UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources | UC Cooperative Extension

Imperial County Agricultural Briefs

March 2024 (Volume 27 Issue 3)

Features from your Advisors

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WELCOME

Ana M. Pastrana, Ph.D.

Ana M. Pastrana joined UC ANR on January 16, 2024, assuming the role of Plant Pathology Advisor for Imperial, Riverside, and San Diego counties. Before this position, Dr. Pastrana contributed her expertise as a Research Scientist in the Department of Agronomy at the University of Seville, Spain, from 2022 to 2024. During her time there, she not only conducted valuable research but also shared her knowledge by teaching a graduate-level Plant Health course. From 2020-2022, Ana played a significant role as a Research Scientist-Plant Pathology at Vineland Research and Innovation Centre in Canada.

Dr. Pastrana earned her Ph.D. in 2015 from IFAPA, Spain, and subsequently advanced her research during post-doctoral studies at the University of California, Davis, USA.

With over a decade of experience, Ana's work has focused on investigating the etiology, epidemiology, and management of plant diseases within agricultural ecosystems.

She is excited about her new role as Plant Pathology Advisor based in Southern California. The varied and intense crop cultivation in this area requires focused research to address disease management challenges and efficient outreach programs to engage a diverse audience. With my background and enthusiasm for community service, I believe I am well-equipped for this role, and I am excited to connect with local growers and PCAs.

Organic Ag Advances - Boosting Sustainability

Jimmy Nguyen, Food Safety and Organic Production Advisors, UCCE Imperial County

The organic agriculture sector continues to make strides in improving food safety practices and promoting environmental sustainability. Here are some of the latest developments:

Mitigating Concerns Over Organic Fertilizers

Scrutiny has increased around potential food safety risks from improperly composted manure fertilizers used in organic production. The USDA has responded by providing $6.8 million in research funding to develop enhanced safety standards around treatment and application of manure-based soil amendments. [1] Projects include studying optimal composting practices and exploring bio-based treatments to reduce pathogens.

Advances in Organic Pest Management

Managing pests and diseases organically remains a key challenge. However, new biological and mechanical solutions show promise. California organic growers have had success using a newly approved bio-fungicide derived from bacteria to prevent bunch rot in grapes.[2] Robotic weeders using artificial intelligence and cameras to distinguish crops from weeds have also become a viable alternative to herbicides for some organic growers.[3]

Promoting Biodiversity and Carbon Sequestration

Environmentalists continue to champion organic agriculture for restoring biodiversity and promoting carbon sequestration to mitigate climate change. A major new study from Oxford University found that organic farms had 30% higher biodiversity of plants, insects and animals compared to conventional farms.[4] The study also calculated that organic methods could capture enough carbon from the atmosphere to meet global food needs in 2050.

Expansion and Market Growth

Driven by consumer demand for sustainably-grown foods, the past year saw the total acreage under organic cultivation in the U.S. grow by another 5%. [5] Worldwide, the organic food market topped $120 billion in sales and is projected to grow at over 12% annually for the next five years.[6] Major food companies are investing heavily to expand organic product lines across numerous categories.

As the organic industry expands, its focus remains on continually enhancing sustainable, eco-friendly practices while reassuring consumers about the safety and quality of organic crops through stringent preventative measures and ongoing research. The latest innovations show the sector's commitment to realizing the full potential of organic agriculture.

References: [1] USDA Organic Fertilizer Research Program Announcement [2] California Dept of Food & Agriculture Biocontrol Approval [3] Robotics Company Press Release on Organic Weeding AI [4] Oxford University Biodiversity Study (published in Nature journal) [5] USDA Organic Agriculture Report 2023 [6] Organic Trade Association Industry Forecast.

