Cooperative Extension • Monterey County

Crop Notes

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In This Issue:

GOOD BYE AND THANK YOU

Sonya Varea Hammond

Word is out that I am retiring. It's true. My last day will be June 29th, twenty and a half years after starting my career with the University of California Cooperative Extension. I was happy and respected in my previous career as the controller for a local ag company, but I wanted to make a difference on a broader scale. I feel that my County Director job for Cooperative Extension has allowed me the honor and privilege of making a difference. Cleaning out my files has taken me on a fun and affirming path down memory lane. I had forgotten about many of the conferences I developed for ag (sexual harassment, bankers' seminars, labor, two conferences on biotechnology, small farms models for success tours…). I even organized one annual strawberry meeting and two irrigation seminars to keep the momentum for clientele while we were between advisors.

Speaking of advisors, my number one goal has been to support and help advance the careers of the first-rate local area advisors. I am extremely proud of the Monterey County advisors, including our cross-county advisors, and could be justifiably accused of being biased, but I have to say truthfully that the Central Coast is unique and very fortunate in having the advisors that are here. The veteran farm advisors are tops among their peers. They are driven, dedicated, and supremely knowledgeable. Above all, they connect with and serve their clientele, and they understand extension. They are singled out repeatedly as role models by UC Ag and Natural Resources statewide. They have made Monterey County and the Central Coast a better place, and they have made me a better person. I would also like to acknowledge my fellow Monterey County Department Heads. I owe a special thanks to my area peers, Laura Tourte, County Director for Santa Cruz County, and retired San Benito County Director, Pat Johns, who have been my ever-reliable support team. My equally important second support team consists of the office manager and clerical staff who are the ones who really run the office.

There are two initiatives I have worked toward, and despite the best efforts of many good people, neither have come to fruition. First, many people have worked valiantly to obtain a UC Research and Extension Center (REC) for the Central Coast. Every major growing area in California has a UC REC, dedicated to the local crops and climate, yet one of the most productive and prosperous agricultural areas in California, indeed in the world – the central coast, is still without a UC REC. If we had fifty acres, that would start the ball rolling. Steve Fennimore, UC Davis weed specialist, has taken over the cause upon my departure. The second initiative is a local agricultural technology center that would serve as a hub and spark for new ag-related businesses and economic development. I have proposals for feasibility studies dating back to 1995 from consultants hired, mostly through economic development grants, to identify the necessary steps to make the technology center a reality. Since the County is very focused now on economic development, perhaps there will be a new determination and concerted effort to set the necessary components in place.

I wish my successor, Maria de la Fuente all the best and I turn over to her the best advisors, support staff, and facilities any manager could hope to have.

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

1432 Abbott Street • Salinas, CA 93901

phone 831.759.7350
fax 831.758.3018

http://cemonterey.ucdavis.edu

LEAF DISEASES OF CARROT

Steven Koike, University of California Cooperative Extension

In coastal California, carrot is subject to three common leaf diseases. These three distinct problems are difficult to differentiate in the field because the symptoms of all three diseases closely resemble each other. In most cases, precise identification of the pathogen will require laboratory examination and testing.

Alternaria leaf blight. Alternaria leaf blight is one of the more important foliar diseases of carrot and occurs worldwide. Severe epidemics reduce carrot root size and yields, though serious outbreaks in Monterey County are rare. Initial symptoms are greenish-brown, water-soaked, angular spots. These spots become dark brown to black and may be surrounded by a yellow halo. Lesions often occur on or near the edge of older leaflets. Extensive spotting results in an overall general browning and yellowing of the entire leaf (Fig.1.). As lesions enlarge and coalesce, the leaf may die. Severely affected crops exhibit large patches where the foliage has a scorched or blighted appearance. Dark, rectangular, elongated lesions are also produced on the petioles. On carrot seed plants the pathogen affects flowers, bracts, and developing seeds. The pathogen is the fungus *Alternaria dauci.*

Cercospora leaf spot. Yield losses can again take place if conditions favor Cercospora leaf spot development. The first symptoms are small (less than 1/8 inch in diameter), necrotic leaf flecks that tend to be angular in shape. These small flecks enlarge to form gray to tan spots that measure up to ¼ inch in diameter and have yellow borders (Fig.2.). As lesions increase in number and coalesce, leaves can wither and die. Petiole lesions are elliptical and brown with a paler center. Severely blighted foliage is weakened and snaps off during mechanical harvesting. In seed crops, early infection may prevent seed development, while later infection results in seed infestation. The pathogen is the fungus *Cercospora carotae*.

