{x} NS = treatment differences were not statistically signficant

Literature Cited

K. W. Tate, E. R. Atwill, J. W. Bartolome, and G. Nader 2006. Significant Escherichia coli attenuation by vegetative buffers on annual grasslands. J. of Environ. Qual. 35:795-805



Important information about the $760 Million Indian Farmer Settlement

What Is This About?

A $760 million class action Settlement in a lawsuit against the United States Department of Agriculture ("USDA") has been reached. The lawsuit, *Keepseagle v. Vilsack*, claimed the USDA discriminated against Native Americans who tried to get farm loans or loan servicing.

Who Is Included?

The Settlement Class includes all Native American farmers and ranchers who:

- Farmed or ranched or attempted to farm or ranch between January 1, 1981 and November 24, 1999; **and**
- Tried to get a farm loan or loan servicing from the USDA during that period; **and**
- Complained about discrimination to the USDA either directly or through a representative during the time period.

Because of a law passed by Congress, excluded are claims of Class Members who **either**:

- Experienced discrimination only between January 1 and November 23, 1997, **or**
- Complained of discrimination only between July 1 and November 23, 1997.

What Does the Settlement Provide?

- $680 million to pay those included in the Settlement.
- Up to $80 million in USDA loan forgiveness for those who qualify.
- Changes in the USDA farm loan program to enhance the ability of Native Americans to continue to farm and ranch.

What Can I Get From the Settlement?

- You may be eligible for a payment of up to $50,000 or more and full or partial loan forgiveness from the Settlement.
- After the Court grants final approval, meetings will be held across the country to help people file claims.
- Register for a Claims Package at the website or by calling the toll-free number listed below.

To register for a Claims Package and to learn more about the Settlement and your legal rights,

Call: 1-888-233-5506

or

Visit: www.IndianFarmClass.com

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University of California Cooperative Extension, Monterey County

2011 South County Pest Management Meeting

Tuesday, January 11
9:00 a.m. to 11:30 plus lunch
Cafeteria King City Fair Grounds

9:00 Weed Control Options for Onions and Peppers
Richard Smith, Vegetable Crop and Weed Science Farm Advisor, Monterey County

9:30 Water and Nitrogen Management of Lettuce
Michael Cahn, Irrigation and Water Resources Farm Advisor, Monterey County

10:00 Fusarium Rot on Lettuce in Monterey County
Steve Koike, Plant Pathology Farm Advisor, Monterey County

10:30 Fusarium Rot on Lettuce in Fresno County
Tom Turini, Vegetable Crop Farm Advisor, Fresno County

11:00 Breeding Efforts to Control Fusarium Rot on Lettuce
Jim McCreight, Lettuce Breeder, USDA

11:30 Lunch

The meeting room, refreshments and lunch are sponsored by:
Crop Production Services, Dune Company, Integrated Crop Management Incorporated and Wilbur-Ellis

2.0 Continuing education credits have been requested. Please call ahead for special accommodations.
For more information call Richard Smith (831) 759-7357 or Steve Koike (831) 759-7356

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University of California Cooperative Extension, Monterey County

2011 Irrigation and Nutrient Management Meeting and Cover Crop and Water Quality Field Day

Wednesday, February 23

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

Irrigation and Nutrient Management Meeting: Agricultural Center 1432 Abbott Street, Salinas, CA

7:45 **Registration and Refreshments**
8:00 ***Nitrification Inhibitor Evaluations***
Richard Smith, Vegetable Crops and Weed Science Farm Advisor, Monterey County
8:30 ***Optimizing Water and Nitrogen Management of Lettuce***
Mike Cahn, Irrigation and water resources Farm Advisor, Monterey County
9:00 ***Regional Irrigation and Nutrient Management Program***
Paul Robbins, Resource Conservation District, Salinas
9:30 ***Potential Strategies for Removing Nitrate from Tile Drain Water***
Brian Largay, Tidal Wetland Project Director, Elkhorn Slough National Estuarine Research Reserve
10:00 ***Break***
10:30 ***Salinas Valley Ground Water Research***
Thomas Harter, Extension Groundwater and Vadoze zone Specialist, UC, Davis
11:00 ***Nitrogen Management Strategies to Comply with the RWQCB Agricultural Order***
Tim Hartz, Vegetable Crops Specialist, UC Davis
11:30 ***Strategies to Reduce Sediment Loss and Achieve Compliance with the RWQCB Agricultural Order***
Mike Cahn, Irrigation and water resources Farm Advisor, Monterey County
12:00 ***Conclusion and travel to lunch and field demonstration site***

Field Trip: Spence Reasearch Station, 1752 Old Stage Road, Salinas, CA

12:45 ***Lunch – on Site***
Pizza lunch
1:30 ***Grass-lined waterway to filter out pesticides, sediment and nutrients***
Mike Cahn, 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**