Root Leachate Treatment Increased Beneficial Nematodes and Improved Plant Growth - A Potential Organic Option for Growers in Low Desert

Philip Waisen Vegetable Crops Advisor, UCCE Riverside

Introduction

Tons of vegetable crop residues are generated every cropping season in California's 'winter salad bowl' - Imperial and Coachella Valleys (Fig. 1). It is the function of the soil-dwelling microbes to decompose and release nutrients that are held in organic form to inorganic or what is called plant-available form for subsequent crops to uptake. An ideal soil contains 5% soil organic matter (SOM) where microbes are accommodated to perform ecosystem services including the decomposition of organic materials. In the southern desert valleys of California, however, SOM content is below 1%. This is because scorching summer temperatures in the low desert environments burn SOM to negligible levels. At least in vegetable fields in Coachella Valley, 0.8% of SOM was observed in three instances (personal communication). This is so low that microbial activity and overall soil health can be compromised. One way to stimulate microbial activity would be to condition the soil with root leachates as pre-plant treatments. Root leachate contains sugars that can recruit and nourish beneficial microbes (Santoyo, 2022). In addition, root leachate can serve as a source of microbes by inoculating planting beds that can jumpstart microbial activity in SOM-deficient desert soil. Furthermore, root leachate as pre-chemigation and pre-plant treatments can break the dormancy of weed seeds or pests to be killed by chemigation. This is especially true for root-knot nematodes that can survive high temperatures during fallow. Microbial biomass and activity can be reflected in nematode community response which can be easily measured. This study aimed to examine the responses of beneficial nematodes and plant growth to root leachate treatments on bell pepper in Coachella Valley.

Figure 1. Winter vegetable crop residues are a common sight in Coachella Valley.

Field Experiment: A field experiment was conducted at the Coachella Valley Agricultural Research Station (33°31'18.0"N 116°09'03.8" W) to examine the benefits of root leachate treatments on beneficial nematode and plant growth responses (Fig. 2). Bell pepper or tomato root leachates were prepared by running 5 gallons of tap water through potted plants and water that passed through was collected and sieved to remove debris. The root leachate was applied directly on 36-inch raised beds a week before transplanting the bell pepper on 3 × 24 ft^2 plots and replicated 12 times. Soil samples were towards the end of the bell pepper crop. At the time of sampling, 6 discrete samples of soil per plot were systematically collected from the top 8 inches of rhizosphere. The soil samples were composited, homogenized, and a subsample of 100 cm^3 was subjected to the Baermann funnel method for extracting nematodes. Individual nematodes present in each sample were morphologically identified to different trophic groups. Plant growth parameters including leaf nitrogen content and chlorophyll content were measured from the third maturing leaf using a Chlorophyll Meter (Amtast USA Inc., Lakeland, FL). Data analysis was done using SAS version 9.4 (SAS Institute Inc., Cary, NC). Data were checked for normality using Proc Univariate and wherever necessary, data were normalized using log10 (x+1) and subjected to a one-way analysis of variance using Proc GLM in SAS. Means were separated using the Waller–Duncan *k*-ratio (*k*=100) *t*-test whenever appropriate and only true means were presented.

Figure 2. Bell pepper field experiment at the Coachella Valley Agricultural Research Station.

Which beneficial nematode trophic groups and genera were affected? Apart from plant-parasitic nematodes (herbivores) that we are more familiar with (e.g., root-knot nematodes), there are also beneficial counterparts that co-exist in the soil. They are beneficial in that they feed on bacteria and fungi (both pathogens and saprophytes) occupying an important niche in the soil food web for recycling nutrients. The beneficial nematode counterparts are grouped into bacterivores (bacterial feeders), fungivores (fungal feeders), omnivores (bacterial and fungal feeders), and carnivores (general feeders). As far as the trophic groups, bacterial-feeding nematodes were dominant followed by fungal-feeding nematodes and omnivorous nematodes. Herbivorous and carnivorous nematodes were not detected. Bell pepper root leachate treatment had numerically increased bacterial feeding nematodes compared to the untreated control (Fig. 3A; $P>0.05$). As far as the fungal feeders, no difference was detected (Fig. 3B).