Bacterial leaf blight. This common disease occurs in most carrot producing areas. Damaging outbreaks are associated with high rainfall or intensive use of overhead irrigation. The first symptoms are angular yellow leaf spots that later develop into irregularly shaped, brown, water-soaked spots with yellow haloes. These lesions dry out and become brittle. Older lesions sometimes appear black. Lesions develop particularly at the leaf margins (Fig.3.). Formation of a gummy exudate and browning of the petioles also occurs. On seed carrot plants the pathogen can cause lesions and a blight of the flower umbels and flower stalks; a yellow exudate can ooze from such lesions. Bacterial leaf blight is caused by the bacterium *Xanthomonas campestris* pv. *carotae*.

Common features. For these diseases all three pathogens are seedborne; this is a key feature that accounts for many outbreaks in production fields. All three pathogens can also survive in carrot leaf and stem debris in the soil. *Alternaria*, *Cercospora*, and *Xanthomonas* are all dispersed by splashing water from rains and sprinkler irrigation; such splashing results in spread of the disease between adjacent carrot plants. However, only the spores of *Alternaria* and *Cercospora* are spread by winds. All three of these carrot pathogens are host-specific to carrot and will not infect celery, parsley, cilantro, or other crops.

Control. Use seed that has been tested and found to not have detectable levels of the pathogen, or that has a pathogen level below significant thresholds. If warranted, treat carrot seed with hot water or fungicides. Rotate carrots with non-susceptible crops so that infected carrot residues can decay and not serve as inoculum sources. Late planted crops should not be grown in close proximity to earlier plantings. If possible, reduce or eliminate the use of overhead sprinkler irrigation. Regularly monitor carrot crops for foliar disease symptoms and apply fungicides (or copper for bacterial blight) in a timely manner as appropriate.

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Fig. 1. Alternaria leaf blight of carrot.

Fig. 2. Cercospora leaf spot of carrot.

Fig. 3. Bacterial leaf blight of carrot.

SUSCEPTIBILITY OF LYGUS BUGS TO COMMONLY USED INSECTICIDES IN STRAWBERRIES

Jianlong Bi[1], Frank Zalom[1], Ian Greene[2], and Mark Bolda[1]
[1]University of California
[2]California Strawberry Commission

Lygus bugs are serious pests of strawberries in costal California. Lygus bugs damage strawberry fruit causing fruit distortion called "cat-facing". Distorted fruits are not acceptable in the fresh market, resulting in economic losses to growers.

Pesticides remain the primary tool for suppression of Lygus populations in strawberries. Extensive reliance on chemical insecticides for Lygus control has resulted in Lygus resistance to almost all major classes of insecticides throughout the world. Reports of poor insecticidal control of Lygus bugs in CA strawberries are commonplace, and resistance management strategies are urgently needed. Resistance monitoring is the first step in development of an integrated resistance management program. Here we report on susceptibility of Lygus populations in Watsonville/Salinas and Santa Maria strawberry fields.

Methods

In the Watsonville/Salinas production area, first-year and second-year strawberry fields near Meridian Road, Prunedale, were selected for the study. The first-year and second-year strawberries were in close proximity. In the Santa Maria production area, two first-year strawberry fields near Guadalupe were used. Lygus bugs in these fields were collected using beating trays. Lygus adults and/or nymphs were collected on August 13, 2009 in the Watsonville/Salinas production area and on July 9 and 20, 2010 in the Santa Maria area. In 2009, collected bugs were treated in the field, while in 2010, samples were immediately shipped to the lab for bioassay experiments.