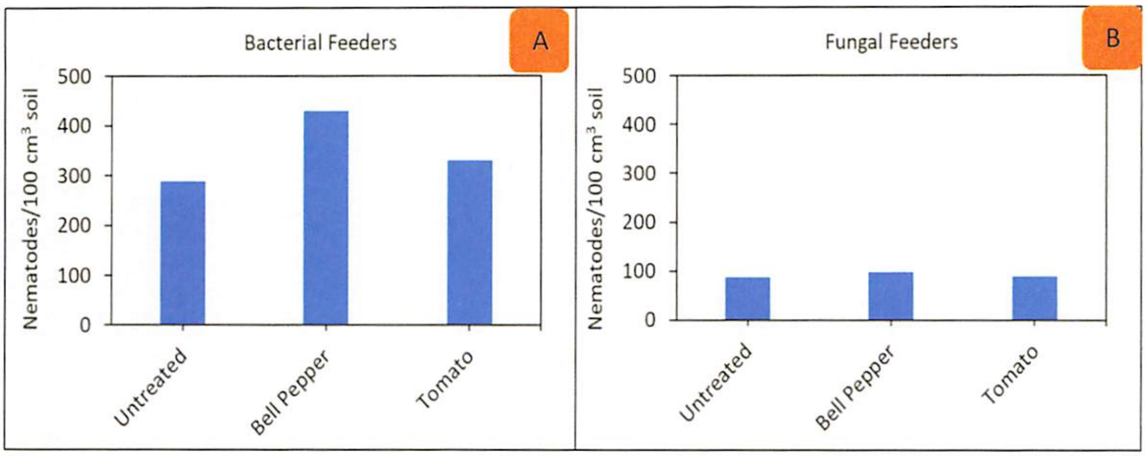

Figure 3. Showing the abundance of A) bacterivores and B) fungivores at the end of the bell pepper crop. Bars represent means (n=12) and are not different, according to the Waller–Duncan k-ratio (k=100) t-test.

A total of 12 genera of beneficial nematodes were detected of which 6 genera of bacterial feeders (*Acrobeles*, *Acrobeloides*, *Cephalobus*, *Eucephalobus*, *Plectus*, and *Prismatolaimus*), 4 genera of fungal feeders (*Aphelenchus*, *Aphelenchoides*, *Filenchus*, and *Tylencholaimelus*), and 2 genera of omnivorous nematodes (*Eudorylaimus* and *Mesodorylaimus*). The most abundant genera of bacterivores were *Acrobeloides* and *Acrobeles* (Fig. 4A & 5A). Bacterial feeders are characterized by open mouthparts to scavenge for bacterial cells (Fig. 4B). Ornamentation in some bacterial feeders exists in their mouthparts. For example, in *Acrobeles* the mouth parts are characterized by having projections called probolae that facilitate feeding (Fig. 5B).

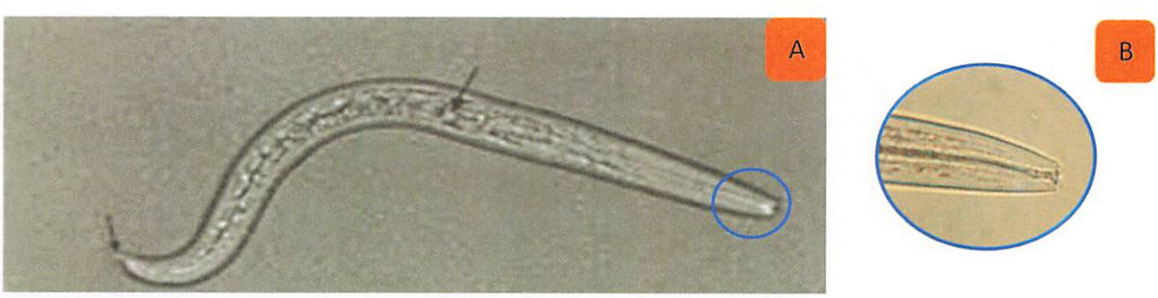

Figure 4. A) An *Acrobeloides* sp. (not shown to scale) and B) a close-up view of the cephalic (mouthpart) region of the bacterial feeding nematode.