The following insecticides were used for bioassay experiments: Brigade WSP, Danitol 2.4EC, Malathion 8 Aquamul, Dibrom 8 Emulsive, Actara and Assail. Mixtures of these pyrethroids or organophosphates with neonicotinoids were also tested. For the 2009 bioassays, only Danitol was tested. Danitol was diluted in distilled water and at least 6 concentrations were used to produce a range of 5-90% mortality. For the 2010 bioassays, all the insecticides were tested. Each of these insecticides at its full label rate was dissolved in deionized water to determine the susceptibility. To bioassay for Lygus adults and large nymphs, the centrifuge tube bioassay method developed by the Frank Zalom laboratory was used (Figure 1). Adults and large nymphs were aspirated into the 50 ml plastic centrifuge tubes. Each tube contained 5 adults or large nymphs. After the insects were inactivated with ice blocks, 3 ml of insecticide solutions or mixtures were pipetted directly onto the Lygus in each tube. Lygus in control tubes were treated the same way with deionized water. The tubes were kept in the laboratory at ambient temperature (25 C) for 24 h and the mortality was then determined.

The resulting data from 2009 experiments were corrected for control mortality and analyzed by probit analysis. LC_{50} and LC_{90} for fenpropathrin (the active ingredient of Danitol) were determined at 24 h after the treatment. Differences in LC_{50s} and LC_{90s} were considered not significant if their respective 95% CI overlapped. Data from 2010 experiments were corrected for control mortality without the probit analysis.

Results

Susceptibility of Lygus adults from the Watsonville/Salinas strawberry fields to Danitol is shown in Table 1. LC_{50} of fenpropathrin for adult Lygus from the first-year field was 10.6 times greater and that from the second-year field was 9.2 times greater compared to the full label rate (239.77 µg ai/ml). LC_{90s} were 25.9 to 27.9 times higher in than the label rate. Differences in LC_{50s} or LC_{90s} from the first-year and second-year fields

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Lygus bugs are serious pests of strawberries in costal California.

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were not significant. These results suggest that the Lygus from the first-year and the second-year fields were in the same population and Danitol had no effect on control of adults in this population.

Bioassay results for Lygus bugs from the Santa Maria area to Danitol, Brigade, Dibrom, Malathion and their tank mix with neonicotinoids are shown in Tables 2 and 3. On July 9 sampling date for adults, Danitol killed 25% while Brigade killed none (Table 2). Dibrom caused 57% mortality and Malathion killed 32%. On July 20, tank mix of Dibrom with Actara or Assail killed 85-90% of adults and 95-100% of large nymphs (Table 3). Tank mix of Malathion with Actara or Assail caused 59-74% adult mortality and 54-67% mortality of large nymphs. Treatments by Danitol mixed with Actara or Assail resulted in 47-62% mortality of adults and 55-58% mortality of large nymphs.

Conclusion

We recently tested susceptibility of adult and/or nymphal Lygus populations from strawberry fields in the Watsonville/Salinas and Santa Maria production areas to commonly used insecticides. Our results revealed that these populations were very resistant to pyrethroids (Danitol and Brigade), while the resistance to organophosphates (Dibrom and Malathion) was relatively less. These Lygus bugs were most susceptible to tank mixes of these organophosphats with neonicotinoids (Actara and Assail). Susceptibility of Lygus adults and nymphs to tank mixes was in the following order: Dibrom mixed with Actara or Assail, Malathion mixed with Actara or Assail, and Danitol mixed with Actara or Assail.

Susceptibility of these Lygus adults and nymphs to tank mixes of commonly used insecticides was in the following order: Dibrom mixed with Actara or Assail, Malathion mixed with Actara or Assail, and Danitol mixed with Actara or Assail.

Figure 1. Centrifuge tubes were used for determination of Lygus bug susceptibility to commonly used insecticides and their tank mixes.