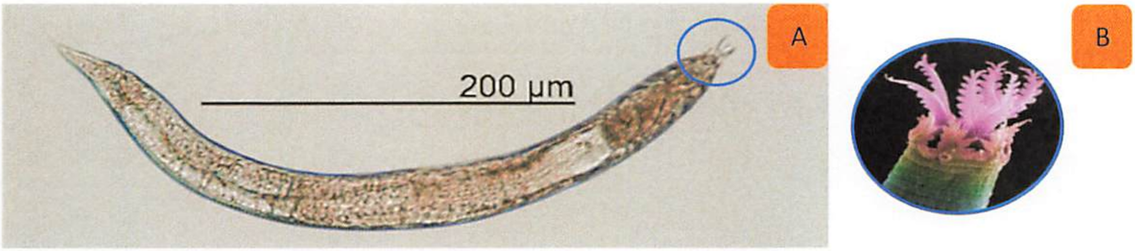

Figure 5. A) An *Acrobeles* sp. (shown to scale) and B) a close-up view of Blaxter lab the ornamentation in the cephalic region of the bacterial-feeding nematode.

As far as the fungal feeders, *Aphelenchus* and *Aphelenchoides* were the 2 dominant genera detected (Fig. 6A). Fungal feeders are characterized by a weak needle-like structure called a stylet in the mouthparts used to puncture fungal cell wall to access the contents (Fig. 6B). Note that the stylet in plant-parasitic nematodes is robust (not shown).

Figure 6. A) An *Aphelenchus* sp. (not shown to scale) and B) a close-up view of the mouthparts showing a weak or fainted stylet, a needle-like structure utilized to puncture fungal cell walls to withdraw contents.

Which root leachate treatment affected the plant growth? Bell pepper root leachate treatment significantly increased chlorophyll contents of plants compared to untreated control (Fig. 7A; $P \leq 0.05$). In addition, bell pepper root leachate treatment numerically increased leaf nitrogen contents (Fig. 7A; $P > 0.05$).

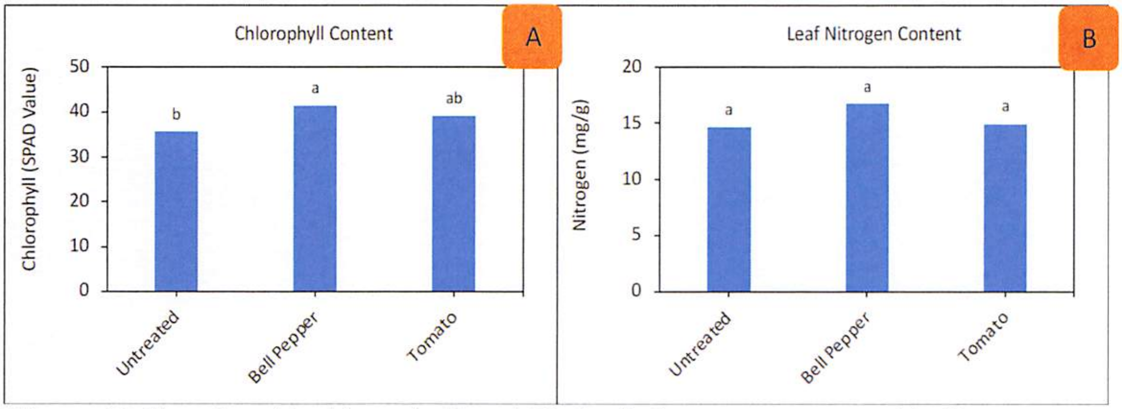

Figure 7. Showing A) chlorophyll and B) leaf nitrogen contents of bell pepper as affected by root leachate treatments. Bars represent means (n=27) and those followed by the same letter(s) are not different, according to the Waller–Duncan k-ratio (k=100) t-test.

Main findings: Prior to growing bell pepper in this field, broccoli was grown and residues incorporated. Because broccoli residues have a relatively low C: N ratio (≈30:1), it was expected to undergo more bacterial decomposition and thus high plant-available nutrients. This was why high bacterial-feeding nematodes dominated by genera *Acrobeles* and *Acrobeloides* were detected (up to 400 on average) compared to other nematode trophic groups. An increase in plant-available nutrients was reflected in increased chlorophyll and leaf nitrogen contents. In particular, this observation was apparent in the bell pepper root leachate treatment. It appears that bell pepper root leachate treatment recruited and maintained high microbial populations that all promoted plant growth. In contrast, tomato root leachate treatment only numerically increased plant growth parameters. In a recent study, we found tomato root leachate treatment significantly increased cantaloupe canopy cover (Waisen and Resendiz, 2023). Plants communicate at chemical levels through various known pathways such as jasmonic and salycylic acid pathways. For example, root leachate prepared from a nematode-infected plant increased root biomass production of healthy neighboring plants (Zhang et al., 2021). This is one such benefit we observed at least with bell pepper root leachate. More research is needed to dissect and understand the mechanisms, but these findings point to a potential organic management option for the growers in the desert.