Table 1. Susceptibility of Lygus adults to Danitol, Prunedale, August 13, 2009

Host plants	n	LC_{50}, µg ai/ml (95% CI)	LC_{90}, µg ai/ml (95% CI)
First year strawberry	180	2551.0 (1923.0 – 3504.2)	6205.6 (4305.1 – 12836.1)
Second year strawberry	130	2197.9 (1480.5 – 4124.1)	6692.5 (3715.8 – 34070.2)

Mortality was determined at 24 hours post treatment. Full label rate was 239.77 µg ai/ml based on a spray volume of 100 gallons per acre.

(Cont'd to page 6)

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Table 2. Susceptibility of Lygus adults to commonly used insecticides, Santa Maria, July 9, 2010

Treatment	Full label rate for Lygus control per acre	% Mortality (mean ± standard error)
Danitol 2.4 EC	10.66 fl oz	25 ± 9.2
Brigade wsp	32 oz	0 ± 4.7
Dibrom 8 Emulsive	1 pt	57 ± 11.0
Malathion 8 Aquamul	2 pts	32 ± 6.7

Insecticides were dissolved at full label rate for Lygus control in deionized water at the rate of 100 gallons per acre. Mortality was determined at 24 hours post treatment.

Table 3. Susceptibility Lygus adults and large nymphs (4th – 5th instars) to insecticide mixtures, Santa Maria, July 20, 2010

Treatment	Full label rate per acre	% Adult mortality (mean ± standard error)	% Nymphal mortality (mean ± standard error)
Dibrom + Actara	1 pt Dibrom 8 Emulsive + 4 oz Actara	90 ± 4.7	95 ± 3.5
Dibrom + Assail	1 pt Dibrom 8 Emulsive + 6.9 oz Assail 30 SG	85 ± 6.3	100 ± 0
Malathion + Actara	2 pts Malathion 8 Aquamul + 4 oz Actara	74 ± 13.5	54 ± 7.4
Malathion + Assail	2 pts Malathion 8 Aquamul + 6.9 oz Assail	59 ± 7.3	67 ± 6.1
Danitol + Actara	10.66 fl oz Danitol 2.4 EC + 4 oz Actara	47 ± 7.3	55 ± 7.7
Danitol + Assail	10.66 fl oz Danitol 2.4 EC + 6.9 oz Assail	62 ± 7.0	58 ± 5.3

Insecticides were mixed at full label rate for Lygus control in deionized water at the rate of 100 gallons per acre. Mortality was determined at 24 hours after treatment. Each treatment tube contained 5 bugs and was replicated 8-10 times.

PRELIMINARY EVALUATION OF SPINACH NITROGEN NUTRITION

University of California Cooperative Extension, Monterey County
Richard Smith and Aaron Heinrich, Farm Advisor and Staff Research Assistant

Background: Basic nitrogen uptake data on modern clipped spinach production is lacking. However, there is some urgency in gaining a more complete understanding on total nitrogen uptake by this crop in the face of proposed regulations by the Central Coast Regional Water Quality Control Board which stipulate that nitrogen fertilizer applications may not exceed crop uptake. Nitrogen nutrition of spinach is made difficult by several factors: 1) it is all sprinkler irrigated and there is no opportunity to utilize drip irrigation; 2) spinach quality is highly dependent on adequate green color at harvest which precludes any tolerance for low levels of nitrogen, especially late in the growth cycle; 3) it is shallowly rooted; and 4) there are many spinach products (i.e. baby & teenage clipped, bunched and freezer) that have distinct nitrogen nutrition requirements. To address these issues, we have initiated a systematic analysis of nitrogen uptake dynamics of spinach in 2011 with funding by the California Leafy Greens Research Board in which we are evaluating total nitrogen uptake by spinach, the uptake curve and basic nitrogen fertilization.

In 2010 we conducted a preliminary study which provided a glimpse into several aspects of spinach nitrogen nutrition. We observed higher than expected nitrogen uptake by this crop. In spite of the relatively low total

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dry biomass at harvest, the crop maintains a high concentration of nitrogen in the tissue (5-6%) which drives total nitrogen uptake up (app. 100 lbs/A). Coincidentally, the trial also provided an opportunity to observe the transformation of urea to ammonium and eventually to nitrate. Urea was transformed to ammonium within 6 days, and the ammonium was nearly completely transformed to nitrate in 10 days. This data provides confirmation of notions of how long it takes to nitrify urea and ammonium fertizliers in Salinas Valley soils during the summer.

We observed higher than expected nitrogen uptake by this crop. In spite of the relatively low total dry biomass at harvest, the crop maintains a high concentration of nitrogen in the tissue (5-6%) which drives total nitrogen uptake up

Methods: The trial was conducted west of Soledad on a site that located adjacent to the Salinas River with soils mapped as psamments and fluvents with a loamy sand texture with the following characteristics: pH – 7.6; organic matter content – 0.96%; sand – 84%; silt – 10%; and clay – 6%. Beds 80 inches wide were formed and preplant fertilizer (13-0-16) was applied on May 3. The applicator was turned off to create the zero N plots. The field was seeded to the variety 'Avenger' on May 7 and received the first germination water the same day. The field was topdressed with urea on May 26 at the 1-2 true leaf stage. Measurements of soil mineral nitrogen were taken to 8 inches deep in the soil on a weekly basis and biomass and tissue N content evaluations were made two times during the growth cycle. The field was sprinkler irrigated throughout the growing cycle. See tables for treatments and evaluation dates.

Results: Soil nitrate levels were low to moderate at all evaluation dates. Soil ammonium levels peaked on June 1, 6 days after topdress application (Table 1 and Figure 1). High soil ammonium levels are rare in warm summer soils where nitrification is assumed to occur rapidly. Soil ammonium levels returned to more normal background levels on June 11, thus indicating complete nitrification of urea in 14 days.

All rates of N fertilizer over 50 lb/A had higher fresh biomass, lower dry matter content, greater whole plant N content, lower C:N ratio and greater biomass N than the 0 and 50 lbs N/A treatments on June 1 (Table 2). Harvest occurred on June 9, 34 days after germination (equivalent to teenage clipped spinach). The highest fresh yields occurred at 150 or greater lbs N/A (Table 3); these treatments also had the lowest dry matter content, highest whole plant N content. Nitrogen uptake in these treatments was >8.0 lbs N/A/day in the final two weeks of growth. Highest percent uptake of N in relation to applied fertilizer N (nitrogen use efficiency – NUE) was in the 100 and 150 lb N/A treatments.

Figure 1. Soil ammonium levels in the 150 lb N/A treatment. Urea topdress was applied on May 26 and the peak of ammonium was detected 6 days later on June 1. Nearly all ammonium was converted to nitrate 10 days later on June 11.

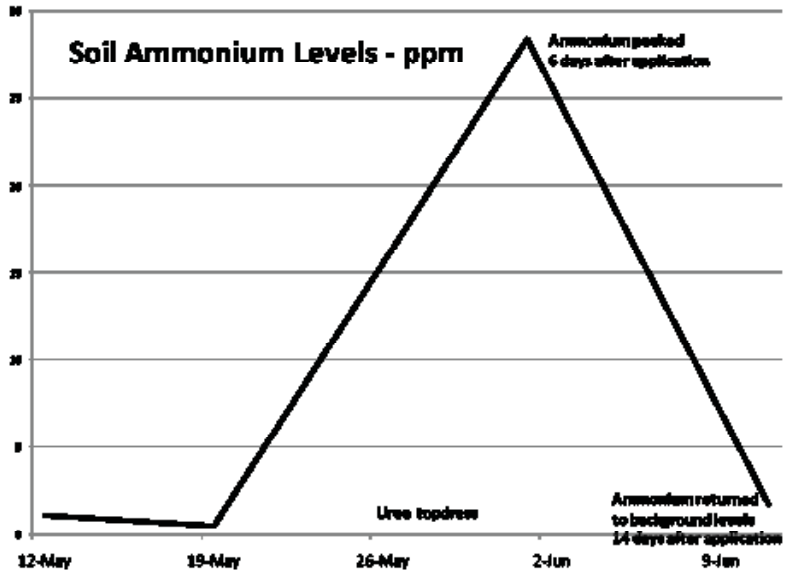

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Table 1. Soil ammonium-N and nitrate-N levels on four dates