References

1. Santoyo, G. 2022. How plants recruit their microbiome? New insights into beneficial interactions. Journal of Advanced Research 40:45-58. https://doi.org/10.1016/j.jare.2021.11.020
2. Waisen, P. and Resendiz, A. 2023. Root leachate and reduced-risk nematicide treatments affected melon plant growth parameters in low desert growing conditions. Imperial Agricultural Briefs 26:83-87. (Link)
3. Zhang, P., Bonte, D., De Deyn, G. B., & Vandegehuchte, M. L. 2021. Leachates from plants recently infected by root-feeding nematodes cause increased biomass allocation to roots in neighboring plants. Scientific Reports 11:2347. https://doi.org/10.1038/s41598-021-82022-9

UC Statewide IPM Program

Pesticide Safety Workshops
Instructor Training
Capacitaciones de Seguridad con Pesticidas
Capacitación de Instructores

English
March 12, 2024
March 21, 2024

8:00am- 5:00pm

via Zoom

Participants who complete this training will become qualified to provide pesticide safety training to fieldworkers and pesticide handlers as required by California state regulations. This training is approved by the California Department of Pesticide Regulation (DPR).

Please submit one registration form per person. Registration fee includes educational materials. **No refunds** will be given; substitutions are allowed. If you have any questions or need assistance, please contact our team at psep@ucanr.edu.

Payment is made online by credit card only. Training fee: $400
(CE approval from DPR pending)

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Al completar esta capacitación serán calificados para capacitar a trabajadores de campo y manipuladores de pesticidas sobre seguridad con pesticidas según las regulaciones estatales de California. Esta capacitación está aprobada por el Departamento de Regulación de Pesticidas de California (DPR).

Envíe un formulario de registro por persona. La tarifa de inscripción incluye materiales educativos. No se darán reembolsos; se permiten sustituciones. Si tienes pregunta o necesitas ayuda, comuníquate con nuestro equipo al psep@ucanr.edu.

El pago se realiza en línea únicamente con tarjeta de crédito.
Costo de capacitación: $400
(CE de DPR pendiente)

The Pesticide Safety and Education Program (PSEP) has opened registration for their annual Train-the-Trainer workshops. Participants who complete this training will become qualified to provide pesticide safety training to fieldworkers and pesticide handlers, as required by California state regulations and the Environmental Protection Agency (EPA) revised Worker Protection Standard (WPS).

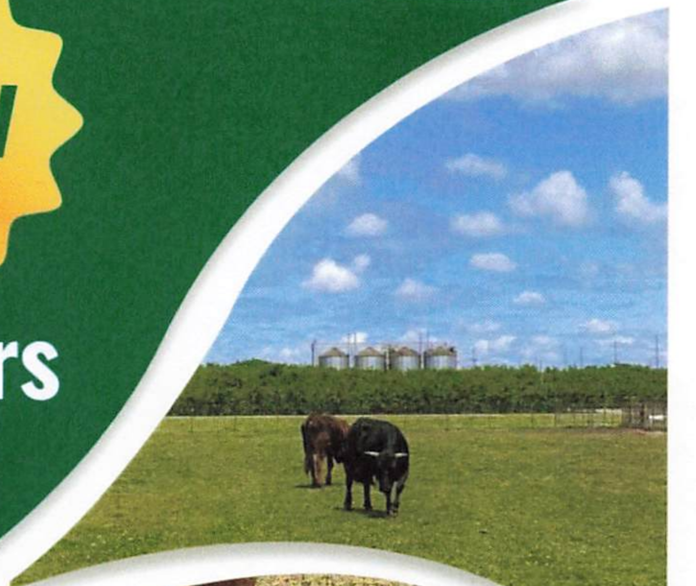
This training is approved by the California Department of Pesticide Regulation (DPR). Training topics include pesticide storage and disposal, personal protective equipment, pesticide exposure first aid, and more. Continuing education units from DPR are currently pending approval.