Treatment Lbs N/A	Preplant Lbs N/A	Topdress Lbs N/A	NH4-N (mg/kg soil)				NO3-N (mg/kg soil)			
			May 12	May 19	June 1	June 11	May 12	May 19	June 1	June 11
			6 DAG[1]	13 DAG	26 DAG	36 DAG	6 DAG	13 DAG	26 DAG	36 DAG
0	---	---	0.3	0.5	0.8	0.6	3.9	4.4	0.7	0.4
50[2]	50	---	1.1	0.5	0.4	0.5	6.3	5.6	0.5	0.4
100	50	50	0.9	0.5	5.7	0.7	6.2	6.8	4.2	0.8
150[3]	50	100	1.1	0.5	28.4	1.7	5.8	7.2	8.5	2.6
200	50	150	0.9	0.4	42.2	5.6	6.8	6.7	9.4	10.4
300	50	250	0.7	0.5	49.8	8.0	5.7	6.2	9.7	10.2
		Pr>Treat	0.596	0.938	<0.001	0.030	0.396	0.279	<0.001	<0.001
		Pr>Block	0.270	0.78	0.738	0.511	0.720	0.355	0.262	0.319
		$LSD_{0.05}$	NS	NS	16.7	5.2	NS	NS	2.5	4.8

1 – days after germination; 2 – preplant application of 13-0-16, no subsequent topdress; 3 – Grower standard

High soil ammonium levels are rare in warm summer soils where nitrification is assumed to occur rapidly. Soil ammonium levels returned to more normal background levels on June 11, thus indicating complete nitrification of urea in 14 days.

Table 2. Biomass and tissue nitrogen evaluations on June 1 (26 days after germination)

Treatment Lbs N/A	Preplant Lbs N/A	Topdress Lbs N/A	Spinach, fresh (tons/A)	Dry matter (%)	Leaf and petiole N (%)	Whole plant N (%)	Whole plant C:N ratio	Biomass N (lbs/A)
0	---	---	1.7	11.3	2.7	2.8	14.5	11.0
50[1]	50	---	2.4	11.1	2.8	2.9	13.8	15.9
100	50	50	3.5	9.2	4.2	4.6	8.4	29.7
150[2]	50	100	4.1	8.6	4.7	5.4	7.2	37.7
200	50	150	4.6	8.5	4.7	5.4	7.2	40.9
300	50	250	3.6	9.4	5.0	5.3	7.3	36.6
		Pr>Treat	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
		Pr>Block	0.734	0.500	0.845	0.906	0.852	0.799
		$LSD_{0.05}$	1.0	0.9	0.6	0.6	2.2	9.2

Table 3. Yield and biomass nitrogen evaluation on June 9 (34 days after germination)

Treatment Lbs N/A	Preplant Lbs N/A	Topdress Lbs N/A	Spinach, fresh (tons/A)	Dry matter (%)	Whole plant N (%)	Whole plant C:N ratio	Bio-mass N (lbs/A)	N Uptake rate (lbs N/A/day)	NUE[1] (%)
0	---	---	3.8	12.7	2.2	17.8	22.5	1.4	-
50[1]	50	---	4.8	11.6	2.4	16.4	26.8	1.4	54
100	50	50	8.9	9.2	4.8	7.8	75.6	5.7	76
150[2]	50	100	13.5	7.6	5.3	7.0	108.0	8.8	72
200	50	150	11.6	7.8	6.1	6.2	107.0	8.3	53
300	50	250	11.4	7.6	6.3	6.1	106.3	8.7	35
		Pr>Treat	<0.001	<0.001	<0.001	<0.001	<0.001		
		Pr>Block	0.136	0.095	0.707	0.686	0.403		
		$LSD_{0.05}$	3.0	1.7	0.5	3.6	19.7		

1 – Nitrogen Use Efficiency (NUE): based on percent of N in plants vs amount applied.