The trainings are on March 12th and 21st in English and March 13th and 22nd in Spanish. All trainings are from 8AM to 4:30 PM on Zoom. Registration is $400 and can be found at *https://surveys.ucanr.edu/survey.cfm?surveynumber=42297* . If you have any questions, please contact psep@ucanr.edu.

Small

NEW

Acreage Landowners Website



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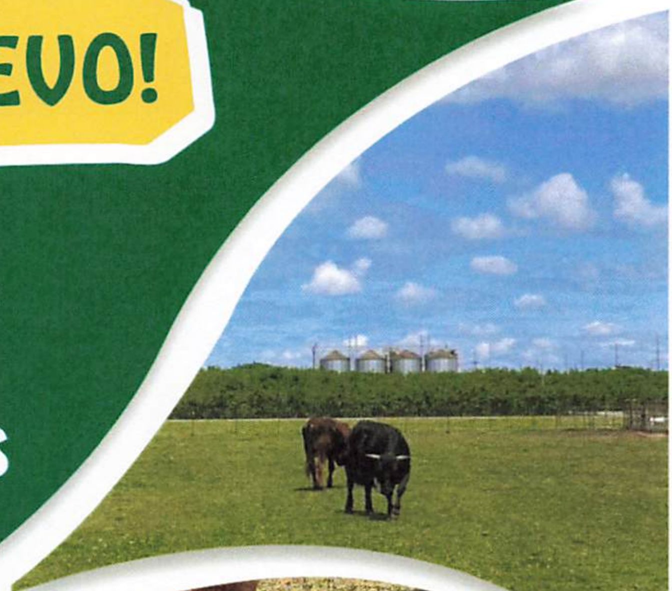
¡NUEVO!

Sitio Web para Terratenientes de Propiedades Pequeñas



¡UCANR presenta un NUEVO sitio web para Terratenientes de Propiedades Pequeñas!! Tiene información para granjas pequeñas sobre muchos temas: la preparación para emergencias, la calidad de aqua, y el manejo de pastos. ¡Mírelo hoy!

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IMPERIAL VALLEY CIMIS REPORT AND UC WATER MANAGEMENT RESOURCES

Ali Montazar, Irrigation and Water Management Advisor, UCCE Imperial, Riverside, and San Diego Counties

The reference evapotranspiration (ET_o) is derived from a well-watered grass field and may be obtained from the nearest CIMIS (California Irrigation Management Information System) station. CIMIS is a program unit in the Water Use and Efficiency Branch, California Department of Water Resources that manages a network of over 145 automated weather stations in California. The network was designed to assist irrigators in managing their water resources more efficiently. CIMIS ET data are a good guideline for planning irrigations as bottom line, while crop ET may be estimated by multiplying ET_o by a crop coefficient (K_c) which is specific for each crop.

There are three CIMIS stations in Imperial County include Calipatria (CIMIS #41), Seeley (CIMIS #68), and Meloland (CIMIS #87). Data from the CIMIS network are available at: http://www.cimis.water.ca.gov/. Estimates of the average daily ET_o for the period of March 1st to May 31st for the Imperial Valley stations are presented in Table 1. These values were calculated using the long-term data of each station.

Table 1. Estimates of average daily potential evapotranspiration (ET_o) in inch per day

Station	March		April		May	
	1-15	16-31	1-15	16-30	1-15	16-31
Calipatria	0.16	0.19	0.22	0.25	0.27	0.29
El Centro (Seeley)	0.19	0.22	0.24	0.28	0.29	0.31
Holtville (Meloland)	0.17	0.21	0.23	0.27	0.29	0.31

For more information about ET and crop coefficients, feel free to contact the UC Imperial County Cooperative Extension office (442-265-7700). You can also find the latest research-based advice and California water & drought management information/resources through link below: http://ciwr.ucanr.edu/.